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Evaluation of Hydropower Energy Development in Austria: Exploring the Energy-Water Nexus using Public Choice Models

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Evaluation of Hydropower Energy Development in Austria

Exploring the Energy-Water Nexus using Public Choice Models

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LIST OF ABBREVIATIONS

AIC .... Akaike information criterion
ASC .... Alternative specific constant
BIC .... Schwarz information criterion
CBA .... Cost Benefit Analysis
CE .... Choice experiment
CO_2 .... Carbon dioxide
CS .... Compensating surplus
CV .... Contingent valuation
ECM .... Error component model
EU .... European Union
EV1 .... Extreme value type 1
GHG .... Greenhouse gases
GWh .... Gigawatt hour
HMWB .... Heavily modified water body
IIA .... Independence from irrelevant alternatives
IID .... Independently and identically distributed
kWh .... Kilowatt hour
LL .... Log likelihood
LR .... Likelihood ratio
MNL .... Multinomial Logit
MW .... Megawatt
MWTP .... Marginal willingness to pay
NIMBY .... Not in my backyard
RUT .... Random utility theory
WFD .... Water Framework Directive
WTP .... Willingness to pay

1 Introduction

Hydroelectric power plays an extremely important role in the Austrian energy sector. More than half of the domestically generated electricity comes from hydropower facilities. Despite this major importance, there is still substantial potential for new hydropower plants, especially for small-scale hydropower. In view of climate and energy-related targets, the further expansion of hydropower may play a significant role. According to international agreements such as the Kyoto Protocol or the EU climate and energy package Austria is bound to reduce its greenhouse gas emissions considerably until 2020. In order to achieve these emission reduction targets Austria is forced to further increase the use of renewable energy sources. Consequently, the extension of hydropower utilisation is an integral part of the Austrian energy strategy. However, the use of hydropower is generally associated with a considerable conflict potential. On the one hand, hydropower use creates multiple benefits like the emission-free generation of electricity, the improvement of domestic energy security or positive impacts for the local economy, especially employment effects. On the other hand, hydropower is subject to some disadvantages, primarily the impacts of new hydropower stations on the landscape and ecosystem of a water body. Thus, the expansion of hydropower utilisation is in conflict with the objectives of nature and water protection mainly determined by the European Water Framework Directive.

The aim of this study is to assess future hydropower energy development in Austria, considering the multiple costs and benefits associated with an intensified use of hydropower, i.e. the construction of new hydropower stations. We especially focus on the "trade-off" between important positive and negative effects or more precisely, between the emission-free generation of electricity and nature conservation.

The present research project was funded by the Austrian Climate and Energy Funds within the third tender of the programme "Neue Energien 2020". The topic area the research project belongs to is the strategic basis of decision-making for the Austrian technology, climate and energy policy. For the social dialogue on the sustainable and environmentally friendly energy future, the valuation of long-term energy strategies such as the expansion of hydropower is extremely important. Especially for arrangements or strategies, which require considerable public investments, a clear insight into the various costs and benefits associated with future energy strategies is necessary. Hence, the present investigation represents an important basis of decision-making for the Austrian climate and energy policy.

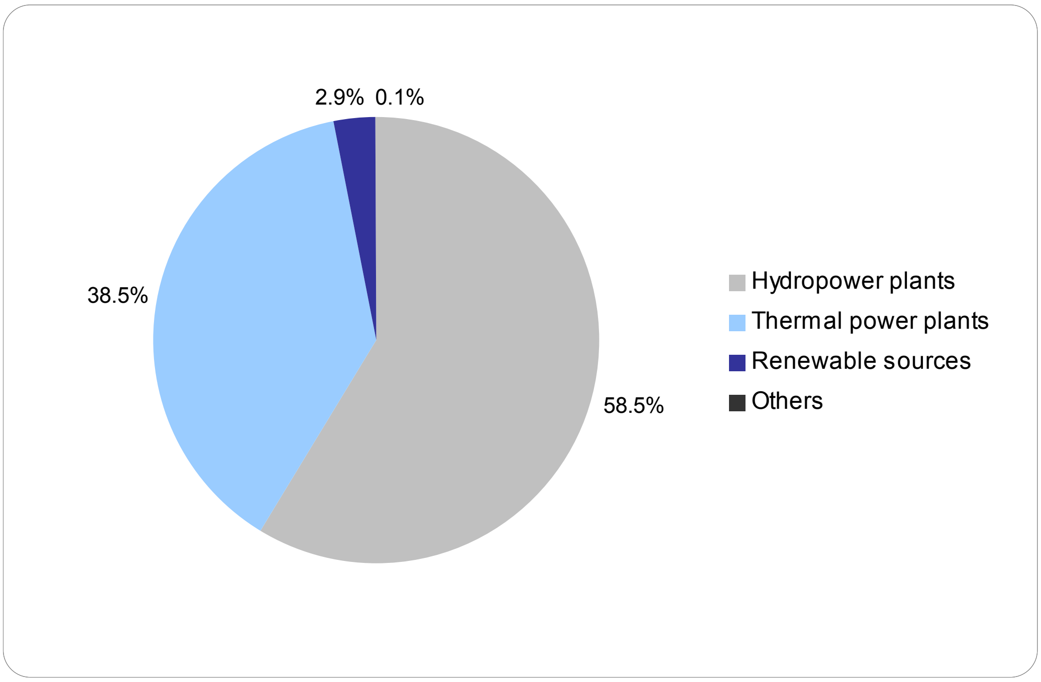
The methodological approach used to value the multiple positive and negative effects of an expansion of hydropower are stated preference techniques, in particular choice experiments. Choice experiment methods enable to assign monetary values to non-use variables like impacts on the ecosystem of a river through direct surveys. In addition, it is possible to determine total public benefits of different hydropower expansion strategies.

The first part of this study, chapter 2, contains a detailed description of the Austrian electricity sector, highlighting the role of hydroelectric power for the domestic electricity generation. Chapter 3 describes the available hydropower potential, which is effectively exploitable, the targets of the Austrian climate and energy policy as well as the conflict potential imposed by the intensified use of hydropower. The theoretical background on stated preference techniques is shown in chapter 4 of this report. This is followed up by a summary of previous economic valuation studies on the topic of renewable energy. The main part of the study starts with chapter 6, describing the development of the choice experiments and questionnaires as well as the survey implementation. Chapter 7 gives an overview of people's general attitude towards the use of renewable energy and hydropower. The econometric results of the study are shown in chapter 8, starting with the description of preferences for an expansion of hydropower. The impact of framing hydropower demand in the context of demand for other renewable energy sources is discussed subsequently, and the last part of the econometrical analysis is made up of stated preferences for two specific hydropower projects in Styria. Finally, chapter 9 contains some concluding remarks summarizing the main findings of the research project.

2 The Austrian electricity sector

The following chapter aims to give an overview of electric power generation in Austria and particularly focuses on the role of hydropower in electricity production. As can be seen from Figure 1, hydropower plays, especially due to auspicious topographic conditions, a substantial role in the Austrian electricity sector. Currently (year 2010) 58.5 % of total electricity produced in Austria comes from hydroelectric power stations; this corresponds to an amount of annually 41,572 gigawatt hours (GWh). Another 27,346 GWh (38.5 %) are produced by thermal power plants and 2,096 GWh (2.9 %) by renewable energy sources.[1]

Figure 1: Gross domestic electricity production, 2010

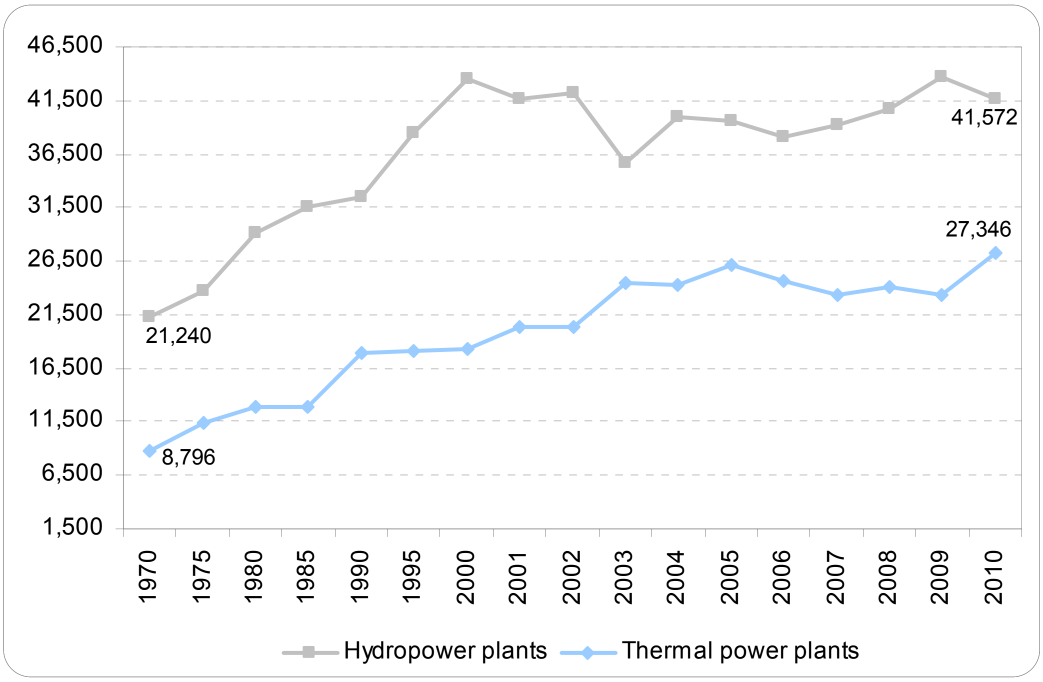


Source: ENERGIE-CONTROL AUSTRIA (2011); OWN DEPICTION

The development of gross electric power generation over time is shown in Figure 2. Hydroelectric power generation has nearly doubled (+95.7 %) since 1970 and increased from 21,240 GWh to 41.572 GWh in 2010. Electricity production from thermal power plants is also marked by an increasing trend and has risen – starting from a lower level compared to hydropower – by 210.9 % since 1970. Besides that, electric power generation from renewable energy sources has experienced a very dynamic development in the last decade; it has increased from 67 GWh in 2000 to 2,096 GWh in 2010.

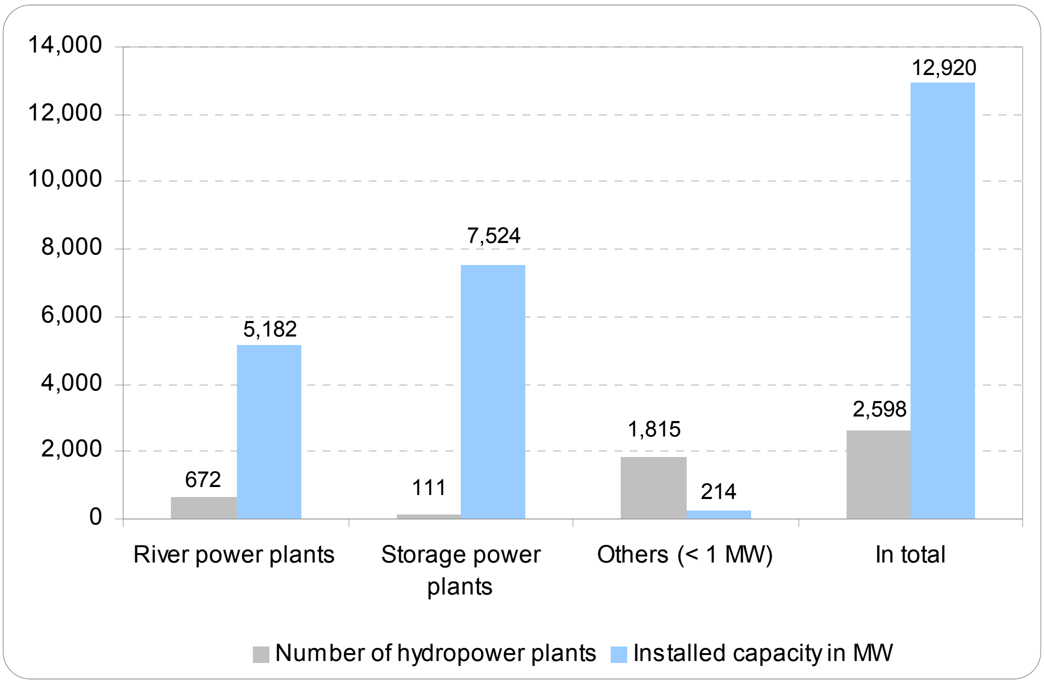
[1] In this classification renewable energy sources include photovoltaics, wind power and geothermics.

Figure 2: Gross domestic electricity production in GWh, 1970 – 2010



Source: ENERGIE-CONTROL AUSTRIA (2011); OWN DEPICTION

Figure 3: Number of hydropower plants and installed capacity in MW, 2010

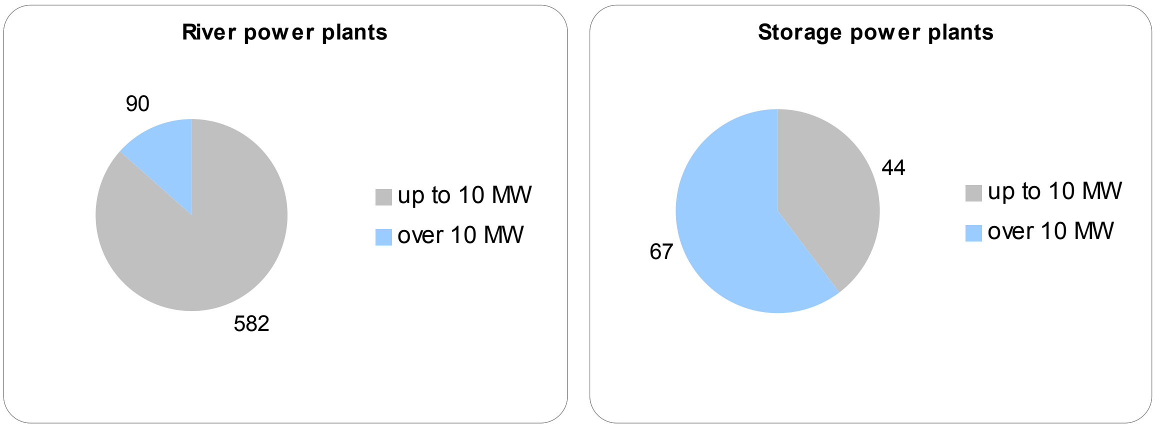


Source: ENERGIE-CONTROL AUSTRIA (2011); OWN DEPICTION

The total number of hydropower plants in Austria is 2,598 with an entire installed capacity of 12,920 megawatt (MW).[2] 672 of those are river and 111 are storage power plants. While the existing storage power plants exhibit a total capacity of 7,524 MW, the installed power plant capacity of the river plants is significantly lower and amounts to 5,182 MW. Moreover there exist a large number of small-scale hydropower plants (1,815) with a capacity lower than one MW, accounting for only 214 MW of the total installed capacity (see Figure 3).[3]

The values presented above already indicate that in the case of river power plants there is a strong tendency towards small-scale hydropower. 582 out of the 672 river power plants have a capacity of less than or equal to 10 MW. In contrast, only 44 out of the 111 storage power plants are small-scaled with a capacity up to 10 MW (see Figure 4).

Figure 4: Hydropower plants in Austria by technology and capacity, 2010



Source: ENERGIE-CONTROL AUSTRIA (2011); OWN DEPICTION

The important role of river power plants in the Austrian power sector becomes further clear by looking at the gross electric power generation. The main part of hydropower generated electricity in Austria – 28,000 GWh or 67.4 % – is produced by river power plants and 13,572 GWh (32.6 %) by storage power plants (see Table 1). Most river power plants operate as base load, while storage power plants generally run in the case of high demand (peak load).

Table 1: Electricity production by power plant technology, 2010

Power plant technology	Production in GWh	in %
River power plants	28,000	67.4 %
Storage power plants	13,572	32.6 %
In total	**41,572**	**100.0 %**

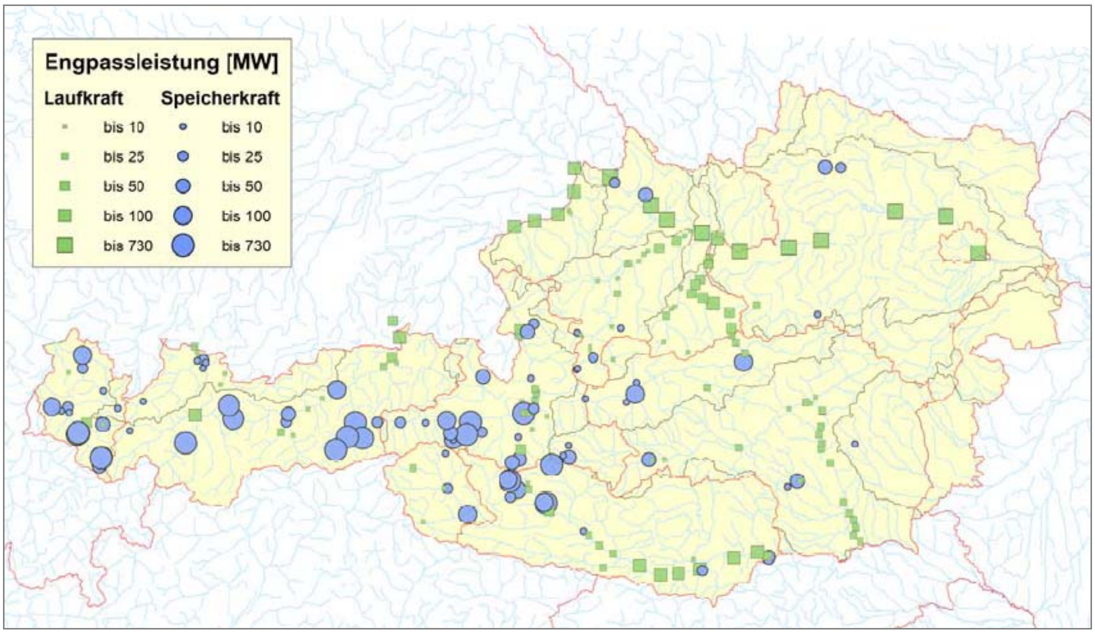
Source: ENERGIE-CONTROL AUSTRIA (2011)

[2] In addition, there are 594 thermal power plants with an installed capacity of 7,425 MW and a large number (5,625) of small renewable energy facilities, which have a total capacity of 1,054 MW (ENERGIE-CONTROL AUSTRIA, 2011).

[3] For these small-scale hydropower plants an attribution to a power plant technology is not possible.

The geographical distribution of hydropower stations in Austria is given in Figure 5. The large storage power plants are located exclusively in the alpine areas of western/southern Austria (mainly Tyrol, Vorarlberg, Salzburg and Carinthia). In contrast, river power plants are mainly located in the eastern part of Austria along the major rivers like Danube, Inn, Enns, Mur and Drau.

Figure 5: Geographical distribution of hydropower stations in Austria



Source: PÖYRY ENERGY GMBH (2008)

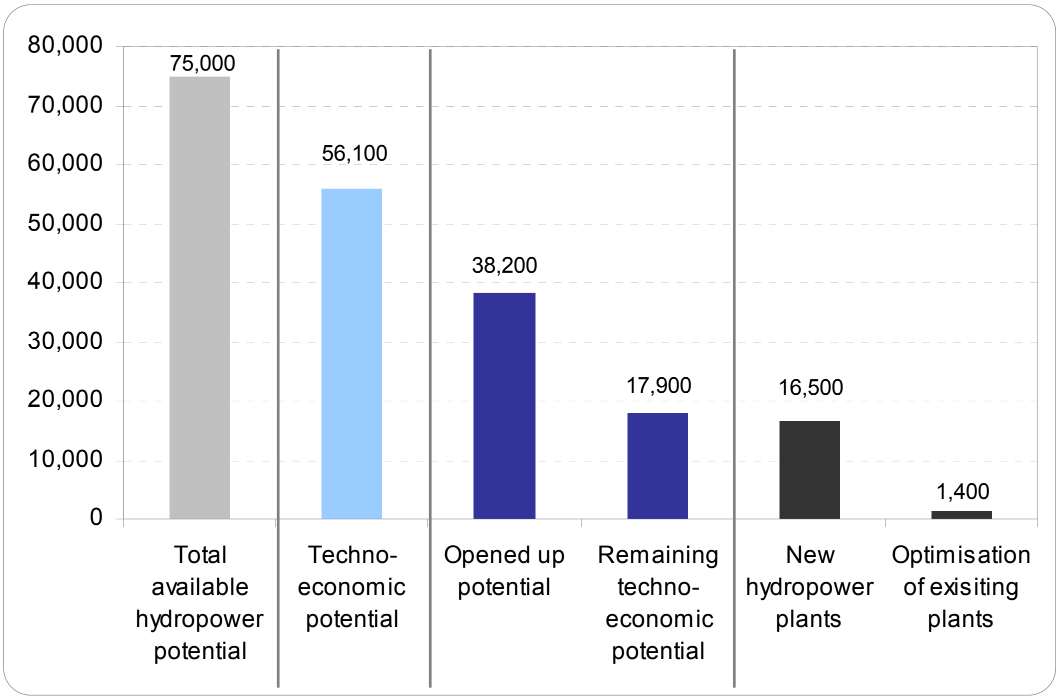
3 Expansion of hydropower utilisation in Austria

3.1 Hydropower potential

Although about 60 percent of the total electricity produced already comes from hydropower installations, there is still substantial potential for new hydropower facilities, especially for small-scale hydropower. According to the hydropower potential study of PÖYRY ENERGY GMBH (2008), the techno-economic potential, which is worth being explored, is estimated at 56,100 GWh. A large part of this potential has already been opened (38,200 GWh), but 17,900 GWh are not used yet. Of that, 16,500 GWh can be explored by new hydropower plants, the remaining part (1,400 GWh) can be explored by the optimisation of existing facilities (see Figure 6). However, these estimates do not consider possible reductions of the techno-economic potential due to environmental and socio-economic restrictions. A first estimate of the reduced techno-economic potential excludes the potentials located in regions with a high degree of sensibility such as national parks and world heritages. This leaves a value of 13,000 GWh, which is effectively exploitable.[4]

[4] This value does not include reductions due to the possible restrictions imposed by the European Water Framework Directive (WFD).

Figure 6: Hydropower potential in Austria in GWh



Source: PÖYRY ENERGY GMBH (2008); OWN DEPICTION

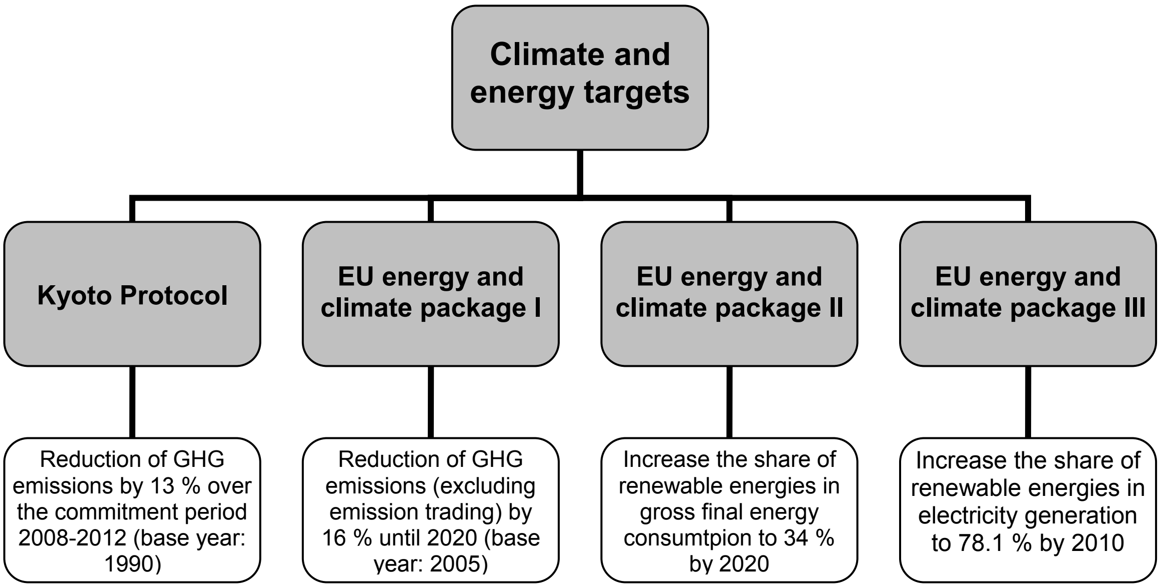
3.2 Austrian climate and energy strategy

One of the major goals of the Austrian climate and energy policy is the reduction of greenhouse gas (GHG) emissions. This reduction target is strongly determined by international agreements (see Figure 7). First, the Kyoto Protocol was adopted in December 1997 and came into force eight years later in 2005. The treaty set binding targets for 37 industrialized countries as well as the European Union (EU) to reduce the emissions over the five-year period 2008-2012 by at least 5 % compared to the base year 1990. The EU is committed to reduce its GHG emissions by 8 %; Austria is bound to reduce them by 13 % (UNFCCC, 2008; UMWELTBUNDESAMT, 2011a).[5]

In addition to the ratification of the Kyoto Protocol, Austria's climate and energy policy is strongly determined by EU initiatives. Thus, in December 2008 the EU member states reached agreement over an extensive "energy and climate package", which aims to reduce the overall emissions to at least 20 % below 1990 levels by 2020. For emission sources beyond the emission trading system the climate package provides a 10 % reduction target compared to 2005. According to the "Effort Sharing" principle, Austria is committed to achieve a 16 % reduction of its emissions, excluding emission trading (COMMISSION OF THE EUROPEAN COMMUNITIES, 2008; UMWELTBUNDESAMT, 2011a).

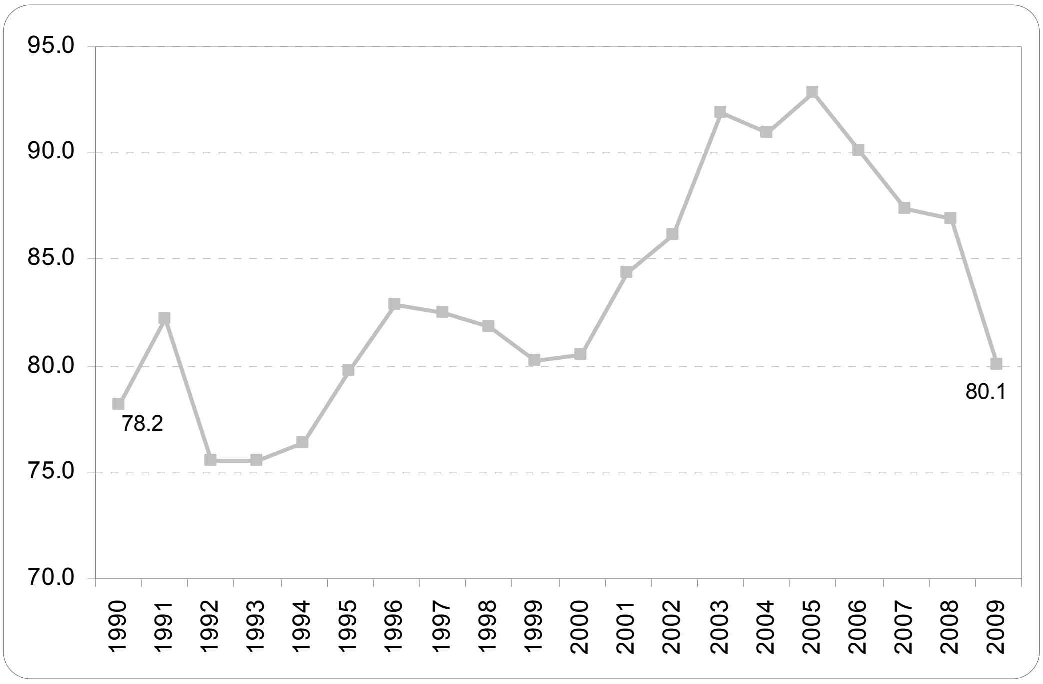
[5] See also *http://unfccc.int/kyoto/protocol/items/2830.php*.

Figure 7: Relevant climate and energy targets for Austria



Soure: UNFCCC (2008); UMWELTBUNDESAMT (2011a); OWN DEPICTION

Figure 8: GHG emissions in Austria in million tonnes CO_2 equivalents, 1990 – 2009

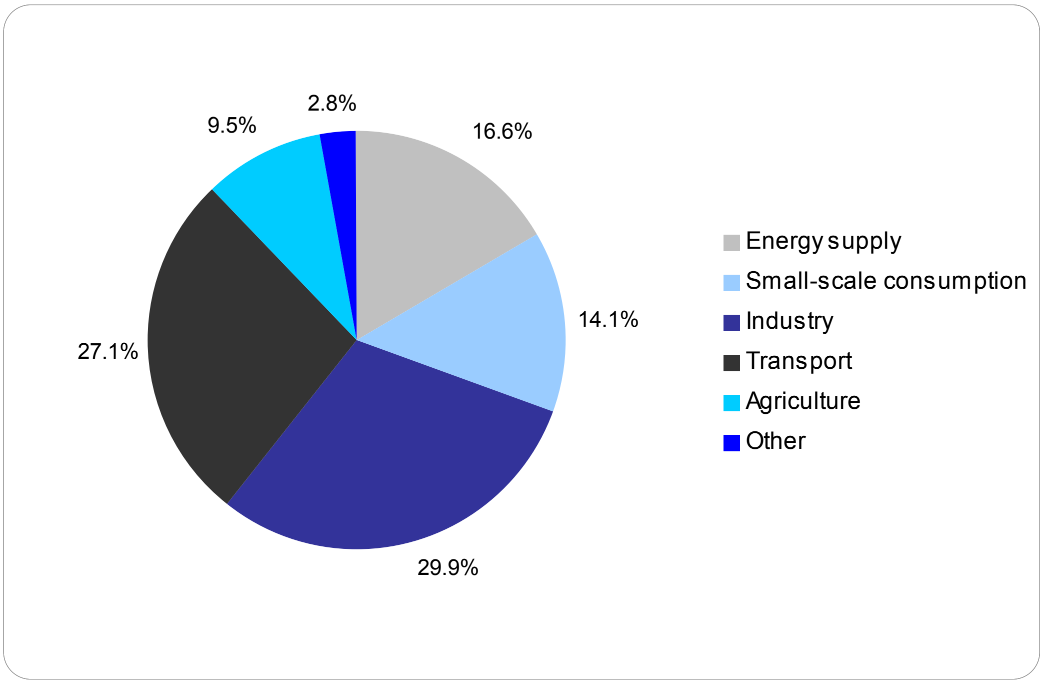


Source: UMWELTBUNDESAMT (2011a); OWN DEPICTION

However, the actual development of GHG emissions shows another image: since 1990 Austrian emissions have risen considerably. In 2009, total GHG emissions amounted to 80.1 million tonnes of carbon dioxide (CO_2) equivalents. Emissions in 2009 were therefore 11.3 million tonnes above the annual mean value of the Kyoto target stipulated for 2008-2012, which is 68.8 million tonnes CO_2 equivalents. Compared to the emission level of 1990 (the base year of the Kyoto commitment), emissions increased by 2.4 %. However, since 2005, a declining trend in Austrian GHG emissions has been observed, amounting to -13.8 % (see Figure 8). This decrease is due to the increased use of renewable energy sources and the implementation of energy efficiency measures set out in the Austrian climate strategy (UMWELTBUNDESAMT, 2011b).

The major part of overall GHG emissions in Austria arises in the industry sector (29.9 %). Furthermore, about 27.1 % of GHG emissions are caused by transport, 16.6 % by energy supply and 14.4 % by small-scale consumption. The agricultural sector is responsible for 9.5 % of total GHG emissions in 2009. Finally, only 2.8 % arise in other sectors (see Figure 9).

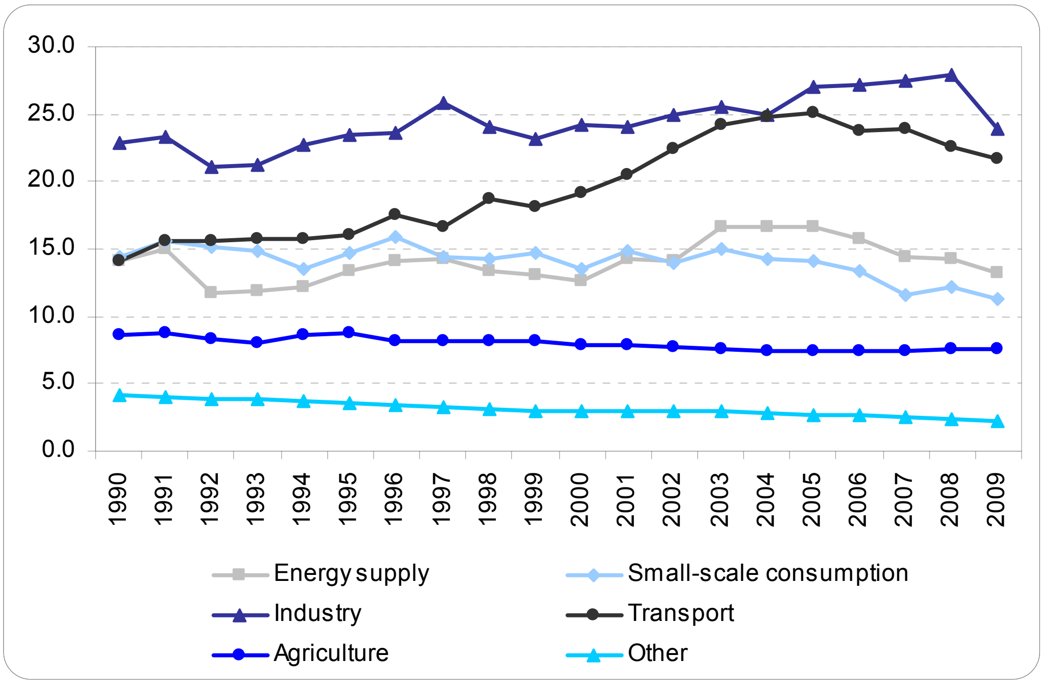
Figure 9: GHG emissions by sectors (in %), 2009



Source: UMWELTBUNDESAMT (2011a); OWN DEPICTION

Compared to the year 1990 the transport sector recorded the highest emission growth rate (+54.4 %), although a slightly negative trend has been observed since 2005. Furthermore, the industry sector was marked by rising emissions amounting to 1.1 million tonnes CO_2 equivalents (+4.7 %). However, from 2008 to 2009 emissions in the industry sector declined markedly by 14.2 %. This substantial decrease can be traced to the decline of industrial production caused by the economic crisis. In the remaining sectors GHG emissions have decreased between 45.9 % (other) and 6.1 % (energy supply) since 1990 (see Figure 10).

Figure 10: GHG emissions in million tonnes CO_2 equivalents by sectors, 1990 – 2009



Source: UMWELTBUNDESAMT (2011a); OWN DEPICTION

In order to reduce GHG emissions, the EU policy is putting a strong focus on increasing the use of renewable energy resources (Renewable Energy Directive 2009/28/EC). Accordingly, the share of renewable energies in EU gross final energy consumption should be increased to 20 % by 2020. For Austria a share of 34 % is envisaged (EUROPEAN PARLIAMENT AND COUNCIL, 2009; COMMISSION OF THE EUROPEAN COMMUNITIES, 2008). Moreover, the climate and energy package aims to increase the share of renewable energies in the transport (substitution of fossil fuels) sector to 10 % by 2020. The aim for renewables in the electricity sector is to achieve a 78.1 % contribution by 2010 (see Figure 7; LEBENSMINISTERIUM, 2010). As can be seen from Table 2, the share of renewable energy sources in the electricity sector currently (2010) amounts to 65.3 %. So Austria failed to achieve the predetermined EU target. In the transport sector the share of renewables increased from 3.3 % in 2006 to 6.3 % (2010), meaning that with additional measures Austria seems to be on a good way to fulfil the 10%-target by 2020. The same applies to the share of renewable energy sources in overall gross final energy consumption, which has increased in the last five years from 26.2 % to 30.8 % in 2010. Thus, the 34 %-target seems reachable.

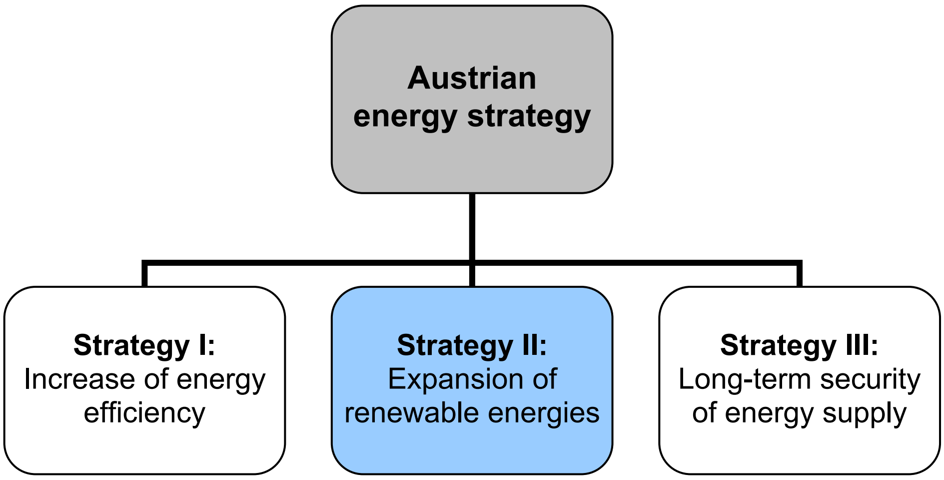
Table 2: Share of renewable energy sources in Austria, 2006 – 2010

	2006	2007	2008	2009	2010
Share of renewables in total	26.2 %	28.2 %	29.0 %	30.9 %	30.8 %
Share of renewables in electricity	61.6 %	64.1 %	64.3 %	67.4 %	65.3 %
Share of renewables in transport	3.3 %	4.1 %	5.2 %	6.7 %	6.3 %

Source: STATISTIK AUSTRIA (2011a)

In order to achieve the national targets of the climate and energy package, the Federal Ministry of Agriculture, Forestry, Environment and Water Management and the Federal Ministry of Economy, Family and Youth presented an Austrian energy strategy. The main goal of this strategy is to stabilize final energy consumption at the level of 205 (1,100 PJ) within the framework of a future oriented and efficient system. The strategy is based on three pillars, namely energy efficiency, renewable energy and security of supply (see Figure 11). First, the Austrian energy strategy aims to increase energy efficiency in the main sectors energy consumption of households and firms, mobility, buildings and the use of primary energy. The long-term security of energy supply represents another part of the Austrian energy strategy to achieve the ambitious EU goals. A major part of the energy strategy is the intensified use of renewable energy sources in electricity generation, the transport sector (biofuels) and the heat sector (BLIEM ET AL., 2011; LEBENSMINISTERIUM, 2010).

Figure 11: Austrian strategy to achieve the targets of the climate and energy package



Source: LEBENSMINISTERIUM (2010); OWN DEPICTION

The intensified use of renewable energy sources represents the core element of a sustainable and future-oriented energy policy. Beside the utilisation of the wind, biomass and photovoltaic potentials, a realizable hydropower expansion of 3,500 GWh is stipulated in the Austrian energy strategy (LEBENSMINISTERIUM, 2010).[6] Prior to the Austrian energy strategy, the master plan for the expansion of hydropower utilisation was presented in 2008 and envisages an increase of hydropower utilisation by 7,000 GWh until 2020 (VEÖ, 2008). Furthermore, the intensified use of hydroelectric power was established by law in 2011 (BUNDESGESETZBLATT ÖSTERREICH, 2011). The green electricity act aims to increase hydropower generation by 3,500 GWh until 2015. Of that, 1,750 GWh are planned to be raised by small-scale hydropower. For the period 2010 to 2020 an expansion target of 4,000 GWh was determined. These target values include the effects of revitalisation measures and the extension of existing facilities.

[6] This target value considers ecological requirements as well as economic aspects.

Currently, 16 hydropower projects with an additional yearly electricity generation of approximately 290 GWh are nationwide in the construction process. Of that, 7 projects are small-scaled with a capacity less than 10 MW. Most of the plants in construction are river power stations, but also four pumped storage power plants with capacities between 360 and 480 MW are built.

Furthermore, 37 concrete hydropower plants are currently in the planning stage. 13 of these planned hydropower stations have a capacity of less than 10 MW (small-scale plants). As before, the focus is on river power plants. However, a number of large-scale pumped storage power stations is also planned to be built, especially to balance the fluctuating electricity supply from wind power and photovoltaics. In addition to the concrete hydropower projects, measures to increase the efficiency of existing facilities are planned. These efficiency increases yield an installed capacity of 926 MW and a corresponding electricity generation of 455 GWh. Finally, various small-scale hydropower stations, not particularly defined yet, with a total capacity of 55 MW and an electricity generation amount of 221 GWh are scheduled (OESTERREICHS ENERGIE, 2012).

3.3 Hydropower conflict potential

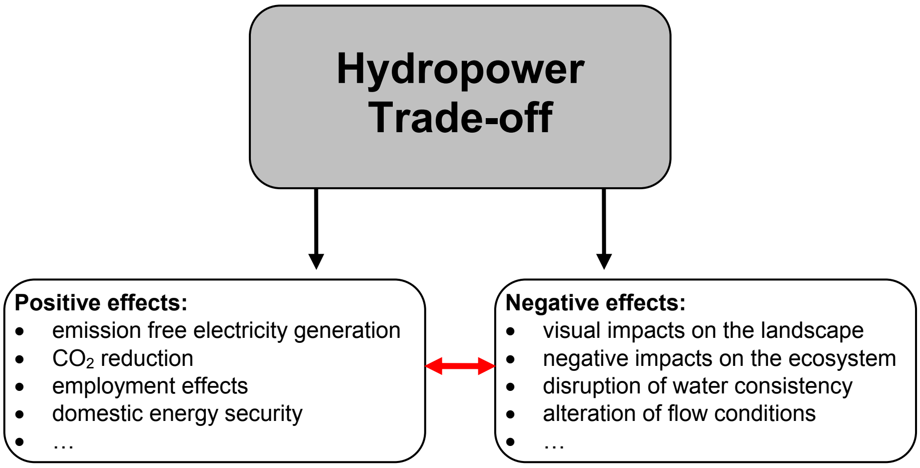
Generally, the use of hydropower is associated with a considerable conflict potential. On the one hand there are the targets of climate and energy policy like the reduction of GHG emissions or the intensified use of renewable energy sources (see section 3.2). On the other hand there are the standards of nature and water protection as for instance the European Water Framework Directive (WFD). Accordingly, the installation of new hydropower stations is associated with external costs and benefits.

EU Water Framework Directive (WFD):
The EU Water Framework Directive (Directive 2000/60/EC) became European law in December 2000 and was transferred into national law three years later, in December 2003. The WFD represents a consistent standard for the protection of water bodies throughout the European Union. The main objective is to achieve a good ecological and chemical status for ground and surface water bodies until the year 2015. For the category of "Heavily Modified Water Bodies" (HMWB) the aim of a good ecological potential is applied. Basically, the good ecological status is given if the water bodies and their symbiotic communities are only marginally affected by a human agency. For the determination of the water body status biological, hydromorphological and physico-chemical quality elements are considered. In addition, the WFD represents a legal framework to ensure that human agency as for instance the construction of new hydropower plants does not lead to a deterioration of the water body status (EUROPEAN PARLIAMENT AND COUNCIL, 2000; LEBENSMINISTERIUM, 2006 and 2007).

In general, hydropower is a highly reliable and well-engineered technology. Furthermore it is highly efficient, permanently available and allows the storage of energy (in the case of storage power plants). Another positive effect when using hydropower is the emission free generation of electricity and the associated CO_2 avoidance. In addition, the development of hydropower is associated with social and economic benefits. In particular, these benefits involve positive impulses for the local economy (especially employment and value-added effects), a strengthening of the economic competitiveness as well as the improvement of domestic energy security and energy-self sufficiency (LEBENSMINISTERIUM, 2010).

However, the construction as well as the operation of new hydropower plants always come along with a negative impact on the water body and its surrounding environment. Consequently, there is a general conflict or "trade-off" between emission-free electricity generation from hydropower and nature conservation (WFD; see Figure 12). Negative effects related to new hydropower plants are visual impacts on the landscape and negative consequences for the ecosystem state of the water body. These impacts range from the disruption of the consistency of the water stream, the alteration of flow conditions and the associated sedimentation, the increase of the water temperature and the related oxygen-deficiency up to a reduction of the water level downstream of the hydropower plant. Altogether, these changes seriously affect fish and other water-dependent wildlife (KNÖDLER ET AL., 2007; MEYERHOFF AND PETSCHOW, 1997; BUNGE ET AL., 2001; WURZEL AND PETERMANN, 2006). In order to minimize these ecological impacts, hydropower plants can be planned in an environmentally friendly way. Thereby measures like the restoration of riverbanks in a near-natural condition as well as the preservation of the water body continuity by for instance the installation of fish ladders play an important role (KNÖDLER ET AL., 2007).[7]

Figure 12: General conflict of hydropower utilisation



Source: OWN DEPICTION

[7] According to the WFD, measures like the installation of fish ladders are obligatory when new hydropower stations are built.

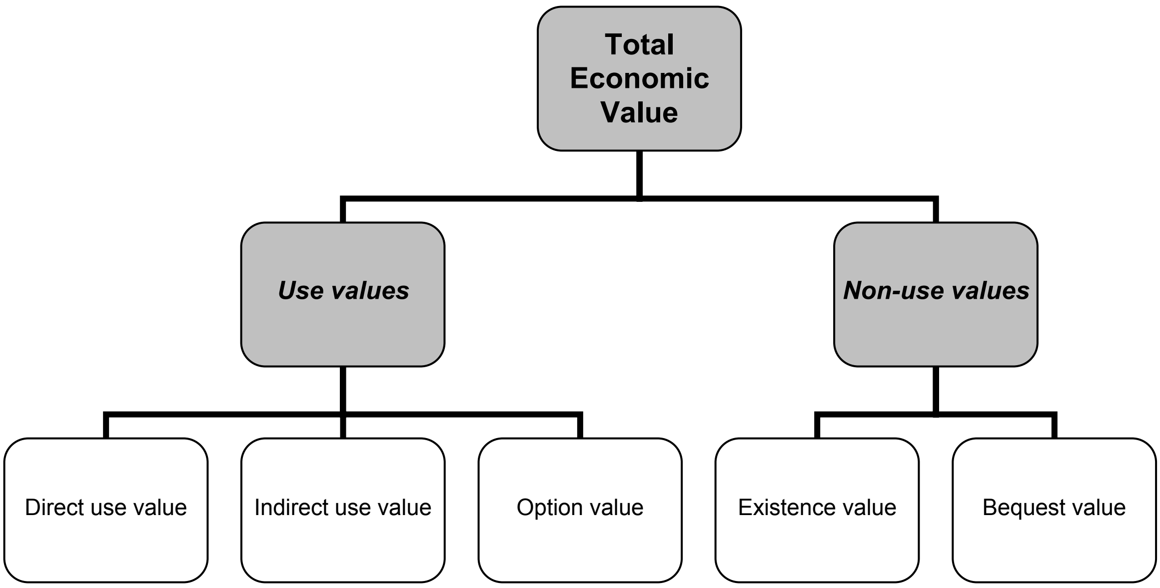
When new hydropower plants are built, all those social, economic and environmental impacts have to be taken into consideration if socially-optimal investments are to be made. Thus, the aim of this project is to examine public perception and preferences for an expansion of hydropower utilisation in Austria considering important costs and benefits associated with hydropower development.

4 Theoretical background

4.1 The concept of total economic value

Renewable energy (especially hydropower) creates multiple benefits like environmental improvements (reduction of GHG emissions), employment effects or independency from fossil energy sources. However, renewable energy is also subject to some disadvantages, for instance landscape changes, negative impacts on the ecosystem (flora and fauna) or noise disturbances. The aim of this study is to quantify the multiple benefits and disadvantages arising from hydropower energy development in Austria. Nevertheless this is a sophisticated process. Renewable energy sources like hydropower consist of various values, the use values and non-use values. Together these values make up the Total Economic Value (TEV). Use-values consist of its direct use values, indirect use values and option values. Non-use values include bequest values and existence values (see Figure 13; PEARCE AND TURNER, 1990).

Figure 13: The concept of Total Economic Value (TEV)



Source: MENEGAKI (2007); OWN DEPICTION

The direct use value from a hydropower station is the electricity produced. The conservation of fossil fuels for other purposes and the related reduction of oil demand by using renewable energy sources is an example of an indirect use value. In addition, individuals may be willing to pay for renewable energy to conserve the option of future use. These potential future benefits constitute an option value. The concept of non-use values refers to the value that people derive from a good or service independent of any (present or future) use. The existence value reflects benefits from simply knowing that a good or service exists. Even though he or she makes no direct of it, an individual may benefit even indirectly from it. The bequest value arises from the desire of individuals to preserve goods for the use of future generations (altruistic motives). For instance, individuals benefit from bequeathing a clearer environment to the next generation as a result of reduced emissions (MENEGAKI, 2007).

The determination of non-use values attributed to renewable energy respectively hydropower is crucially more difficult than quantifying use values, because for these goods and services no market, hence no market prices, exist. In the case of use values the markets have already worked out eliciting values from customers, e.g. people buy green electricity from renewable sources to get their homes supplied with electricity.[8] To conclude, the environmental costs and benefits arising from an expansion of hydropower use represent non-market services (and disservices or bads). Basically, there are two ways of estimating values attached to non-market goods and services (and bads): *revealed* and *stated preference techniques* (PEARCE AND ÖZDEMIROGLU, 2002).

Revealed preference methods quantify the value of a non-market good by studying actual (revealed) behaviour on a closely related market, the complementary or proxy market. The two most popular revealed preference approaches are the travel cost method and the hedonic pricing method (ALPIZAR ET AL., 2001). The basic idea of the travel cost approach is to value environmental or recreational assets (e.g. national parks etc.) via the expenditures on travelling to the site (travel costs, entrance fees etc.). Hedonic pricing is based on the idea that market prices reflect the prices of the individual attributes of a good. The method therefore refers to the measurement of effects, which show up in real markets like labour or property markets (PERMAN ET AL., 2003; PEARCE AND ÖZDEMIROGLU, 2002). The main advantage of revealed preference methods is the fact that they are based on actual choices made by individuals. However, there are also a number of disadvantages, most notably the impossibility of measuring non-use values. Thus, research in the area of non-market valuation has increasingly focussed on stated preference methods over the last 20 years (ALPIZAR ET AL., 2001). Accordingly, the following section will focus on these techniques.

4.2 Stated preference techniques

Generally, stated preference approaches are based on constructed markets, i.e. the method assesses the economic value of non-market goods by using individuals' stated behaviour in a hypothetical setting. Stated preference methods are classified into contingent valuation and choice modelling techniques.

[8] Market prices in principle reflect social values and can often be used to derive welfare effects.

4.2.1 Contingent Valuation

Contingent valuation studies elevate willingness to pay (WTP) for non-market goods and services asking directly how much people are willing to pay within the scope of a survey (MITCHELL AND CARSON, 1990). In doing so, a hypothetical market is created where people can state their maximum willingness to pay or minimum compensation requirement for a change of the regarding good or service. The elicitation method can have various forms:

- *Open-ended question:* In an open-ended question WTP is elicited through direct questions like "What are you willing to pay for an expansion of hydropower use in Austria?" However, with such an interrogative form people are sometimes overextended. For that reason it is often tried to design the WTP question in a more comprehensible and familiar way. One opportunity is the so-called bidding game, which represents an attempt to gradually converge to the maximum WTP.[9] The second possibility is the method of payment cards, where people are confronted with a card showing different amounts of money. People are then asked to choose the money amount which approximately corresponds to their WTP. The information gained from an open-ended question is the actual maximum WTP held by the surveyed people.
- *Dichotomous question:* With a dichotomous question people are asked whether they are willing to pay a given sum of money for a non-marketed good or service. For instance "Are you willing to pay € 5 per month for an expansion of hydropower use in Austria?" The answer to this question can be "yes" or "no", whereas the predetermined money amount varies by individual. In further consequence, the maximum WTP is indirectly determined through the share of yes votes.

The interrogative form of the WTP question is crucial, due to the fact that it determines which kind of WTP measure can be calculated. The ascertained values can differ substantially dependent on the way people were asked to state their WTP (BAUMGART, 2005; CARSON ET AL., 2000; HAUSMAN, 1993; PEARCE AND ÖZDEMIROGLU, 2002).

4.2.2 Choice Experiments

The Choice Experiment (CE) approach is based on the assumption that consumers derive utility from the properties or characteristics of a good and not from the good per se (LANCASTER, 1966). Hence, if values for the individual characteristics or attributes of a good or service are required, then choice modelling is preferable over contingent valuation. According to Lancaster's theory, the value of a good or service (e.g. a hydropower expansion strategy) can be expressed by its characteristics or attributes, which have in turn different levels. By varying the attribute levels different versions (alternatives) of a hydropower expansion programme can be created. Then respondents are asked to choose between a

[9] In particular, people are for instance asked "Are you willing to pay € 3 per month for an expansion of hydropower use in Austria?" If the answer to this question is "yes", the bid will be increased until the respondent refuses to pay the stated amount.

selection of these alternatives in a hypothetical setting. As mentioned above, the alternatives are described by a number of attributes which vary between different alternatives. Usually the respondents are asked to make a sequence of choices. This sequence of choice outcomes enables the analyst to model the probability of an alternative being chosen in terms of the value attached to the attributes used to describe the alternatives. Such models provide information on the willingness of respondents to make trade-offs between the individual attributes. If a price or cost factor is included as an attribute, it is possible to obtain willingness to pay measures for the different attributes used in the choice experiment (ALPIZAR ET AL., 2001; BENNETT AND BLAMEY, 2001; LOUVIERE ET AL., 2000).[10]

Compared to contingent valuation methods, choice experiments possess major advantages:

- First, choice modelling considers the multidimensionality of an environmental good. The method allows valuing the individual attributes that make up an environmental good (e.g. landscape) and enables to estimate the trade-off between these attributes. This is important since many management or policy decisions are concerned with changing attribute levels, rather than losing or gaining the environmental good as a whole (BOXALL ET AL., 1996; HANLEY ET AL., 1998).
- Furthermore choice experiments avoid the so-called "yea-saying" problem, which is often dominant in contingent valuation studies using dichotomous question forms. In choice models respondents are not faced with an "all or nothing" choice. Instead they have to choose one of the alternatives given in an individual choice set, of which they receive many. Thus, they have repeated opportunities to state their preferences within a CE design (HANLEY ET AL., 1998).
- Embedding effects are given if the sequence of questions or the embedding of the good into a broader framework affects the results of the environmental valuation. In choice experiments such problems can be avoided since the individual attributes represent the parts of a good or programme and these parts are embedded into the whole good. Therefore respondents are constrained to weigh between the attributes (parts) of the good avoiding implausible high valuations of individual attributes (ADAMOWICZ ET AL., 1998; BAUMGART, 2005; LOUVIERE ET AL., 2000).
- Finally, discrete choice experiments offer the possibility of benefits transfer, provided that for the measurable attributes of an environmental good, monetary values can be estimated and that socio-demographic characteristics are included in the choice model (BAUMGART, 2005; HANLEY ET AL., 1998; HENSHER ET AL., 2005).

Even though choice experiments provide valuable advantages, some disadvantages of the method have to be faced as well. One limitation of the CE method is that its hypothetical situations are constructed by the researcher and it has to be tested whether the attributes and levels which the expert includes really correspond to the respondent's true preferences. Another disadvantage is, that the hypothetical situations can lead to hypothetical bias, which

[10] More on the theoretical and statistical framework behind discrete choice models is given in section 8.1 of this report.

means that people can state a high WTP, knowing that there will not be any real consequences from the choices made (ALRIKSSON AND ÖBERG, 2008).

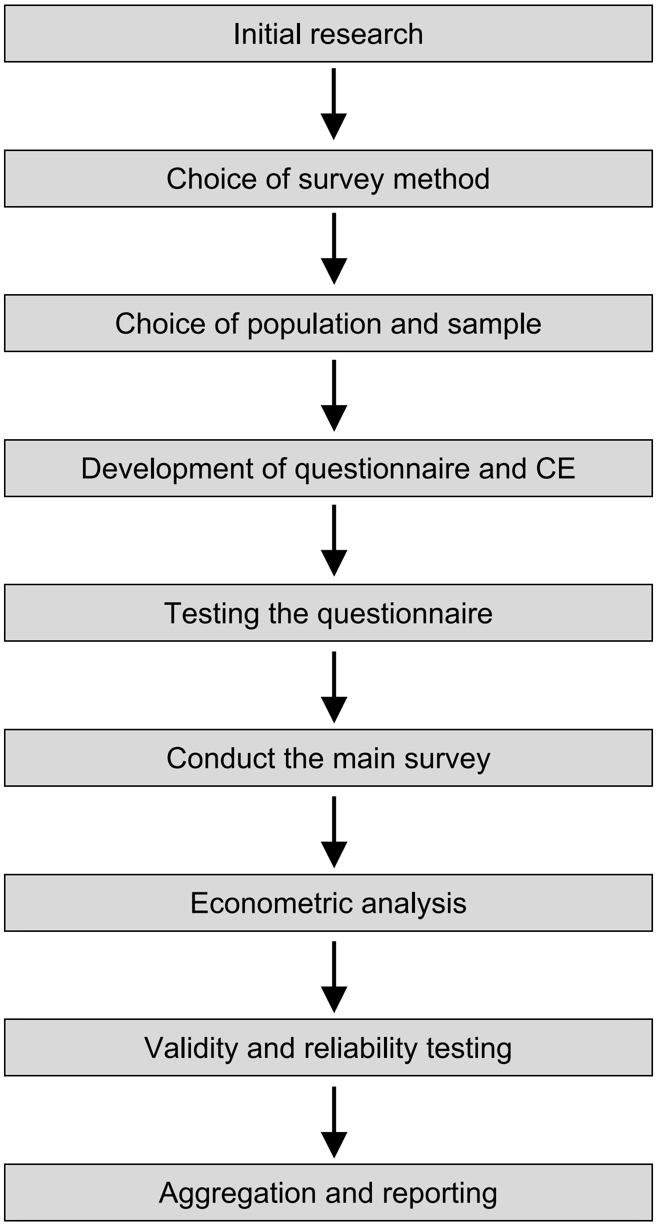
Another limitation is the difficulty to give the respondents the right amount of information about their task and the environmental amenity which has to be valued. On the one hand there should not be too little information to prevent that respondents do not understand the task correctly. On the other hand, too much information may overtax people intellectually. In this case the experiment becomes too complex with the consequence that the results may not be representative for the general community anymore (ROLFE ET AL., 2000).

In spite of these limitations, a discrete choice experiment seemed to be the most appropriate approach to value the multiple costs and benefits associated with different hydropower expansion strategies in Austria. Generally, a stated preference study should follow the multi-stage process depicted in Figure 14.

The procedure starts with some initial research defining the research question to be answered as well as the object or impact being valued. After that, the survey method (face-to-face, mail, online or postal survey) must be decided; a following step is the definition of the target population and the kind of sample drawn from this population. The main and most important part of a CE study is the development of the questionnaire and the choice experiment. Before conducting the main survey, the draft questionnaire has to be tested within focus group sessions and pilot surveys.[11] The final steps of a CE study involve the econometric analysis, some kind of statistical tests as well as the aggregation and reporting of the study results.

[11] More on study design and pretesting can be found in section 6 of this report.

Figure 14: Multi-stage procedure of a stated preference study



Source: PEARCE AND ÖZDEMIROGLU (2002); OWN DEPICTION

5 Previous research

Prior to the development of the choice experiment (see chapter 6) it was useful to find out what kind of research has already been done in the field of renewable energy valuation. In the course of this literature review it was found that there exists only a very limited number of studies using choice experiments to value the multiple costs and benefits of hydropower use. In contrast, most of the available choice experiment analysis focuses on the valuation of renewable energy investments in general and not especially on hydropower investments. Furthermore, other valuation studies investigate the effects of wind power. The following overview section presents several choice experiment applications which have been carried out in the past ten years on the topics of hydropower, renewable energy and wind power.

Most of these studies have been conducted in Europe, but also one study focuses on the United States and one focuses on Korea.

5.1 Hydropower studies

KATARIA (2009) conducts a CE investigating people's willingness to pay for environmental improvements in hydropower regulated rivers in Sweden. The study considers the attributes *increased fish stock* (0%, 15% or 25% increase)*, improved conditions for bird life* (yes or no)*, species richness* (high, moderate, considerably reduced) and *additional annual electricity payments for households*. The outcome reveals that the Swedish population is willing to pay for environmental improvements of hydro regulated rivers. When looking at the importance of different attributes, it is noted that the highest WTP is for river margin vegetation and erosion, followed by the attribute increased species richness.

An investigation from **SUNDQVIST (2002a)** provides an attempt to value the environmental impacts arising from hydroelectric production by non-residential electricity consumers (small and medium sized firms) using the choice experiment approach. The main objective of the study was to analyse Swedish non-residential attitudes towards green electricity from hydropower. The water-related attributes *downstream water level* (with the levels minimum flow, 25 % higher or 50 % higher water level)*, erosion and vegetation* (-25 %, -50 %) as well as *impacts on fish life* (adapted to migratory fish species or to all fish species) are included in the choice experiment. In order to obtain willingness to pay measures for these attributes the price attribute is defined as an *increase in electricity price per kilowatt hour (KWh)*. The results show, that respondents are willing to incur extra costs for environmental improvements, like the reduction of erosion and vegetation or the preservation of fish species. The analysis also indicates that environmental improvements must be provided at a low cost since firms are sensitive to price increases. The same choice experiment was applied to a random sample of households **(SUNDQVIST, 2002b)**. This investigation principally yields the same results as in the case of non-residential electricity consumers.

5.2 Renewable energy studies

BERGMANN ET AL. (2004) look into different impacts that are caused by specific renewable energy investment strategies and it is investigated how those affect welfare changes in Scotland. The authors focus on the attributes *landscape impact* (with the levels none, low, moderate or high impact), *wildlife impact* (slight improvement, no impact, slight harm)*, impacts on pollution levels* (none, slight increase)*, number of jobs created* (1-3, 8-12, 20-25) and *annual increase in a household's electricity prices*. The study uses coloured pictograms in the choice cards to present the different attributes. A Multinomial Logit (MNL) model is applied and the study finds that the avoidance of air pollution is the most important attribute in respondent's valuation. Moreover, people in Scotland show a high willingness to pay to avoid high impacts on the landscape. However, people are not willing to pay to reduce landscape impacts, if these impacts are small. Furthermore, the results of the research show that Scottish people find it very important to avoid impacts on wildlife. Especially an increase in wildlife is related to a high economic value. However, in order to have no impact on wildlife people are only willing to pay 75 % of what they are willing to pay to reduce landscape impacts. Finally, the paper looks into special issues, investigating differences in preferences of the rural and urban population. The outcome shows that the rural population is more willing to accept negative environmental impacts compared to the urban population. Conversely, the rural population is more willing to pay for a reduction in air pollution and wildlife benefits. Employment creation is also valued higher by the rural than by the urban population.

BERGMANN ET AL. (2008) extend the study of BERGMANN ET AL. (2004) by taking into account the type of technology used and found out that large off-shore wind farms are preferred to small on-shore wind farms. It is also found that large on-shore wind farms are the least preferred option.

BORCHERS ET AL. (2007) investigate the willingness to pay for voluntary participation in green energy programs in New Castle County, Delaware, USA. The authors analyse whether consumers are willing to pay more for a specific green energy source than for a generic green energy source. Furthermore, the marginal willingness to pay for specific green energy sources is estimated. The specified sources looked at in their paper are solar, wind, biomass and farm methane. The attributes used in the CE are the *energy source*, the *percentage of a respondent's monthly electric use that comes from this energy source* and the *monthly increase in electricity bill*. No pictograms or pictures are used in the choice cards. Instead the attributes are only described in keywords. However, it must be mentioned that people were shown pictures of the potential energy sources before answering the Choice Experiment questions. The outcome demonstrates that the marginal mean willingness to pay for the change from the status quo to green electricity is positive. Furthermore, it is shown that people prefer solar to a generic green or wind source. Farm methane and biomass are the least preferred energy sources.

BURKHALTER ET AL. (2009) conduct an online survey with a choice experiment in the East of Switzerland and discuss whether standard electricity products meet Swiss customers' preferences. The study includes a whole range of attributes, the most relevant are *different power mixes*, *location of production* (either in their region, in Switzerland, in neighbouring countries or in Eastern Europe) and *monthly electricity costs*. Also other attributes related to the electricity package are investigated, for example how soon it is possible to end the contract with the supplier, whether the supplier is local or international, whether the electricity product is certified or not and what price model the supplier uses. However, these attributes show a rather low relevance for respondents in the outcome. Regarding the choice cards no pictures or pictograms are used but the attributes are simply indicated in text form. The main results of the study reveal that customer preferences are not met by electricity products offered on the Swiss market. The power mix at that time consisting mainly of nuclear- and hydropower only takes rank four out of five and is therefore the second to last preferred option. Swiss electricity consumers prefer renewable energy to nuclear power and within the renewable energy sources solar power is the most preferred option. In general, a diversified portfolio of renewable energy is preferred to an energy supply purely derived from hydropower. Finally, people have a clear preference for locally produced electricity over electricity imports.

Fimereli et al. (2008) study people's preferences for the use of low-carbon technologies in electricity production. They conducted a labelled Choice Experiment in South-East England and the renewable sources looked at are on-shore wind power, nuclear power and biomass. The attributes the authors look at are *distance to a respondent's home* (ranging between levels of 400m, 10km, 16km and 29km), *carbon emission reductions for producing 20% of electricity* (0%, 50%, 95% reduction), *local biodiversity impacts* (less, no change, more), *land requirements to produce 20% of electricity* (568ha, 1594ha, 5832ha, 816000ha) and *increase in annual electricity bill.* In this study pictures of the different technologies are used to introduce the alternatives in the beginning, but they are not put in the choice cards. The study applies a MNL model and concludes that people's choices are significantly affected not only by the attributes but also by the labels of the alternatives. People have a strong preference for wind and biomass and an aversion to nuclear power. Finally, people prefer energy sources to be placed at a larger distance from their homes and they opt for technologies that increase biodiversity and lead to higher reduction of CO_2 emissions.

Ku and Yoo (2010) look into the willingness to pay for renewable energy investment in Korea. The considered attributes are *landscape improvement* (with the levels 0%, 25% or 50% improvement), *wildlife improvement* (0%, 25% or 50% improvement), *decrease in air pollution* (0%, 70% or 100% decrease), *employment creation* (0, 10 or 30 jobs created) and *increase in electricity price*. Coloured photographs of different renewable energy technologies are shown to respondents when introducing the Choice Experiment, but not in the choice cards themselves. The analysis shows that the Korean population values the protection of wildlife and a reduction in pollution as well as the creation of more jobs. However, the improvement of landscapes is not significantly valued by respondents.

Longo et al. (2008) investigate people's WTP for a hypothetical program in Bath, England, promoting renewable energy production. The attributes which are looked at are *reduced GHG emissions, better security of energy supply* and *higher employment rates*. The payment vehicle used is an *increase in people's quarterly electricity bill*. The study does not use any pictograms or pictures in the choice cards. After having applied a MNL model Longo et al. find that respondents prefer a policy that promotes renewable energy compared to the status quo. Respondents value the reduction of GHG emissions highly and also show some preference for the creation of jobs, although less than for the reduction of GHG emissions.

NAVRUD AND BRATEN (2007) elicit the preferences and WTP of the Norwegian population regarding different energy sources and their characteristics. The authors include the following attributes: *energy source, size of power plant* (which ranges from few large power plants over more medium sized to many small power plants) and *annual increase in the electricity bill*. Energy alternatives considered in this study are wind, hydro, natural gas and on-going import of electricity from coal fired power plants. After the application of a MNL model the results demonstrate that domestic wind power is preferred to power from hydro or natural gas and to imported electricity from coal fired power plants. Increased local hydropower and natural gas production would even lead to reduced utility compared to an on-going import from Danish coal power, which is the case right now. Regarding wind energy, few large wind farms are preferred to many small wind farms. NAVRUD AND BRATEN also find confirmation of the NIMBY (Not in my backyard) effect of renewable energy. They compare one rural and one urban sample and look at the WTP confidence intervals of both samples for replacing imported fossil fuel power with local production of renewable energy. The outcome shows that people from rural areas value a change to renewable energy significantly lower than people from urban areas, which is confirmed by the non-overlap of the confidence intervals. This confirms the NIMBY effect, because people living in rural areas are more likely to encounter renewable energy plants close to their residential areas, as there is more space to install new renewable energy power plants in the countryside and therefore most power plants will probably be located in rural areas.

5.3 Wind power studies

ALVAREZ-FARIZO AND HANLEY (2002) research environmental impacts of onshore wind farms in Spain. The authors conduct personal interviews which take the attributes *protection of cliffs, protection of habitat and flora, protection of landscape,* and *cost* into consideration. All the attributes, except cost, have two levels, namely either protection or loss. Cost levels are at 500, 1000 and 1500 Pesetas per year, whereas in the study it is not explicitly specified how these costs are paid. Furthermore, in the choice experiment no pictures or pictograms are used to represent the different attributes. Instead, each attribute is presented only using a few keywords, like for example: loss of landscape. A MNL model is used for their estimations. The findings show that strong environmental impacts are associated with the development of wind farms. The conservation of flora and fauna is found to be perceived as more important by people than the preservation of landscape, which is on rank two, or the protection of unique cliffs, which ranks third.

EK (2005) aims at examining households' preferences for the environmental attributes associated with wind power generation in Sweden. The attributes included in the choice experiment are the following: *noise level* (with 30 dB and 40 dB), *location* (with the levels mountain, offshore or onshore), *height* (up 60 metres, higher than 60 metres) and *grouping of windmills* (small wind farms, large wind farms and separate windmills). The *change of the electricity price per kWh* is included as the monetary attribute. The results show that offshore wind farms are preferred over wind farms in the mountains. Large onshore wind farms should be avoided in order to minimize the external costs associated with wind power. Moreover, a reduced noise level is considered to be an environmental improvement. The height of the windmills does not have any significant impact on choice. Finally, Swedish house owners are cost conscious and prefer low electricity prices over higher. Consequently, future measures towards decreasing the external impacts of wind power must come at a relatively low cost.

MEYERHOFF ET AL. (2009) analyze landscape externalities from onshore wind power in Westsachsen and Nordhessen, Germany via phone interviews. Several attributes are taken into account, which are *size of wind farms* (either small or large)*, maximum height of turbines* (110m, 150m 200m), *reduction of red kitten population* (by 5%, 10% or 15%),[12] *minimum distance to residential areas* (750m, 1100m, 1500m) and *a monthly surcharge on the electricity bill.* Only text and no pictures or pictograms are used in the choice cards to represent the attributes. The findings show that especially the impact on birds and the distance to homes strongly influence people's choices. MEYERHOFF ET AL. (2009) notice that people have a preference for turbines which are located further away from residential areas, impacts on biodiversity are also valued negatively. However, the height of the turbines does not matter significantly to German citizens.

5.4 Comparison of previous studies

An overview of all the studies that have been reviewed is given in Table 3. Comparing the previous studies, it can be noted that different energy sources are looked at in different studies, but in fact all studies investigate either the WTP for different renewable energy technologies or look into the importance of impacts related to energy technologies. Although the context differs across the Choice Experiments, all the studies taken into consideration here find that consumers in general show a positive willingness to pay for the use of renewable energy sources.

What has been mentioned in many studies is that several renewable energy technologies can cause substantial negative externalities. Large amounts of space are required in order to capture renewable energy from wind, water or solar radiation in quantities which are commercially viable (BERGMANN ET AL., 2004). The outcomes of various studies show that people value impacts on nature or wildlife negatively. A significant number of studies find these impacts on nature and wildlife to be important compared to other attributes. A high WTP to reduce negative impacts on such attributes is shown by ALVAREZ-FARIZO AND HANLEY (2002); BERGMANN ET AL. (2004); FIMERELI ET AL. (2008); KATARIA (2009); KU AND YOO (2010), MEYERHOFF ET AL. (2009) and SUNDQVIST (2002a and 2002b).

[12] The red kite is a bird that is most threatened by wind turbines in this region.

Quite a few studies additionally discuss the attribute landscape impacts and find out that people show high preferences for reduced landscape impacts (ALVAREZ-FARIZO AND HANLEY, 2002; BERGMANN ET AL., 2004) except in Korea where the improvement of landscapes is not significantly valued (KU AND YOO, 2010).

A number of articles take the distance of power plants to residential areas into consideration and find that there is a preference for larger distances to power plants. This has been explicitly the case when it comes to wind turbines (BERGMANN ET AL., 2008; FIMERELI ET AL., 2008; MEYERHOFF ET AL., 2009). The NIMBY effect of renewable energy, which is confirmed by NAVRUD AND BRATEN (2009) also shows that people have a preference for power plants not being located close to their home. Other attributes which have been found to be significant in several studies are air pollution, CO_2 emission reductions and job creation.

Most of the studies which compare different energy sources conclude that solar power is the most preferred form of renewable energy (BORCHERS ET AL., 2007; BURKHALTER ET AL., 2009) followed by wind power which is favoured over other renewable energy sources to some degree (BORCHERS ET AL., 2007; FIMERELI ET AL., 2008; NAVRUD AND BRATEN, 2007). However, the implicit prices for different energy sources vary significantly among studies.

As far as methodological issues are concerned, almost all studies use two alternatives plus one status-quo-option in each choice card. The experiments are either conducted via telephone, face-to-face, mail or online and no clear preference for one of these data collection methods can be distinguished. Most of the studies use a MNL model for their estimations, which is the simplest econometric model for Choice Experiments.

Another interesting observation is that the majority of the studies do not include pictures or pictograms in the choice cards. This might have been done to avoid that people are attracted more to one attribute only because they like the picture better. Also some attributes like for example a low, moderate or strong impact on nature, are difficult to express in a pictogram and the attribute might be misunderstood due to the pictogram.

Table 3: Literature review on choice experiment studies

Authors	Study-year	Country	Data collection method	Type of CE	Main objective	Attributes used in the CE
KATARIA	2009	Sweden	Mail survey	Unlabelled	Investigate WTP for environmental improvements in hydropower regulated rivers	– Increased fish stock – Improved conditions for bird life – Species richness – Additional annual electricity payment for households
SUNDQVIST	2002a 2002b	Sweden	Mail survey	Unlabelled	Valuing the environmental impacts arising from hydroelectric production	– Downstream water level – Erosion and vegetation – Impacts on fish life – Increase in electricity price per kWh
BERGMANN ET AL.	2004	Scotland	Mail survey	Unlabelled	Investigate the impacts caused by renewable energy investment strategies and how those affect welfare changes	– Landscape impact – Wildlife impact – Impact on pollution level – Number of created jobs – Annual increase in household's electricity bill
BERGMANN ET AL.	2008	Scotland	Mail survey	Labelled	Same as previous, taking into consideration the type of technology used	– Technology – Landscape impact – Wildlife impact – Impact on pollution level – Number of created jobs – Annual increase in household's electricity bill
BORCHERS ET AL.	2007	USA	Face-to-face Interviews	Unlabelled	Investigate WTP for participation in a voluntary green energy program where 25 % of electricity comes from the specified source	– Energy source – Percentage of monthly electric use that comes from this source – Monthly increase in electricity bill

BURKHALTER ET AL.	2009	Switzerland	Online survey	Unlabelled	Study whether standard electricity products meet customers' preferences	– Power mix – Location of production – Monthly electricity costs
FIMERELI ET AL.	2008	England	Mail survey	Labelled	Studying peoples' preferences for the use of low-carbon technologies	– Renewable source – Distance to a respondent's home – Carbon emission reduction – Local biodiversity impacts – Land requirements – Increase in annual electricity bill
KU AND YOO	2010	Korea	Face-to-face interviews	Unlabelled	Investigate WTP for renewable energy investments in Korea	– Landscape improvement – Wildlife improvement – Employment creation – Increase in electricity price
LONGO ET AL.	2008	England	Face-to-face interviews	Unlabelled	Looking at WTP for a hypothetical renewable energy programme	– Reduction of GHG emissions – Impact on the security of energy supply – Impact on employment rates – Increase in quarterly electricity bill
NAVRUD AND BRATEN	2007	Norway	Face-to-face interviews	Labelled	Measuring people's WTP for different energy sources and their characteristics	– Energy source – Size of the power plant – Annual increase in electricity bill
ALVAREZ-FARIZO AND HANLEY	2002	Spain	Face-to-face interviews	Unlabelled	Study the environmental impacts of wind farms	– Protection of cliffs – Protection of habitat and flora – Protection of landscape – Cost per year

EK	2005	Sweden	Postal survey	Unlabelled	Examining households' preferences for the environmental impacts of with wind power	– Noise level – Location – Height – Grouping of windmills – Change of the electricity price per kWh
MEYERHOFF ET AL.	2009	Germany	Telephone interviews	Unlabelled	Analyzing landscape externalities from onshore wind power	– Size of wind farms – Maximum height of turbines – Reduction of red kitten population – Minimum distance to residential areas – Monthly surcharge on electricity bill

Source: OWN DEPICTION

6 Study design and implementation

As investments into hydropower and renewable energy are expected to grow in the future, it is important for policy makers to know how the Austrian population perceives different hydropower expansion strategies and their related potential impacts. On the one hand, there will be positive impacts based on an increase in employment or a reduction in CO_2 emissions. On the other hand, also negative impacts like for instance effects on landscape and nature will occur. This trade-off has already been elucidated in section 3.3 of this report. All these positive and negative effects can be considered as characteristics, criteria or attributes that have to be taken into account when thinking of a hydropower utilisation strategy for Austria. It is useful and policy relevant to gain knowledge on the relative economic values of these attributes in order to determine which hydropower expansion strategy would be preferred by the Austrian population. Hence, a choice experiment together with a comprehensive questionnaire has been developed over a period of several months. The following sections contain a description of the developed choice experiment, the questionnaire, design and testing procedures.

6.1 The choice experiments

The choice modelling approach is based on the idea that any good can be described in terms of its attributes or characteristics and the levels they take (see also section 4.2.2). Due to this assumption it is possible to convey information on which attributes are significant determinants of the values people attach to non-market goods. In principle, the development and design of a choice experiment involves several steps (BENNETT AND BLAMEY, 2001).

- **Identification of the decision problem:** At the beginning of a discrete choice experiment the research question and the relevant context of the decision problem has to be characterised.
- **Selection of attributes and levels:** In the second step the relevant attributes and their levels used to describe a hydropower expansion strategy have to be seleceted. This is usually done through literature reviews (see section 5), focus group discussions or direct questioning. It is important that the chosen attributes are relevant to the problem which is being analyzed. Next, for each attribute the corresponding levels have to be determined. They should be realistic and credible and may include policy targets.
- **Experimental design and construction of choice sets:** Another important task is the experimental design of the choice model. By combining the levels of the determined attributes, a number of alternative hydropower expansion strategies are generated. The generated alternatives are then grouped into choice sets to be presented to respondents. A choice set usually contains a baseline scenario (status quo) and several alternative options in which the specified attributes are changed in quantity.

- **Measurement of preferences:** The further steps of a choice experiment study include the design of the survey including pretesting of the questionnaire, data collection and finally, the estimation of an econometric model describing the preferences of the surveyed population (BAUMGART, 2005; LOUVIERE ET AL., 2000; PEARCE AND ÖZDEMIROGLU, 2002).

6.1.1 Choice Experiment: hydropower expansion

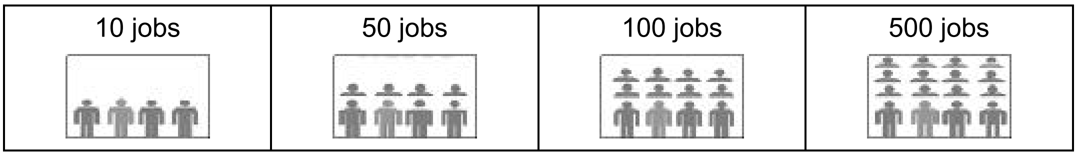
As already mentioned before, the utilisation of the available hydropower potential represents an import part of the Austrian climate and energy strategy. However, an extension of hydropower use is associated with positive and negative effects (see section 3.3 of this report). These impacts can be thought of as the attributes of a hydropower expansion strategy. The determination of the attributes used to describe the hydropower expansion alternatives is a rather tricky task, since several requirements should be fulfilled in order to choose the appropriate attributes. Firstly, the attributes must be relevant to the problem which is being analyzed. Secondly, the attributes have to be credible and realistic and easily understandable for the sample population. Finally, the attributes should be applicable to policy analysis (BERGMANN ET AL., 2004; PEARCE AND ÖZDEMIROGLU, 2002).

A rule of thumb is not to choose more than four or five attributes to describe the decision problem of a choice experiment. This principle ensures that the choice situation can be handled by respondents. For the description of different hydropower expansion strategies in Austria, we decided to use the five attributes presented below. Various pictograms were used for the explanation of the choice experiment attributes, improving the comprehensibility for respondents. However, in order not to influence people’s perception and to avoid a preference for one of the alternatives caused by the attractiveness of a picture, all pictograms are held as simple as possible and in black and white.

Employment creation

The expansion of hydropower utilisation in Austria is accompanied by positive impacts for the local economy (LEBENSMINISTERIUM, 2010). In particular, investments in hydropower lead to job creation. According to the Austrian master plan for promoting hydropower, about 6,000 jobs can be created over a period of ten years (VEÖ, 2008). This is why employment was considered to be a relevant attribute and it was included in the choice experiment with the four levels shown in Figure 15. The attribute levels thereby refer to jobs created in the residential area of the respondent. An attribute describing employment effects has also been used in the studies of BERGMANN ET AL. (2004), BERGMANN ET AL. (2008) as well as KU AND YOO (2010) as part of the impacts caused by renewable energy investments.

Figure 15: Levels of the employment attribute

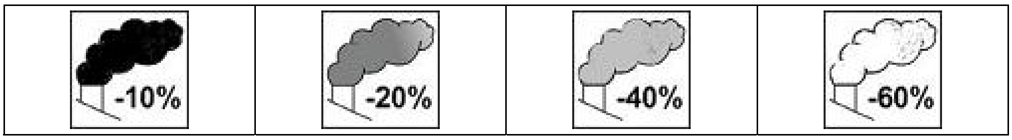


Source: OWN DEPICTION

Reduction in CO_2 emissions

As discussed in chapter 3.2 of this report, Austria aims to reduce GHG emissions by 16 % in 2020. The necessity to reduce emissions and to prevent climate change is therefore one of the main reasons why there is such a strong need for the expansion of renewable energies such as hydropower. Depending on the amount of electricity generated from hydropower, different levels of CO_2 emission reductions in the electricity sector can result. The respondents in the underlying experiment could make a decision between the levels shown in Figure 16. Emission attributes have also been used in different forms in previous research (see BERGMANN ET AL., 2004; BERGMANN ET AL., 2008; FIMERELI ET AL., 2008 and LONGO ET AL., 2008).

Figure 16: Levels of the CO_2 reduction attribute



Source: OWN DEPICTION

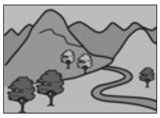
Impact on nature and landscape

As mentioned before, there are also some negative impacts related to hydropower utilisation. These are visual impacts on the landscape and negative consequences for the ecosystem of the water body (e.g. disruption of the consistency of the water stream, alteration of flow conditions, reduction of the water level downstream of the hydropower plant). Altogether these changes seriously affect fish and other water-dependent wildlife (KNÖDLER ET AL., 2007; MEYERHOFF AND PETSCHOW, 1997; BUNGE ET AL., 2001; WURZEL AND PETERMANN, 2006). In order to minimize these ecological impacts, hydropower plants can be planned in an environmentally friendly way. Thereby measures like the restoration of riverbanks in a near-natural state as well as the preservation of the water body continuity with for instance the installation of fish ladders play an important role (KNÖDLER ET AL., 2007). We decided to use two levels for the *nature and landscape attribute*, namely a small and strong impact (see Figure 17). With a strong impact only the minimum requirements predetermined by the Water Framework Directive are fulfilled.[13] A small impact, in contrast, implies that higher environmental standards (beyond the given standards of the Water Framework Directive) are

[13] The Water Framework Directive represents a legal framework to ensure that new hydropower plants do not lead to a deterioration of the water body status. Measures like the installation of fish ladders or a minimum amount of residual water are obligatory when new hydropower stations are built (STIGLER ET AL., 2005).

fulfilled to minimize the impact of the hydropower plant on the landscape and the natural environment. Wildlife and biodiversity impacts have also been considered in previous choice experiments valuing the multiple impacts arising from hydropower or renewable energy (see for instance BERGMANN ET AL., 2004; FIMERELI ET AL., 2008; KATARIA, 2009 or SUNDQVIST, 2002).[14]

Figure 17: Levels of the nature and landscape attribute

Small impact	Strong impact
	

Source: OWN DEPICTION

Distance to home

The fourth attribute used in the choice experiment of this study describes the distance of the nearest power plant to the respondent's home. That this is a relevant issue can be seen from previous studies like FIMERELI ET AL. (2008) or MEYERHOFF ET AL. (2009) showing that people prefer energy sources to be placed at a larger distance from their homes. In order to find evidence for this "Not in my backyard" theory, distance of the power plant to home is taken into consideration with the following levels:

Figure 18: Levels of the distance attribute

2 km	4 km	8 km	20 km

Source: OWN DEPICTION

Increase in monthly electricity bill

In order to estimate WTP measures a cost factor should be included in the choice experiment as one of the attributes (PEARCE AND ÖZDEMIROGLU, 2002). This is crucial since the generation of renewable energy (hydropower) is currently more costly than the generation of traditional electricity from fossil fuels. This is why an increase in hydropower use is considered to be associated with an increase in electricity prices (BERGMANN ET AL., 2008). The payment vehicle included in the choice experiment of this project is specified as an increase in respondents' monthly electricity bill with the levels presented in Figure 19.

Figure 19: Levels of the monetary attribute

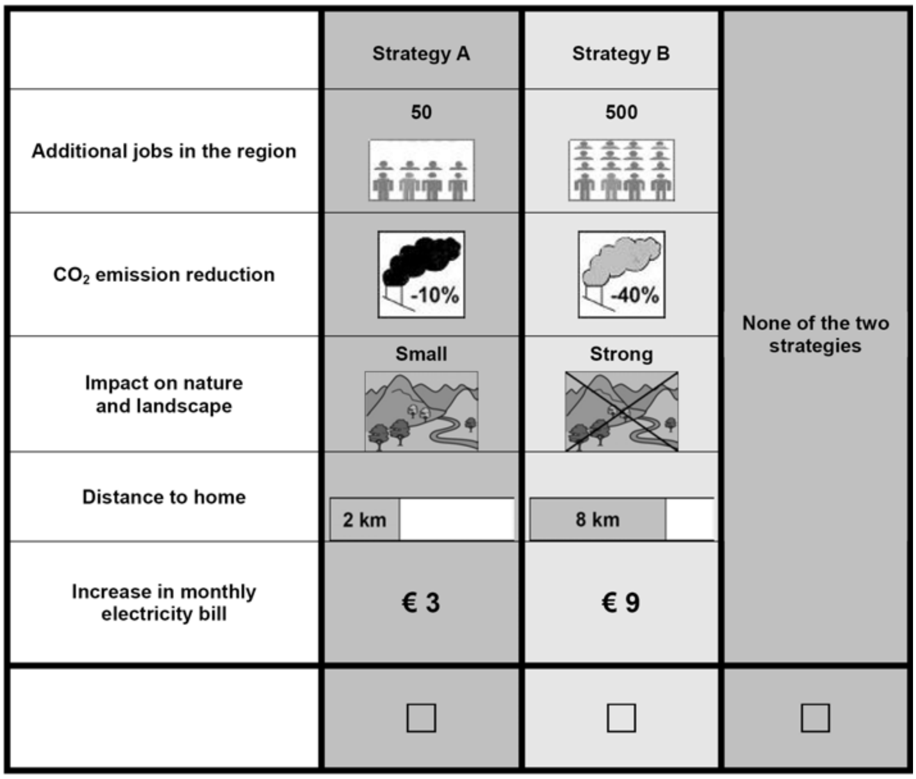
€ 3	€ 6	€ 9	€ 12	€ 15	€ 18

Source: OWN DEPICTION

[14] In contrast to the choice experiment of this study, previous analysis used the attribute describing environmental impacts in quite another form. On the one hand, landscape and wildlife impacts were often used as two separate attributes. On the other hand, environmental impacts associated with hydroelectric production are described in greater detail referring for instance to downstream water level or impacts on fish life.

Choice sets were created using a D-efficient experimental design in the software package Sawtooth. Each choice set consists of three alternatives, including an opt-out alternative referred as "none of the two strategies". This opt-out alternative is included in all choice sets. The design was finally blocked into 50 versions, each containing six choice tasks.[15] An example of a choice card is presented in Figure 20. Such a choice experiment is called an *unlabelled experiment*, since it uses generic titles (*Strategy A* and *Strategy B*) for the alternatives. The title *Strategy A* does not convey any information to the respondent other than that this is the first of the alternatives (HENSHER ET AL., 2005).

Figure 20: Choice card example hydropower



Source: OWN DEPICTION

6.1.2 Choice experiment: renewable energy expansion

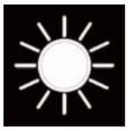
One bias that can arise in stated preference analysis is the problem of framing effects. Framing effects are given if WTP depends on how the question is framed. More precisely, in the presence of framing effects WTP varies with the frame when it intrinsically should be the same for the same good (PEARCE AND ÖZDEMIROGLU, 2002).

What does this mean for the research on the intensified use of hydropower? The expansion of hydropower use is surely an important strategy to meet future energy goals like the reduction of GHG emissions. However, the expansion of hydropower is only part of a broad

[15] PEARCE AND ÖZDEMIROGLU (2002) recommend the use of not more than 4-6 choice tasks in order to keep the experiment manageable for the respondents.

strategy aiming at expanding the use of renewable energy sources. Beside hydropower, there are also significant future potentials for the use of biomass, wind power and photovoltaic (BLIEM ET AL., 2011; ÖSTERREICHISCHER BIOMASSE-VERBAND, 2008). This circumstance should also be reflected in the choice experiment in order to describe a realistic decision situation. This is why hydropower expansion was embedded into a broader strategy promoting an expansion of renewable energy sources. The renewable energy sources investigated in this context are – beside hydropower – biomass, solar (photovoltaics) and wind power. These renewable energy sources represent the labels of the choice experiment. For each technology a meaningful pictogram is used (see Figure 21).

Figure 21: Labels of the choice experiment

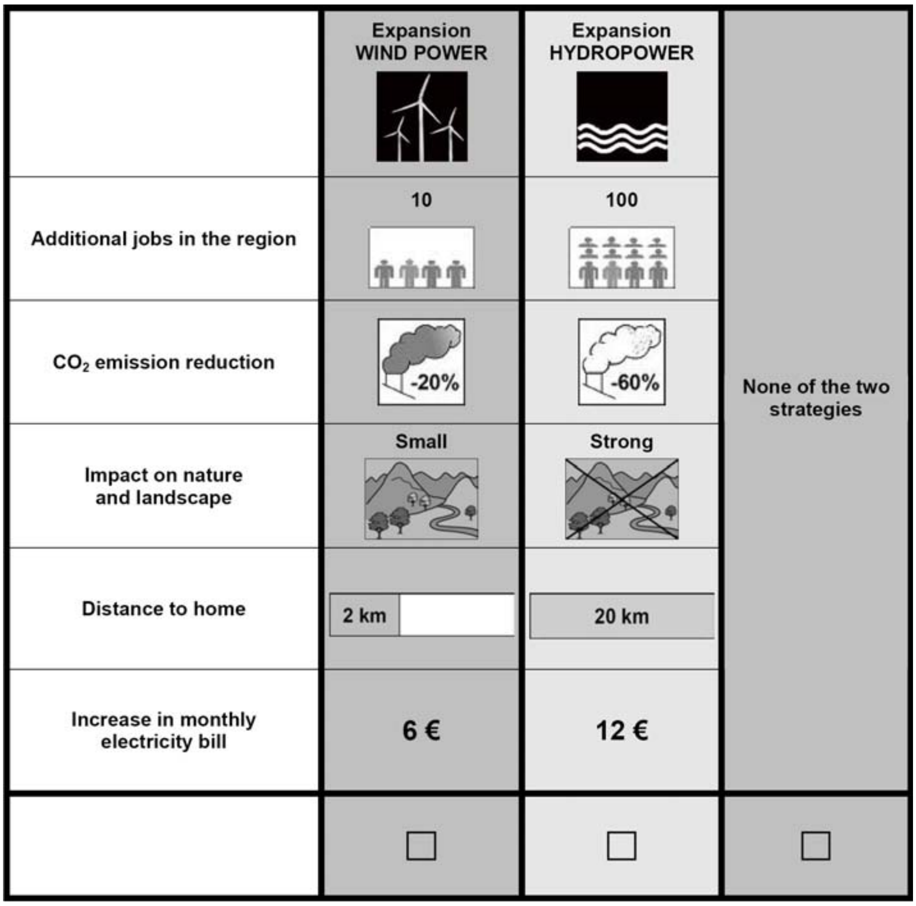
Expansion BIOMASS	Expansion SOLAR POWER	Expansion HYDROPOWER	Expansion WIND POWER
			

Source: OWN DEPICTION

The attributes used to describe the different renewable energy expansion strategies are the same as in the case of hydropower only (see chapter 6.1.1), since employment creation, CO_2 emission reductions, impacts on nature and landscape as well as distance to home also play a role when referring to an expansion of biomass, solar or wind power.

Choice sets were again created using a D-efficient experimental design. As in the case of the hydropower choice experiment, each choice set contains three alternatives including an opt-out alternative (none of the two strategies). The final design consists of 50 versions, each containing six choice tasks. A choice card example is given in Figure 22. Such an experiment is called a labelled experiment, which attaches the name of a renewable energy source to each alternative in the choice card. In contrast to the hydropower choice experiment, respondents can now decide between different renewable technologies. That's the only difference between the two choice models; the attributes and levels are equivalent. This approach depicts the decision situation in a more realistic way, since not only hydropower represents an option when talking about the expansion of renewable energy. Furthermore, it enables to test for framing bias. To rule out the presence of framing effects, WTP for hydropower and its attributes should be equivalent, no matter in which context (hydropower only or renewable energy) respondents made their choices. Additionally, a useful side effect of the labelled choice experiment is the possibility to gain information on the ranking of different renewable energy sources.

Figure 22: Choice card example renewable energy



SOURCE: OWN DEPICTION

6.1.3 Choice experiment: regional hydropower case study

Beside the valuation of the national strategy for expanding hydropower use, two regional hydropower case studies are considered within the scope of this research project. These case studies refer to specific hydropower projects in the province of Styria (Graz-Puntigam and Gratkorn).

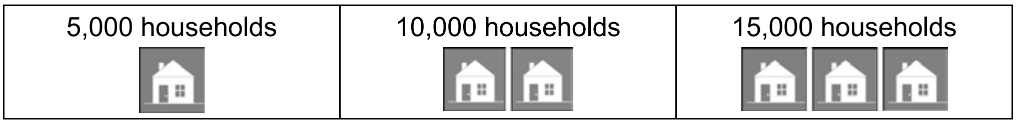
As in the case of a hydropower expansion strategy, a new hydropower plant can be described by its characteristics. The attributes used to describe the planned hydropower stations fairly differ from those in the previous choice experiments referring to hydropower and renewable energy. In the CE of the regional case studies the new hydropower plants are described by the following four attributes. Again pictograms are used to make it easier for people to understand the attributes.

Electricity generation amount (households)

The main advantage of the installation of a new hydropower plant is the emission-free generation of electricity for local consumers and the associated greenhouse gas reduction. For the two hydropower projects in Styria the amount of households that could be provided with electricity is estimated between 13,000 and 20,000 households (DOBROWOLSKI AND

SCHLEICH, 2009; VERBUND AUSTRIAN HYDRO POWER, 2009a). In view of a conservative estimate, the levels were fixed between 5,000 and 15,000 households (see Figure 23).

Figure 23: Levels of the electricity generation attribute



Source: OWN DEPICTION

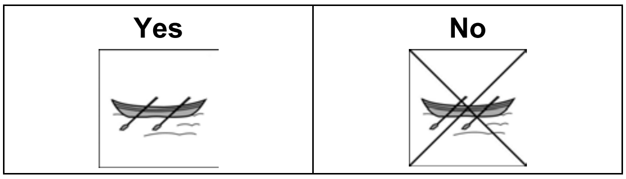
Impact on nature and landscape

Negative impacts on the landscape and the ecosystem of the water body associated with hydropower development play a specific role when referring to a concrete hydropower project. For that reason the nature and landscape attribute was included in the regional CE with the same levels (small and strong impact) as before (see section 6.1.1).

Recreational activities

The third attribute included in the choice experiment describes possible future recreational activities along the riverside like biking, boat trips or canoeing that can be created when building a new hydropower plant (DOBROWOLSKI AND SCHLEICH, 2009). The levels take a yes/no-form meaning that recreational activities are possible or not (see Figure 24).

Figure 24: Levels of the recreation attribute



Source: OWN DEPICTION

Increase in monthly electricity bill

Finally, the monetary attribute was specified as an increase in respondents' monthly electricity bill. Due to consistency requirements, the payment levels ranged between € 3 and € 18, as in the previous choice experiments on hydropower and renewable energy.

The various choice sets were created using a D-efficient design with the software package Sawtooth. Each choice card is made up of two alternatives and an opt-out ("none of the two alternatives"). The final CE design was blocked into 30 versions, each containing six choice cards. An example card can be found in Figure 25. As in the hydropower study, this is an unlabeled choice experiment using generic titles for the alternatives.

Figure 25: Choice card example regional hydropower case studies

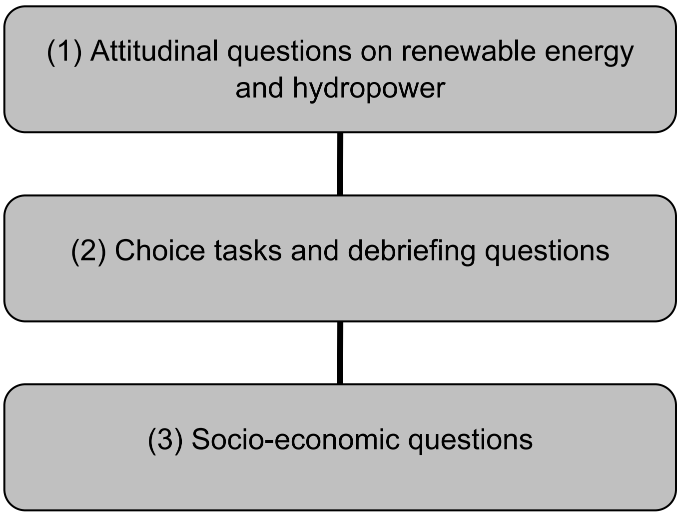
	Alternative A	Alternative B	
Electricity for...	5,000 households	15,000 households	None of the two alternatives
Impact on nature and landscape	Small	Strong	
Recreational activities	No	Yes	
Increase in monthly electricity bill	€ 3	€ 9	
	☐	☐	☐

Source: OWN DEPICTION

6.2 The questionnaire

The previously presented choice experiments were embedded in a comprehensive questionnaire on renewable energy and hydropower.[16] The questionnaire comprises three parts as shown in Figure 26.

Figure 26: Structure of the questionnaire



Source: OWN DEPICTION

[16] A full version of each questionnaire including the choice experiment can be found in the annex to this report.

The first section of the questionnaire contains questions about the respondent's general perception and attitudes towards renewable energy and hydropower use. The extent of this part of the questionnaire depends on which choice experiment is used (hydropower, renewable energy or regional case study). Respondents are for example asked whether or not they do already consciously obtain electricity from renewable energy sources, what they think from which energy sources electricity in Austria should be derived in the future or how important they think it is to increase the share of renewable energy. These general questions are included in each version of the questionnaire. The hydropower questionnaire contains some additional questions referring to hydropower and its intensified use. For instance, people are asked whether they have heard of the plan to expand hydropower utilisation in Austria, what their attitude towards the construction of new hydropower stations is or how far away the next hydropower station is from their home. In the regional case study questionnaire, additional questions referring to the specific hydropower project are included. Here respondents are for example asked whether they have heard from the plan to build new hydropower plants, what their attitude towards the new hydropower project is or if they feel positively or negatively affected by the project.

The second part of the questionnaire is made up of six choice experiment questions, which are introduced by an explanatory text, familiarizing respondents with the relevant attributes. Furthermore, the explanatory text gives a short overview of the current situation regarding renewable energy and hydropower in Austria. In this context it is mentioned that currently the major part of domestically generated electricity comes from renewable energy sources especially hydropower and that there is still substantial potential for new facilities. Also pictograms for each attribute level are used in the explanatory section to better explain the text. As seen before, these pictograms are included in the choice cards as well, in order to make it easier for people to understand the attributes.

The choice experiment is followed up by a number of debriefing questions related to the perceived complexity of the experiment. Moreover, this section aims to find out which attributes respondents perceived as more important compared to others and to reveal the possible presence of protest responses.

In the final part of the questionnaire, information on respondents' demographic and socio-economic status like household size, number of children, profession, educational level or household income is elicited. Furthermore, the last section contains a number of questions referring to people's current electricity bill. A very important task included in the last part of the questionnaire is an open-ended CV (Contingent Valuation) question asking for the monthly amount that people are at maximum willing to pay to support the expansion of renewable energy and hydropower. The use of both, a CV and CE method, is recommended since an additional CV question increases the robustness of the results and enables to check the outcomes of the choice experiment for consistency (PEARCE AND ÖZDEMIROGLU, 2002).

6.3 Pre-Testing

The choice experiment and questionnaire design presented in the previous sections is the result of a series of pre-tests carried out over a period of several months. Generally, questionnaires need to be tested in order to ensure that the design is appropriate for the research question and gives the desired results. If the CE design works on small groups (focus groups) or in a pilot survey, it is reasonable to assume that it will also give reliable and valid results using the full sample. The design and testing of questionnaires should be closely connected, and iteration between the two may be needed. What is learnt from testing can be fed back to improve the design of the questionnaire. It is very important to start with the full survey only if the questionnaire has performed satisfactorily in focus groups and pilot surveys (PEARCE AND ÖZDEMIROGLU, 2002).

Within the scope of this research project, questionnaires have been tested several times. In a first pre-test round about 90 people got the first draft questionnaire using face-to-face interviews and a postal survey. Special attention was given to the choice experiment and how understandable the experiment and its design would fit people. After this first pre-test, the questionnaire and CE design was revised in light of people's responses, to eliminate any problems and maximise the amount of information that can be gathered.

The revised questionnaires were retested within a second pre-test round. The second pre-test sample contained 110 respondents in total. First, a web-based survey was implemented on a small sample of respondents. Furthermore, three focus group discussions were conducted revealing useful information regarding comprehensibility and plausibility of the questionnaire, especially the choice experiment. After this test round, the questionnaire was slightly modified once again and pilot-tested on a sample of 290 respondents using a web-based survey.[17] This final pre-test showed that the questionnaire performs satisfactorily and can be used in the final survey using the full sample.

After testing and modifying the questionnaires on hydropower and renewable energy, the questionnaire referring to the regional case studies was directly tested within a pilot online-survey of 103 respondents.[18] The experiences of this test round showed that there was no need for any modifications of the regional questionnaires.

6.4 Data collection and sampling procedure

In order to guarantee a representative sample for Austria we decided to use an online survey. Another option would have been to conduct face-to-face or telephone interviews but this would have been much more expensive and time consuming than putting questionnaires online. Advantages of online surveys are that no bias can be caused by the interviewer and

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[17] This pilot survey was conducted by a professional survey agency.
[18] This survey was again carried out by an external survey agency.

that respondents can take as much time as they need to fill in the questionnaire (BENNETT AND BLAMEY, 2001). Moreover, the subsequent analysis is quicker since data inputting stage is not necessary. However, a major disadvantage of online surveys is usually the low response rate. Another problem that can arise is the so-called sample selection bias since only people with internet access will be able to answer the questionnaire. For those reasons a professional survey agency (MARKETAGENT.COM) was asked to conduct the online survey. Yet, the programming of the web-based survey was done by the project team itself, using the software package Sawtooth. Here the general survey questions as well as the choice cards were inserted and finally put online. The survey agency MARKETAGENT only delivered the address data and was responsible for the distribution of the survey across respondents. Marketagent is active in Austria, Germany, Slovenia and Switzerland and is specialized in online market research. The agency provides an online access panel containing about 300,000 participants and guarantees the requested number of filled questionnaires as well as the representativeness of the sample.[19]

Due to the fact that more than one choice experiment had to be conducted, the overall sample was divided into three main subsamples: renewable energy, hydropower and regional case studies. In order to apply some kind of methodological testing these subsamples have in turn been splitted (see Table 4). The first three subsamples refer to the expansion of renewable energy sources. Subsample 2 involves a mixed choice experiment containing three cards on the decision between renewable technologies and three cards on hydropower expansion. In each of the three samples the area of investigation is Austria as a whole. Subsamples 4 and 5 are subject to hydropower expansion, while the last two subsamples refer to the specific hydropower projects in the province of Styria.[20] The hydropower survey was conducted only in those federal states where hydropower expansion indeed plays a role. These are the provinces of Carinthia, Salzburg, Styria, Tyrol, Vorarlberg and Vienna.[21] In contrast, the regional case studies include only respondents from Graz and its surrounding communities.

[19] For more information see *http://www.marketagent.com/customer/ma_customer_main_free.aspx*.
[20] As an aside, not all the subsamples presented in Table 4 are used for the econometrical analysis in this final report. As already mentioned, the division in subsamples allows a series of methodological tests (e.g. comparisons between preferences) to be handled in scientific articles and papers.
[21] Vienna was included simply due to the fact that it represents the capital of Austria and therefore cannot be ignored when conducting a nationwide survey.

Table 4: Different subsamples of the online survey

(1) Renewable Energy	(2) Hydropower	(3) Regional case studies
Subsample 1 *Sample size:* 600 respondents *Region:* Austria CE with one restriction: technology hydropower in every choice card	**Subsample 4** *Sample size:* 453 respondents *Region:* Austria (only Carinthia, Salzburg, Styria, Tyrol, Vorarlberg and Vienna) Questions on current electricity bill asked before the CE	**Subsample 6** *Sample size:* 211 respondents *Region:* Graz & surroundings Survey referring to the hydropower project in Graz-Puntigam
Subsample 2 *Sample size:* 200 respondents *Region:* Austria Mixed CE: 3 choice cards on renewable energy, 3 choice cards on hydropower	**Subsample 5** *Sample size:* 452 respondents *Region:* Austria (only Carinthia, Salzburg, Styria, Tyrol, Vorarlberg and Vienna) Questions on current electricity bill asked after the CE	**Subsample 7** *Sample size:* 213 respondents *Region:* Graz & surroundings Survey referring to the hydropower project in Gratkorn
Subsample 3 *Sample size:* 301 respondents *Area:* Austria CE on the decision between technologies without any restriction		

Source: OWN DEPICTION

The online survey was finally conducted between the beginning of June and mid of July 2011. The different subsamples were started subsequently, beginning with the regional case studies in Styria. Afterwards the surveys referring to hydropower expansion, and lastly, the surveys on renewable energy were implemented.

The response rates[22] were between 16.7 % and 22.0 %, whereas the highest rates of return have been achieved in the regional samples. Due to the presence of protest votes[23] and missing values the number of observations applicable for statistical and econometrical analysis reduced slightly, as can be seen from Table 5.

[22] Response rates were calculated as the ratio between filled questionnaires and the overall number of people invited to the online survey.
[23] More on protest votes can be found in sections 8.2.4 and 8.4.6 of this report.

Table 5: Response rates and number of observations

Subsample no.	Response rate	Usable observations
1	17.9 % (n=600)	n=599
2	16.7 % (n=200)	n=199
3	16.9 % (n=301)	n=299
4	19.5 % (n=453)	n=446
5	17.5 % (n=452)	n=446
6	22.0 % (n=211)	n=199
7	21.6 % (n=213)	n=208

Source: OWN CALCULATIONS

7 Descriptive analysis

This chapter aims to depict the representativeness of the collected data, i.e. socio-economic characteristics of the samples, and respondents' general perception and attitude towards the use of renewable energy sources and hydropower. For descriptive data analysis, the different subsamples have been clustered, leaving two major groups. First, general questions on renewable energy and socio-economic characteristics have been answered by all respondents. This group represents the first basis for data analysis with 1,989 observations. The second group is made up of only those respondents answering the additional questions on hydropower (n=892).[24]

7.1 Socio-economic characteristics

The first step in data analysis is to compare the survey sample with Austrian population characteristics. Table 6 shows that representativeness is given with respect to gender and age. The gender of the respondents is very close to the Austrian average with 48.7 % men and 51.3 % women. The age structure corresponds in principle to that of the total population in Austria. Contrary to expectations, the age category 70 to 75 years lies well within the distribution of the population in Austria.

[24] There is also a third group made up of respondents answering the questionnaires on the regional hydropower case studies. This sample is analysed separately in chapter 8.4 of this report.

Table 6: Gender and age of respondents compared to total population

	Sample (n=1,989)	in %	Total population
GENDER			
Male	975	49.0 %	48.7 %
Female	1,014	51.0 %	51.3 %
AGE			
18-19 years	96	4.8 %	3.3 %
20-29 years	353	17.7 %	17.4 %
30-39 years	376	18.9 %	18.2 %
40-49 years	429	21.6 %	22.7 %
50-59 years	366	18.4 %	17.8 %
60-69 years	268	13.5 %	14.6 %
70-75 years	101	5.1 %	5.9 %

Source: OWN CALCULATIONS; STATISTIK AUSTRIA (2011b and 2011c)

With respect to the educational situation, the sample is slightly higher educated than the average Austrian population. The secondary level (higher school certificate) is rather overrepresented (21.0 % compared to 13.6 % in the Austrian population), while people who only finished compulsory school are underrepresented with 13.3 % compared to 19.5 % in the total population. However, regarding tertiary education (university level) and the level of apprenticeship and professional school, the sample is representative (see Table 7).

Table 7: Educational level of respondents compared to total population

Educational level	Sample (n=1,989)	in %	Total population
Compulsory school	265	13.3 %	19.5 %
Apprenticeship, professional school	1,048	52.7 %	52.3 %
Higher school certificate	418	21.0 %	13.6 %
College of education	43	2.2 %	3.5 %
University (of applied sciences)	206	10.4 %	11.1 %
Other	9	0.5 %	0.0 %

Source: OWN CALCULATIONS; STATISTIK AUSTRIA (2012)

The distribution of disposable monthly household income is given in Table 8. 50.2 % of the respondents in the sample have a household income less than € 2,000 per month. The monthly disposable household income of the other 49.8 % is higher than € 2,000. Furthermore, the median monthly household income falls into the category € 1,501 – 2,000, which is considerably below median household income in Austria of approximately € 2,500 (STATISTIK AUSTRIA, 2011b). Consequently, the income distribution in the sample is slightly skewed towards those with lower incomes.

Table 8: Distribution of disposable monthly household income

Income category	Sample (n=1,989)	in %
Up to € 1,000	322	16.2 %
€ 1,001 – 1,500	331	16.6 %
€ 1,501 – 2,000	347	17.4 %
€ 2,001 – 2,500	286	14.4 %
€ 2,501 – 3,000	272	13.7 %
€ 3,001 – 3,500	159	8.0 %
More than € 3,500	272	13.7 %
Median category	€ 1,501 – 2,000	-
Median (total population)	€ 2,487	-

Source: OWN CALCULATIONS; STATISTIK AUSTRIA (2011b)

Regarding the employment situation, the sample is in general representative. There are only marginal deviations from the distribution in the total population. First, the category "Employed" is overrepresented in the sample with 61.5 % compared to 53.5 % in the Austrian population. Besides that, unemployed people are slightly underrepresented (2.5 % compared to 5.2 % in the total population). The same applies for the category "Retired", which is also underrepresented with 20.2 % in the sample compared to 25.5 % in the Austrian population (see Table 9).

Table 9: Employment situation of respondents compared to total population

Employment situation	Sample (n=1,989)	in %	Total population
Employed	1,223	61.5 %	53.5 %
Unemployed	50	2.5 %	5.2 %
In education	159	8.0 %	7.3 %
Retired	402	20.2 %	25.5 %
Housewife	143	7.2 %	7.5 %
Other	12	0.6 %	0.9 %

Source: OWN CALCULATIONS; STATISTIK AUSTRIA (2011d)

The distribution of respondents among Austrian federal states is given in Table 10. As an aside, the values presented in this table refer to the sample on "Renewable energy". The survey on hydropower has only been conducted in those federal states which are actually affected by the Austrian hydropower expansion plans. These are Carinthia, Salzburg, Styria, Tyrol, Vorarlberg and Vienna.[25] In each of these states approximately 150 respondents have been surveyed. Consequently, the sample on hydropower is not representative with respect to the population distribution but with respect to hydropower expansion in Austria. In contrast, the survey on the expansion of renewable energy was conducted in all Austrian provinces.

[25] Vienna is not directly affected by the hydropower expansion plans, however, cannot be neglected since it represents the capital of Austria.

As can be seen from Table 10, the sample is representative. The distribution among Austrian federal states corresponds in principle to the distribution of total population.

Table 10: Distribution among federal states compared to total population

Federal state	Sample (n=1,097)	in %	Total population
Burgenland	35	3.2 %	3.4 %
Carinthia	68	6.2 %	6.7 %
Lower Austria	212	19.3 %	19.2 %
Upper Austria	198	18.0 %	16.8 %
Salzburg	64	5.8 %	6.3 %
Styria	165	15.0 %	14.4 %
Tyrol	90	8.2 %	8.4 %
Vorarlberg	45	4.1 %	4.4 %
Vienna	220	20.1 %	20.3 %

Source: OWN CALCULATIONS; STATISTIK AUSTRIA (2011b)

7.2 General perception of renewable energy and hydropower

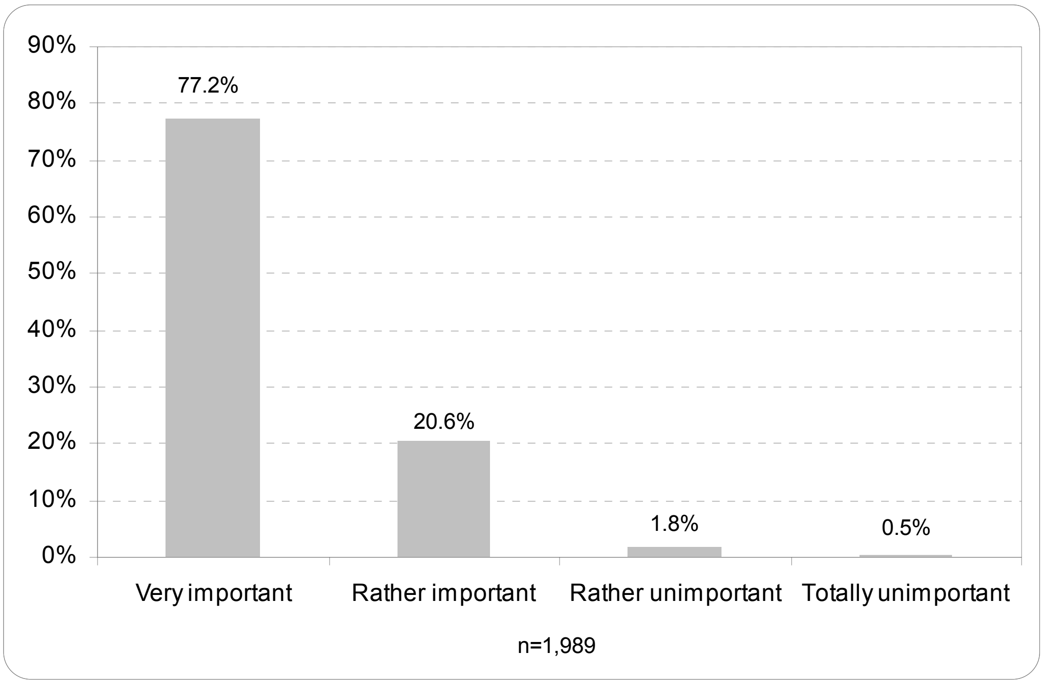
This section aims to display people's general attitude towards renewable energy and hydropower in Austria. The results of the statistical analysis are shown in the following sections, starting with the general attitude towards renewable energy followed by the perception of hydropower use. Finally, we analyse stated willingness to pay for an expansion of renewable energy and hydropower.

7.2.1 People's attitude towards renewable energy

The perceptions of the respondents for renewable energy and hydropower use in Austria were elicited through a series of questions. First, 86.6 % of the respondents answered that it is important for them to get their electricity from renewable energy sources. Of those 38.2 % stated that they consciously choose an electricity supplier that provides them exclusively with electricity from renewable energy. Finally, 39.5 % from the respondents, who are consciously buying green electricity, are willing to accept an increased electricity price in order to obtain electricity from renewable energy sources.

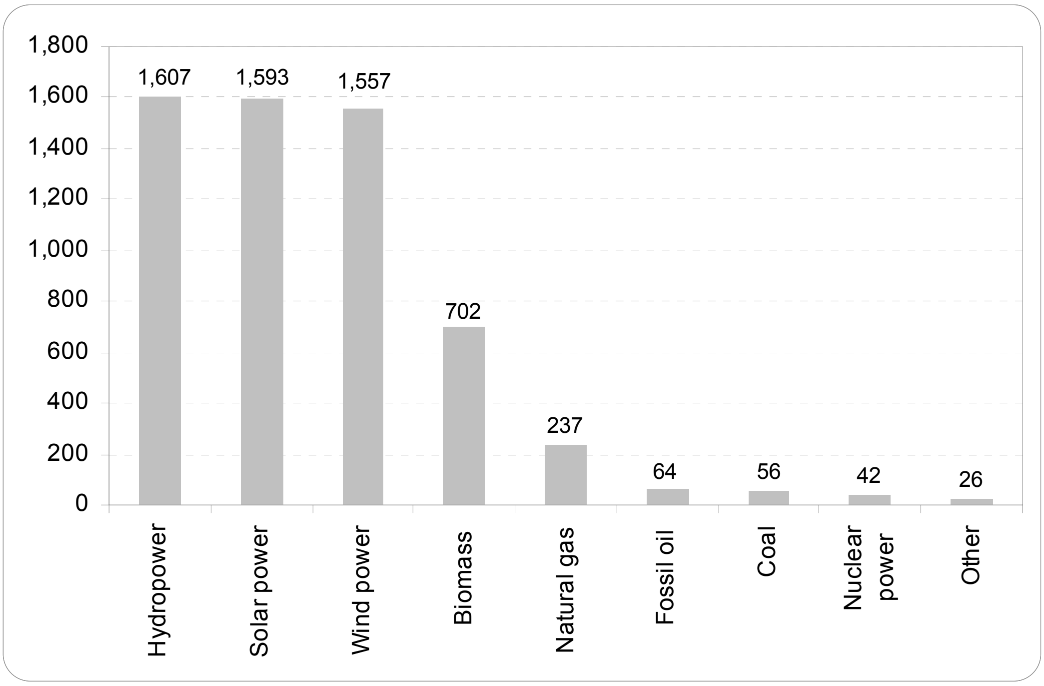
When asking respondents how important it is to increase the share of renewable energy in the future, a majority (77.2 %) answered that the intensified use of renewable energy sources in the future is very important; another 20.6 % think that it is rather important. Only 2.3 % of the respondents consider the expansion of renewable energy as rather unimportant or totally unimportant (see Figure 27).

Figure 27: Importance of an intensified use of renewable energies in the future



Source: OWN CALCULATIONS

Figure 28: Preferred energy sources for future electricity production in Austria

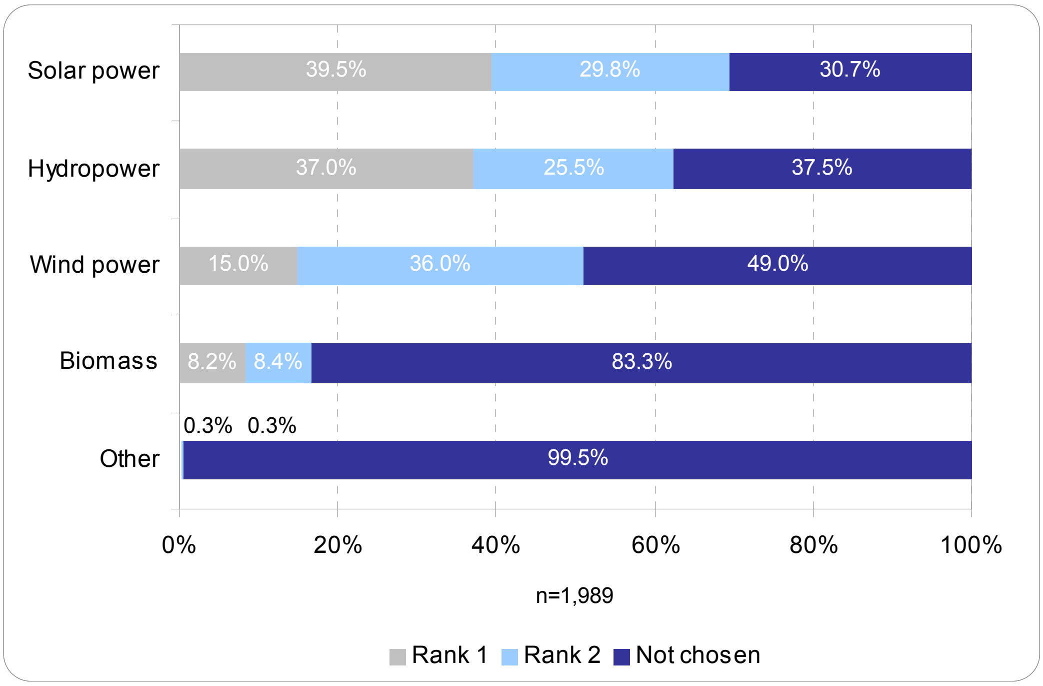


Source: OWN CALCULATIONS

Respondents were also asked what they think from which energy sources electricity in Austria should come from in the future. People were allowed to choose several randomly ordered options. The results reveal that most people (1,607 or 80.8 %) think that hydropower should be an important future energy source. The two other most preferred energy sources are solar and wind power, which were selected by 1,593 (80.1 %) respectively 1,557 (78.3 %) respondents. Biomass is less preferred, being selected by 702 of the respondents (35.3 %), followed by natural gas, which 237 or 11.9 % see as a preferred energy source for future electricity generation. Oil, coal, nuclear power and other energy sources rank very low, whereas the category "Other" mainly contains geothermal energy (see Figure 28).

In another question respondents were asked to rank the two most important renewable energy sources, which they believed should be promoted in the future. They could choose rank one for their most preferred renewable energy source and rank two for the second most preferred option. The outcome is shown in Figure 29. Solar power is the first preferred energy source for 39.5 % of the respondents, followed by hydropower which is the first choice of 37.0 % of the respondents. Wind power and biomass are less preferred. Accordingly, 15.0 % chose wind power as their most preferred option and biomass was chosen by 8.2 %.

Figure 29: Preferred renewable future energy sources in Austria



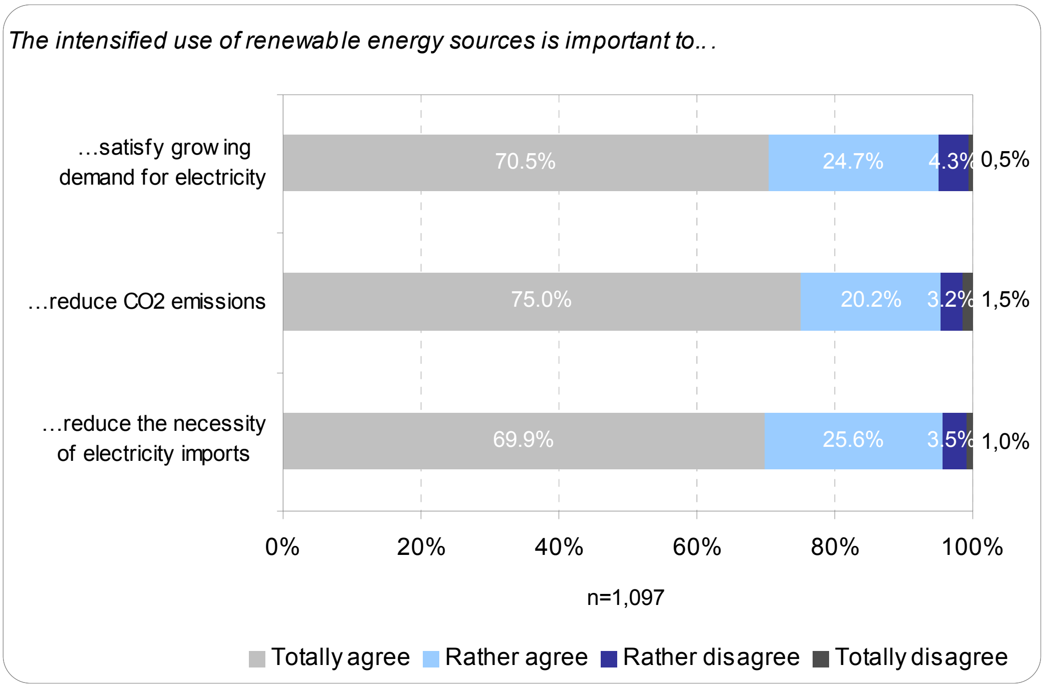
Source: OWN CALCULATIONS

Figure 30 presents respondents' agreement to several statements concerning renewable energy. A high commitment was found for a statement regarding the importance of an increased use of renewable energy sources to satisfy growing demand for electricity in Austria. Here 70.5 % of the respondents totally agreed and 24.7 % rather agreed, whereas only 4.8 % rather or totally disagreed.

Regarding the second statement, which said that the increased use of renewable energy is important to reduce CO_2 emissions, 75.0 % totally agreed, 20.2 % rather agreed, 3.2 % rather disagreed and 1.5 % totally disagreed.

The last statement was that the increased use of renewable energy is important to reduce the necessity of electricity imports to Austria. Here 69.9 % of the respondents totally agreed and 25.6 % rather agreed, while in total 4.5 % rather or totally disagreed.[26]

Figure 30: Respondents' agreement to several statements on renewable energy



Source: OWN CALCULATIONS

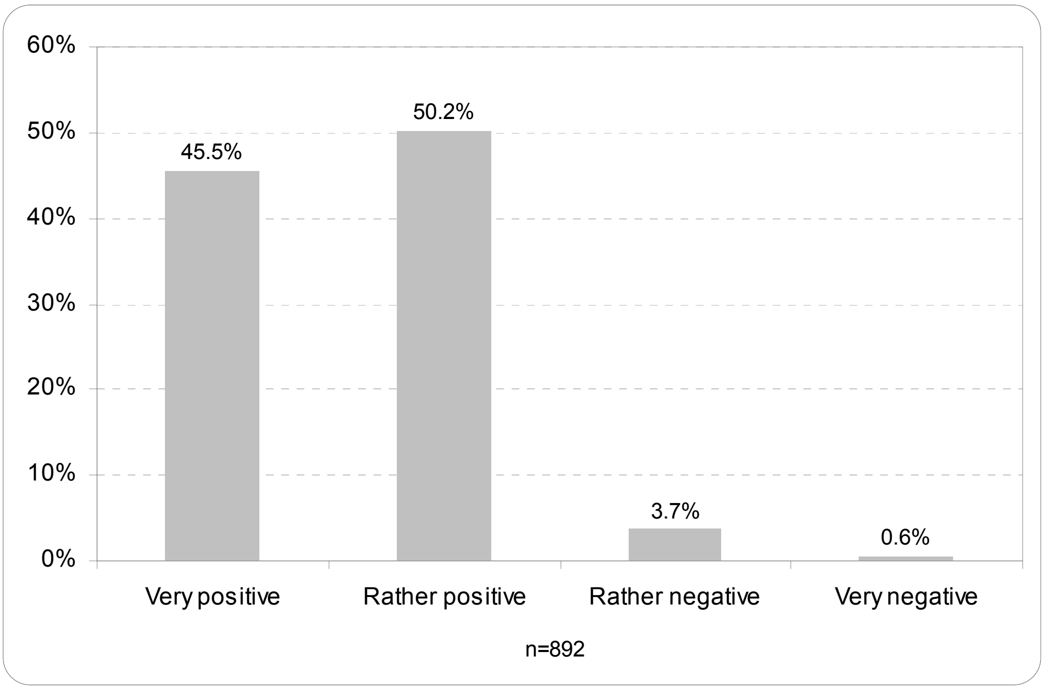
7.2.2 People's attitude towards hydropower

As mentioned above, respondents who got the choice experiment on different hydropower expansion strategies were in addition to the previously presented questions confronted with a series of attitudinal questions on hydropower use and expansion in Austria. The results of the analysis of these questions are presented below.

First, people were asked about their general attitude towards hydropower use in Austria. The findings here show that 45.5 % of the respondents have a very positive attitude and 50.2 % a rather positive attitude towards hydropower use in Austria. In contrast, 3.7 % are rather negatively and 0.6 % very negatively confronted with hydropower use (see Figure 31).

[26] The same statements plus two additional ones have also been asked with regard to hydropower instead of renewable energy. This question was analysed separately and the results are presented below.

Figure 31: General attitude towards hydropower use in Austria



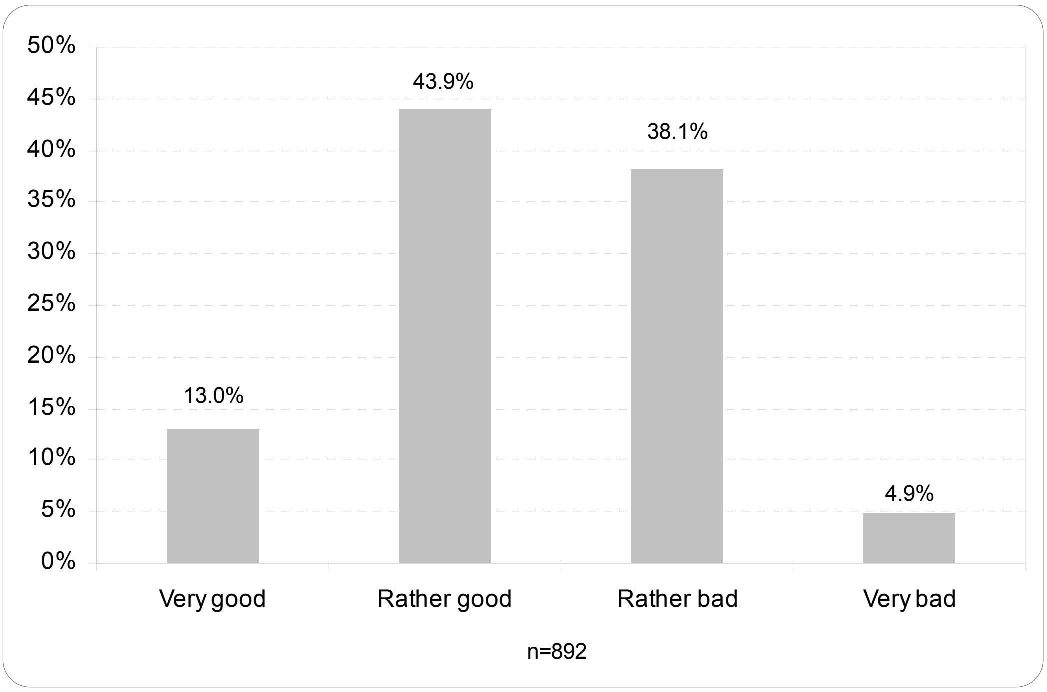
Source: OWN CALCULATIONS

Although people's general attitude towards hydropower use in Austria is rather positive, there is a substantial lack of information concerning hydropower, as can be seen from Figure 32. Only 13.0 % of the respondents feel very well informed about hydropower in Austria. Another 43.9 % think that they are rather good informed on the topic. However, 38.1 % are rather bad and 4.9 % even very bad informed about hydropower in Austria.

In addition, respondents were asked whether they heard about the plan to expand hydropower use in Austria, i.e. to build new hydropower stations. Slightly more than half of the respondents (58.6 %) answered this questions with "yes". This result again elucidates the prevalent information deficit.

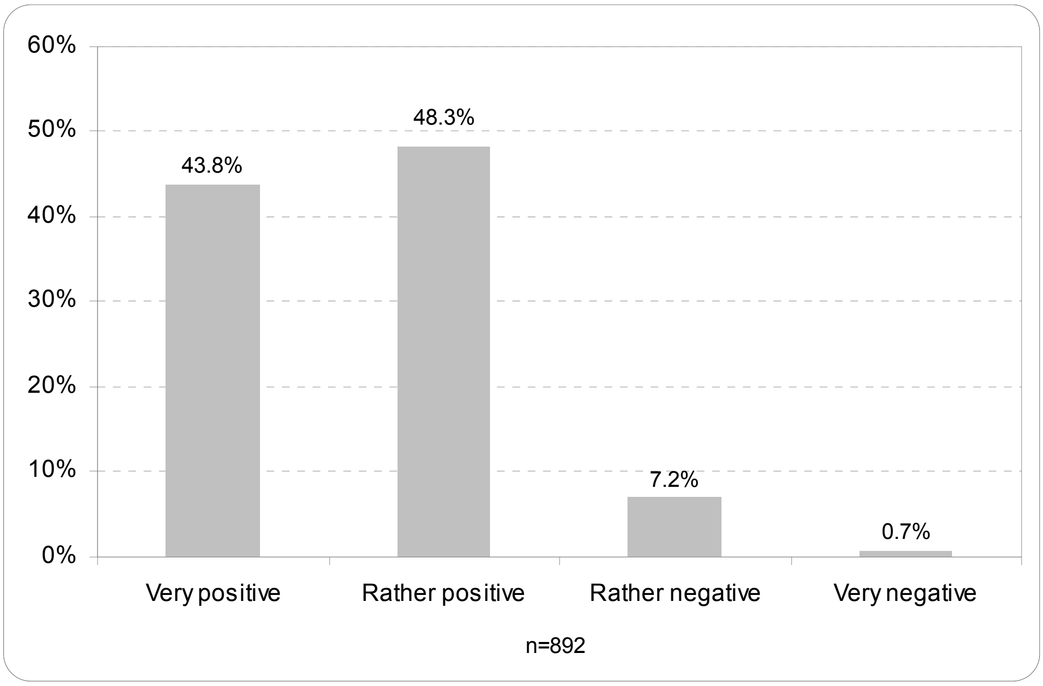
Regarding people's general attitude towards the construction of new hydropower plants, it was found that 43.8 % have a very positive attitude. The share of people with a rather positive attitude is 48.3 %. Only a minority of 7.9 % is in principle against the construction of new hydropower plants in Austria (see Figure 33).

Figure 32: Level of information regarding hydropower in Austria



Source: OWN CALCULATIONS

Figure 33: General attitude towards the construction of new hydropower plants in Austria



Source: OWN CALCULATIONS

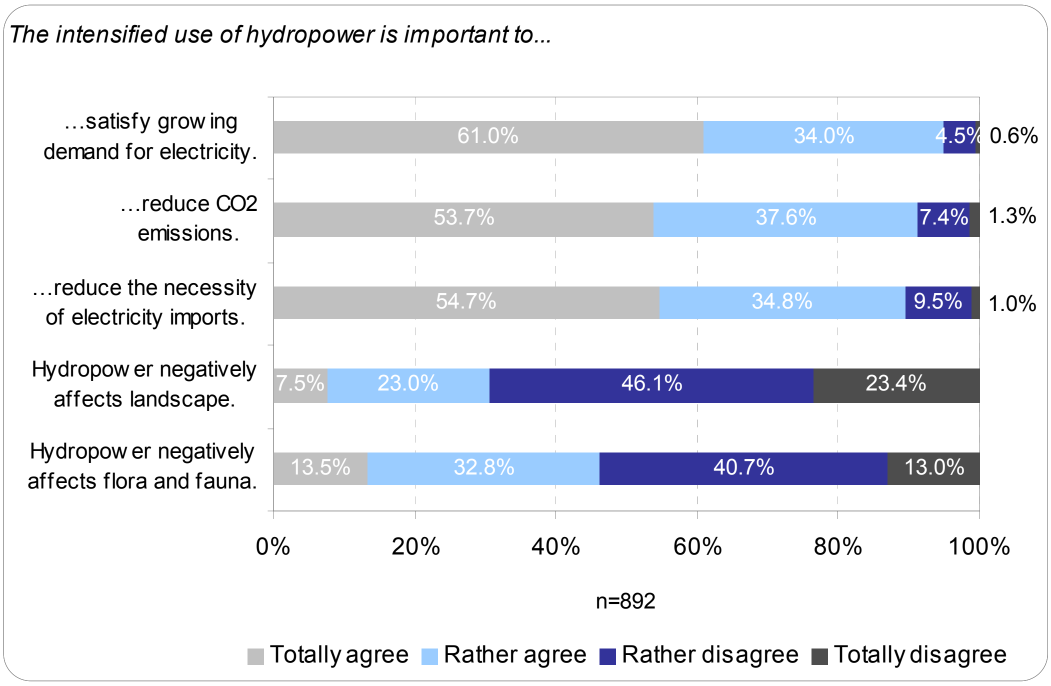
Also in the hydropower sample people were confronted with several statements to which they had to attach their personal agreement (see Figure 34). The highest commitment was found for the importance of an intensified use of hydropower to satisfy the growing demand for electricity in Austria. Here 61.0 % totally agreed and 34.0 % rather agreed whereas only

4.5 % rather disagreed and 0.6 % totally disagreed. Compared to the results on renewable energy (see section 7.2.1, Figure 30), the share of those who totally agreed is significantly lower (70.5 % to 61.0 %).

Furthermore, 53.7 % of the respondents totally agreed and 37.6 % rather agreed that the increased use of hydropower is an important measure to reduce CO_2 emissions. The share of those who rather or totally disagreed is 8.7 % in total. Again the agreement rate is lower when referring to hydropower instead of renewable energy. Hence, people obviously think that the promotion of renewable energy sources as a whole can contribute more to CO_2 reduction than the expansion of hydropower.

The same applies to the necessity of electricity imports. While 54.7 % of the respondents totally agreed that the intensified use of hydropower contributes to reduce the necessity of electricity imports, this share is 69.9 % in the sample referring to the increased use of renewable energy sources. Furthermore 34.8 % rather agreed and 10.5 % in principle disagreed to this third statement.[27]

Figure 34: Respondents' agreement to several statements on hydropower



Source: OWN CALCULATIONS

A relatively high disagreement was found concerning the impacts of hydropower use on the landscape and ecosystem of a water body. First, it is stated that a hydropower plant negatively affects the landscape. Here 7.5 % of the respondents totally agreed and 23.0 %

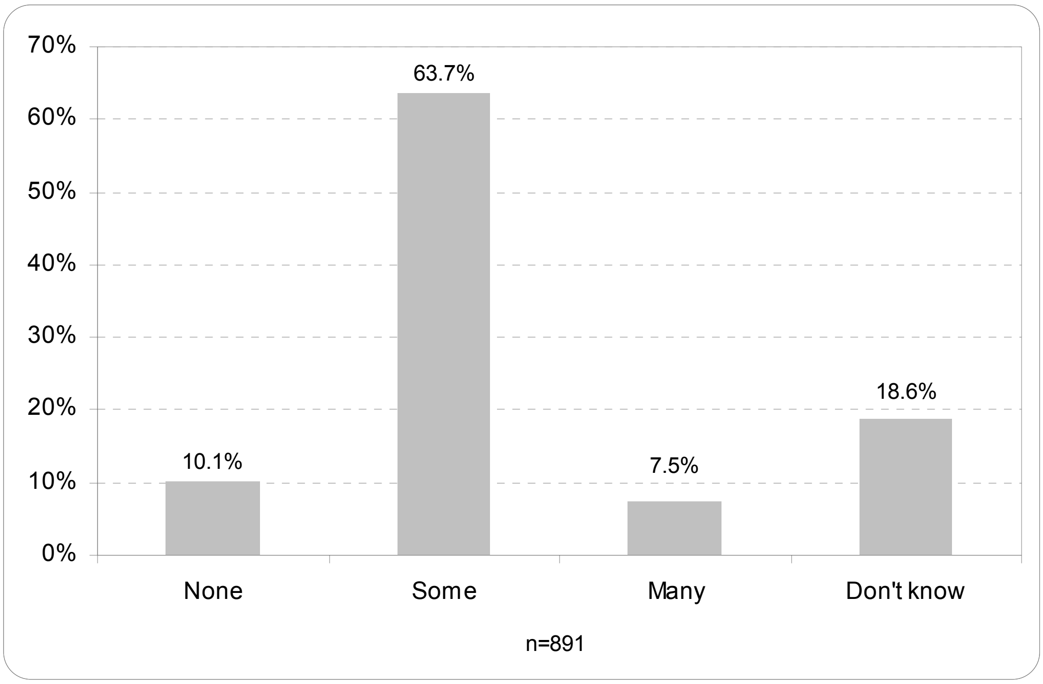
[27] The differences between the people's agreement on renewable energy and hydropower are statistically significant as shown by the Wilcoxon ranksum test (*statement 1*: z=-4.213, p=0.000, *statement 2*: z=-9.769, p=0.000, *statement 3*: z=-7.364, p=0.000).

rather agreed. In contrast, a majority (69.5 %) thinks that hydropower has no negative effect on landscape. Finally, 13.5 % of the surveyed people absolutely think that hydropower plants negatively affect the habitats of flora and fauna. 32.9 % rather agreed to the statement that hydropower has a negative impact on wildlife. The disagreement rate to this statement amounts to 53.7 % in total.

The personal experience with hydropower was elicited through several questions. First, people were asked if there residence is close to a river. The results show that the majority of the respondents (84.4 %) live in a distance of maximum 10 kilometres to a river. For those respondents recreational activities along the riverside may play an important role. The most frequently exerted recreational activities along Austrian rivers are walking along the riverbank, sportive activities and recreating/enjoying the landscape.

Another question aimed to get a perception of how many hydropower stations are in the respondents' surrounding area. 18.6 % of the respondents were not able to make an assumption about the number of hydropower stations in their neighbourhood. The majority (63.7 %) stated that there are some hydropower plants in their surrounding area, 7.5 % said that there are many hydropower stations. In contrast, a share of 10.1 % stated that there are no hydroelectric facilities near their residence (see Figure 35).

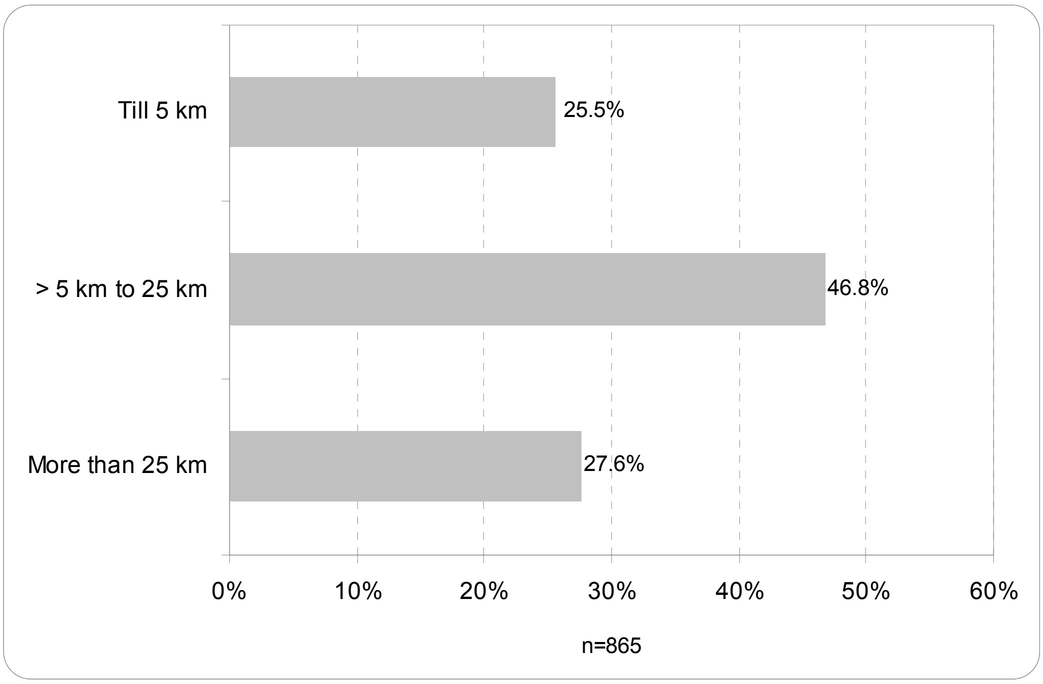
Figure 35: Perceived amount of hydropower plants in respondents' surrounding area



Source: OWN CALCULATIONS

In a follow up question people were asked to state the approximate distance (as the crow flies) between the nearest hydropower station and their home. The outcome is given in Figure 36.[28] About one quarter of the respondents (25.5 %) is living very close by a hydropower station (maximum five kilometres). The major part of the respondents, namely 46.8 %, lives at a distance of 5 to 25 kilometres to the next hydropower facility. For the remaining 27.6 % of the respondents the stated distance is more than 25 km. The mean distance is 27.9 kilometres; due to the existence of outliers the median value is significantly lower with 15 kilometres.

Figure 36: Stated distance between the nearest hydropower plant and respondents' home



Source: OWN CALCULATIONS

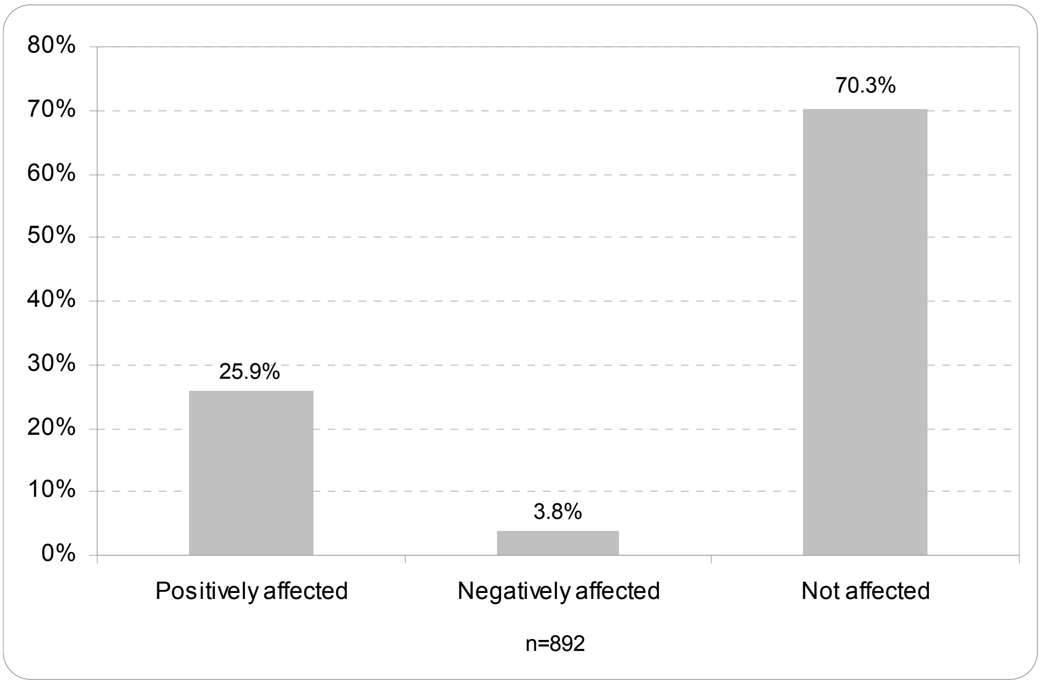
Furthermore, the questionnaire aimed to find out how people are generally affected by a hydropower station. On the one hand, 70.3 % of the respondents stated that they are not affected by the nearest hydropower plant to their home. On the other hand, 25.9 % of the respondents feel positively affected, while 3.8 % feel negatively affected by the next hydropower station (see Figure 37).

Subsequently, people were asked why they feel positively or negatively affected by a hydropower plant. As can be seen from Table 11, positive concernments are mainly related to the possibility of getting electricity from a renewable energy source and the principal positive attitude towards hydropower. The primary reasons associated with a negative

[28]At this point it must be mentioned that the distance question was voluntary and as people were not obliged to state the approximate distance, 27 respondents did not give any information about their distance to the nearest hydropower station. This fact explains why the number of observations is only 865 instead of 892 in the total hydropower sample.

concernment are the negative impacts on the landscape as well as flora and fauna imposed by the use of hydropower.

Figure 37: Individual concernment by the nearest hydropower station



Source: OWN CALCULATIONS

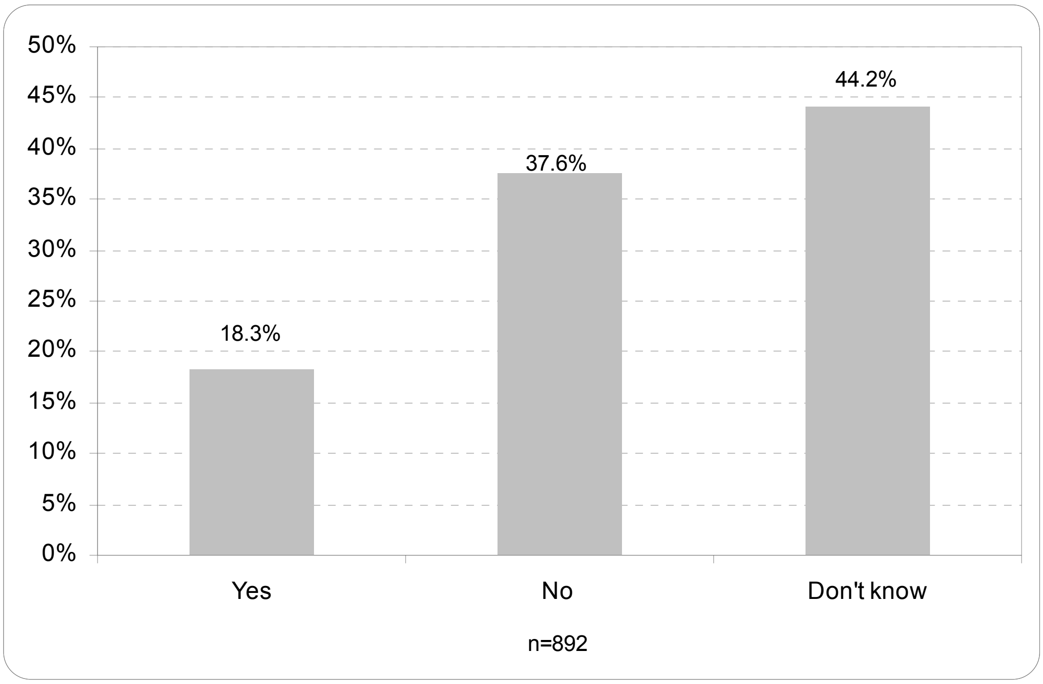
Table 11: Reasons for the individual concernment imposed by a hydropower plant

Why positively affected		
Reasons	**Sample (n=231)**	**in %**
I can get electricity from a renewable energy source.	118	51.1 %
The hydropower plant has a positive effect on the landscape.	36	15.6 %
The hydropower plant facilitates new recreational activities.	31	9.1 %
I am principally pro hydropower.	55	23.8 %
Other reasons	1	0.4 %
Why negatively affected		
Reasons	**Sample (n=34)**	**in %**
The hydropower plant limits the possibilities for recreation.	7	20.6 %
The hydropower plant has a negative effect on the landscape.	15	44.1 %
The hydropower plant has a negative effect on flora and fauna.	10	29.4 %
I am principally against hydropower.	1	2.9 %
Other reasons	1	2.9 %

Source: OWN CALCULATIONS

Finally, people were asked if a new hydropower station is built or in the process of planning near to their home (see Figure 38). 18.3 % of the respondents answered this question with “yes”, while 37.6 % think that there are no plans to build a new hydropower plant near their residence. The remaining 44.2 % fall in the category "don't know". This result illustrates once again the prevalent information deficit throughout the Austrian population.

Figure 38: Plans to build a new hydropower plant near respondent's home



Source: OWN CALCULATIONS

7.2.3 Directly stated willingness to pay

The questionnaire included a willingness to pay (WTP) question asking directly how much people are willing to pay for an expansion of renewable energy sources especially hydropower in order to get green electricity for their household. WTP was thereby defined as a monthly payment on top of the electricity bill. As shown in Table 12, the mean WTP for increasing the use of renewable energy sources was € 14.1; for the expansion of hydropower mean WTP amounts to € 15.3.[29] Looking at the calculated standard deviation, it can be seen that in both samples stated WTP fluctuates substantially around its mean. This may be due to the existence of outliers. In the sample referring to renewable energy 44 respondents stated a monthly WTP of more than € 50. In the hydropower sample, the number of respondents with a WTP higher than € 50 amounts to 46. In the presence of outliers (extremely deviating values), it may be appropriate to use the median, since this measure is more robust. Median WTP is in both samples, renewable energy as well as hydropower, € 10.0 per month. Finally, there is also a number of people not willing to pay for renewable energy or hydropower expansion. In total, 88 people stated a WTP of zero for renewable energy. The zero bids for hydropower amount to 60 respondents.

[29] Statistically significant differences between the two samples are not given, as can be shown by the outcome of a two-sample t-test (t=-0.981, p=0.327).

Table 12: Stated willingness to pay for renewable energy and hydropower

	Willingness to pay for…	
	…expansion of renewable energy	*…expansion of hydropower*
Mean	€ 14.1	€ 15.3
Standard deviation	€ 24.9	€ 29.4
Median	€ 10.0	€ 10.0
Minimum	€ 0.0	€ 0.0
Maximum	€ 300.0	€ 300.0
Observations	1,097	892

Source: OWN CALCULATIONS

Moreover, it is interesting to compare the stated WTP values with the amount people currently pay for their electricity bill. In the questionnaire one question was included asking respondents how much they are currently paying for their monthly electricity bill. The responses allowed a calculation of the average electricity costs in Austrian households, which are presented in Table 13.[30]

Table 13: Current electricity bill of respondents

	Sample renewable energy	**Sample hydropower**
Mean	€ 70.4	€ 69.7
Standard deviation	€ 44.1	€ 53.1
Median	€ 65.0	€ 55.0
Minimum	€ 10.0	€ 10.0
Maximum	€ 500.0	€ 700.0
Observations	1,092	884

Source: OWN CALCULATIONS

The average monthly electricity costs per household are about € 70. Again the stated values fluctuate considerably around their means which implies a very heterogeneous sample. Median values are a bit lower and amount to € 65 respectively € 55. Dividing median WTP calculated before by the current electricity costs shows that on average, people are at most willing to pay 15.4 % of what they pay at the moment for an increased use of renewable energy sources. For increasing the use of hydropower people are even willing to pay 18.2 % on top of their current electricity bill.[31] These values approximately correspond to the existing markups accounted for the promotion of green electricity in Austria.

[30] The smaller number of observations is related to the fact that it was not obligatory to answer this question.

[31] If mean values are used for the calculation, the accepted surcharge for additional eco-electricity is 20.0 % in the case of renewable energy and 22.0 % in the case of hydropower. However, due to the presence of many outliers it seems more appropriate to use the calculated median values.

8 The choice models

In this chapter the results of the choice experiments are reported. First, the theoretical framework behind the estimated choice models is presented. The second part of this section contains the results of the choice model on hydropower expansion. In the next step it is shown how robust the hydropower results are if the model is embedded in a broader framework, namely renewable energy. Finally, the results of the regional hydropower case studies in Styria are shown.

8.1 The econometric model

Choice experiments belong to the family of stated preference techniques and are based on traditional microeconomic theory. They combine Lancaster's characteristics theory of value as well as random utility theory (RUT). First, Lancaster's theory states that consumers derive utility from the properties or characteristics of a good and not from the good per se (LANCASTER, 1966). Thus, the value of for instance a hydropower expansion strategy can be expressed by its characteristics respectively costs and benefits like the obtainable reduction of CO_2 emissions or the impact on landscape and natural environment.[32] Moreover, choice theory is based on the assumption that individuals are acting rationally, meaning that they compare alternatives and choose the one which gives the highest level of utility (HENSHER ET AL., 2005). So for instance if two alternatives, say *i* and *j*, are at choice, a rationally acting individual *n* will choose alternative *i* only if its utility is higher than the utility of alternative *j* (LOUVIERE ET AL., 2000). This fact is represented by equation (1):

$$U_{in} > U_{jn} \quad \forall\, i \neq j \qquad (1)$$

However, "RUT postulates that utility is a latent construct that exists (if at all) in the mind of the consumer, but cannot be observed directly by the researcher" (BENNETT AND BLAMEY, 2001). Instead it is possible to explain a significant proportion of the unobservable consumer utility, but some part of the utility will always remain unobserved. That is:

$$U_{in} = V_{in} + \varepsilon_{in} \qquad (2)$$

V_{in} represents the systematic or explainable component of the utility held by consumer *n* for choice alternative *i* and ε_{in} is the random or unexplainable component of latent utility (BENNETT AND BLAMEY, 2001). Therefore, the probability that individual *n* will choose alternative *i* over alternative *j* is given by equation (3) (TRAIN, 2003; HENSHER ET AL., 2005). The model of this equation is called a random utility model (LOUVIERE ET AL., 2000).

[32] A detailed description of the attributes used in the different choice experiments is given in section 6.1 of this final report.

$$
\begin{aligned}
P_{in} &= P(U_{in} > U_{jn}) \quad \forall\, i \neq j \\
P_{in} &= P(V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}) \quad \forall\, i \neq j \qquad (3) \\
P_{in} &= P(\varepsilon_{jn} - \varepsilon_{in} < V_{in} - V_{jn}) \quad \forall\, i \neq j
\end{aligned}
$$

Equation (3) in principle states that the probability of consumer *n* choosing alternative *i* is equal to the probability that the difference between the unobserved components of utility of alternative *j* compared to *i* is smaller than the difference between the systematic components of utility associated with alternative *i* compared to alternative *j*. However, ε_{in} *and* ε_{jn} are random pieces of information (HENSHER ET AL., 2005). Therefore we have to make assumptions about the distribution of these random components of utility in order to calculate the choice probabilities. Usually the random part is assumed to be independently and identically distributed (IID) with an extreme value type 1 (EV1) distribution (LOUVIERE ET AL., 2000).[33] The EV1 distribution is associated with popular binary or multinomial logit (MNL) models (BENNETT AND BLAMEY, 2001). Generally, different assumptions about the distribution of the random component of utility lead to different choice models. In the mixed logit model, also referred to as random parameter logit model, it is assumed that the unobserved portion of utility consists of two parts. One part is IID with extreme value distribution as in the case of multinomial logit models. The other part of unobserved utility follows a distribution, which is specified by the researcher (TRAIN, 2003).

Furthermore, the independence from irrelevant alternatives (IIA) property states that the relative probabilities of two options being selected are unaffected by the introduction or removal of additional alternatives. The IIA property represents a consequence of the initial assumption that the unobserved part of the utility function (ε) is independently and identically distributed (LOUVIERE ET AL., 2000). Consequently, violation of IIA requires more complex statistical models like nested or mixed logit models that relax some of the assumptions regarding the unobserved part of utility (ε).[34]

In the classical multinomial logit (MNL) model the observed component of utility V_{in} from equation (2) is assumed to be linear additive in the attributes and parameters. Thus, each parameter is a single fixed estimate, i.e. a fixed parameter (HENSHER ET AL., 2005). However, the MNL model has two substantial disadvantages. First, the statistical model is based on the IID and in further consequence on the IIA property. Second, the MNL model cannot capture preference heterogeneity not embodied in the individual characteristics of respondents (GREENE AND HENSHER, 2005; HENSHER AND GREENE, 2002). Therefore we draw on more complex choice models, namely mixed logit (with error components). In the mixed logit model

[33] This distribution is also referred to as Weibull, Gumbel or douple-exponential distribution.
[34] The most widely used test for violation of the IIA assumption is the so-called Hausman test, developed by Hausman and McFadden in 1984 (LOUVIERE ET AL., 2000).

parameters are not fixed but random, meaning that they have a mean and standard deviation. Formally this can be depicted in the following way:

$$\beta_{in} = \beta_i + \sigma_i \upsilon_{in} \qquad (4)$$

In this equation β_i represents the population mean and v_{in} the individual specific heterogeneity (with zero mean and a standard deviation of one). σ_i is the standard deviation of the distribution β_{in} around β_i. The components estimated by the analyst are β_i (mean) and σ_i (standard deviation; BEVILLE AND KERR, 2009). In order to get a better understanding of sources of preference heterogeneity within a sampled population the mixed or random parameter logit model can be extended to allow variance heterogeneity (GREENE ET AL., 2005). With variance heterogeneity in the random parameters the σ_i in equation (4) becomes a heteroscedastic term (σ_{in}; BEVILLE AND KERR, 2009). This heteroscedastic standard deviation of a random parameter can simply be treated as an additional error component. Therefore such models are called random parameter or mixed logit error component models (HENSHER AND GREENE, 2002).

8.2 Preferences for an expansion of hydropower

8.2.1 Model results – CE hydropower

Based on a recoded version of the dataset presented in section 6.4, an econometric model was estimated explaining people's preferences for the planned increase of hydropower use in Austria. First, in a set of models not presented here a variety of variables including socio-economic characteristics like income or educational level as well as interaction terms between these characteristics and choice attributes were included in the model specification. However, not all of these variables showed up to be statistically significant in the estimated models. The result of this iterative estimation procedure is the statistically best fit model which has the following indirect utility form:

$$\begin{aligned} U_{in} = {} & \alpha + \beta_1 \mathrm{Jobs}_{in} + \beta_2 \mathrm{CO2}_{in} + \beta_3 \mathrm{Nature}_{in} + \beta_4 \mathrm{Dist}_{in} + \beta_5 \mathrm{Cost}_{in} + \beta_6 \mathrm{Epay} * \mathrm{Cost} \\ & + \beta_7 \mathrm{Renew} * \mathrm{CO2} + \beta_8 + \varepsilon_{in} \mathrm{Residence} * \mathrm{Nature} + \beta_9 \mathrm{Plants} + \beta_{10} \mathrm{Gender} \qquad (5) \\ & + \beta_{11} \mathrm{Age} + \beta_{12} \mathrm{Educ} + \varepsilon_{in} \end{aligned}$$

Beside the CE attributes, the statistically best fit model presented in equation (5) includes a number of socio-economic characteristics as well as interaction terms.[35] α represents the alternative specific constant (ASC) and β_1 to β_{12} refer to the coefficients related to the attributes of the choice model, the interaction terms and the socio-economic characteristics. A detailed description of the variables used in the final model is given in Table 14.

[35] The dependent variable is Choice indicating which alternative (A, B or none of the two alternatives) was chosen by the respondent.

Table 14: Description of the variables used for estimation (CE hydropower)

Variable	Description	Levels/Coding
Jobs	Number of jobs created by an expansion of hydropower in the residential area of the respondent.	10, 50, 100, 500 jobs
CO_2	Reduction of CO_2 emissions in the electricity sector obtainable by the intensified use of hydropower.	-10 %, -20 %, -40 %, -60 %
Nature	Impact of new hydropower plants on the landscape and the natural environment.	1 = strong impact, 0 = small impact
Dist	Distance of the next planned hydropower station to respondent's home.	2, 4, 8, 20 km
Cost	Increase in the respondent's monthly electricity bill.	3, 6, 9, 12, 15, 18 €
Epay	The respondent's electricity bill is paid by another household member.	1 = yes (25.3 %) 0 = no (74.7 %)
Renew	Importance of getting electricity from renewable energy sources.	1 = important (86.9 %) 0 = not important (13.1 %)
Residence	The respondent's residence is at a distance of maximum 10 km to a river.	1 = yes (84.4 %) 0 = no (15.6 %)
Plants	There are many hydropower plants near respondent's home.	1 = yes (7.5 %) 0 = no (92.5 %)
Gender	Gender of the respondent.	1 = female (51.2 %) 0 = male (48.8 %)
Age	Age of the respondent in years.	metric scaled variable
Educ	Educational level of the respondent.	1 = tertiary level (13.7 %) 0 = below tertiary level (86.3 %)

Source: OWN DEPICTION

A cardinal-linear scaling was used for the CE attributes Jobs, CO_2, Distance and Cost, while Nature was dummy coded. The baseline category of Nature is small impact. Furthermore, three interaction terms were included in the choice model. The dummy variable Epay indicates whether the electricity bill in the respondent's household is paid by another person and was interacted with the cost attribute. The variable Renew is also dummy coded and shows whether it is important for the respondent that his or her electricity comes from renewable energy sources. Together with the CO_2 reduction attribute this variable represents the second interaction term. The variable Residence indicates whether a respondent's home is near to a river (maximum distance 10 km) and was interacted with the Nature attribute. Additionally, a variable was included in the econometric model describing the amount of hydropower plants near the respondent's home. Finally, gender, age and the educational level were included in the econometric model as the only socio-demographic characteristics. No other socio-economic characteristics were found to be statistically significant. This includes household income, which is usually a strong predictor of stated willingness to pay.

The statistically best fit models are presented in Table 15.[36] Both, the results of a standard multinomial logit (MNL) model as well as the model estimates of a mixed logit error component (ECM) model are reported. Looking at the MNL estimates all coefficients are indeed significant at least at the 10 % confidence level and have the expected signs, except for the interaction between Epay and the Cost attribute. However, the estimated coefficients of a MNL model ignore so-called taste differences, which are captured by the mixed logit error component model. As can be seen from Table 15, the derived standard deviations of random parameter distributions are all statistically significant at least at the 5 % level, except for the standard deviation of jobs which is only marginally statistically significant. Significant parameter standard deviations indicate the presence of preference heterogeneity in the sampled population (HENSHER AND GREENE, 2002). Hence, the ECM model is more appropriate than a standard MNL model, meaning that it can capture people's preferences better than the standard choice model version.[37]

Looking at the ECM model estimates, it can be seen that the coefficients of the five choice attributes, the interaction terms and socio-economic characteristics are all statistically significant and have the expected sign, except for gender which is statistically not significant. First, the alternative specific constant (ASC) can be interpreted similarly to the constant in a regression model and represents on average the effect of all factors that are not included in the model (HENSHER ET AL., 2005; TRAIN, 2003). Thus, the positive ASC shown in Table 15 indicates that the respondents have some inherent propensity to choose for one of the hydropower expansion scenarios over the opt-out (none of the two alternatives) for reasons that are not captured in the estimated model.

Regarding the estimated coefficients, it is possible to interpret the significance and direction of the relationship first.[38] The attribute Jobs has a positive sign which implies that respondents have preferences for alternatives where more jobs can be generated by increased hydropower use. The CO_2 attribute exhibits a positive sign too, meaning that alternatives with a higher level of CO_2 reduction are preferred. In addition, this positive effect is amplified if it is important for respondents to get their electricity from renewable energy sources.

[36] NLOGIT 4.0 econometric software was used to estimate the models.

[37] Although the Hausman test result showed that the IIA assumption is not violated (χ^2=6.316, p=0.389), we stick to the ECM model since preference heterogeneity is given in the sampled population.

[38] The magnitude of the estimated coefficients will be analysed by calculating willingness to pay. At the moment we cannot say anything about the magnitude of the relationship between the explanatory variables and choice.

Table 15: Model estimates – CE hydropower

Variable	**Coefficients MNL Model**	**Coefficients ECM Model**
ASC	2.034*** (0.000)	4.013*** (0.000)
Jobs	0.0002* (0.073)	0.0003** (0.029)
CO_2 reduction	0.004* (0.073)	0.007* (0.071)
Nature (strong impact)	-0.768*** (0.000)	-1.155*** (0.000)
Distance	0.008*** (0.009)	0.007* (0.053)
Cost	-0.089*** (0.000)	-0.129*** (0.000)
Epay*Cost	0.007 (0.274)	0.026*** (0.001)
Renew*CO_2	0.008*** (0.000)	0.010** (0.014)
Residence*Nature	-0.316*** (0.001)	-0.438*** (0.006)
Many plants	0.305** (0.027)	0.812* (0.056)
Gender	-0.216*** (0.001)	-0.255 (0.259)
Age	-0.017*** (0.000)	-0.031*** (0.000)
Tertiary education	0.416*** (0.000)	0.677** (0.049)
Std. Dev. Jobs	-	0.0007 (0.102)
Std. Dev. CO_2	-	0.021*** (0.000)
Std. Dev. Nature	-	2.139*** (0.000)
Std. Dev. Distance	-	0.031*** (0.001)
Std. Dev. Random effect (error component)	-	2.752*** (0.000)
Log likelihood	-5,069.369	-4,307.025
McFadden Pseudo R^2	0.123	0.267
Chi-squared (d.f.)	-	3,132.313 (18)
AIC	1.901	1.618
BIC	1.917	1.640
Number of respondents	891	891
Number of observations	5,346	5,346

p-values in parentheses

Significance: *** 1 % level ** 5 % level * 10 % level

Source: OWN CALCULATIONS

In contrast, alternatives with a strong impact on landscape and natural environment are less preferred compared to those with only a small impact. This relationship is captured by the negative sign of the coefficient on the attribute Nature. Furthermore, the effect of the strong nature impact is enhanced if the respondent lives near to a river. More precisely, if respondent's home is at a distance of less than 10 kilometres to a river, a strong impact on landscape and nature is valued more negatively compared to a situation where respondent's residence is further away from a river.

In addition, a statistically significant distance decay effect was found, meaning that respondents prefer alternatives where new hydropower stations are built further away from their home. This result provides confirmation of the "Not in my backyard" theory, which has already been mentioned several times in the existing literature (see FIMERELI ET AL., 2008; MEYERHOFF ET AL., 2009). Thus, people are in general for an expansion of hydropower capacities, but not close to their home.

The cost attribute is negative and highly significant reflecting standard economic theory. It indicates that respondents prefer lower electricity bills. However, if the electricity bill is not paid by the respondent himself but instead by another household member, the negative effect of cost diminishes, suggesting lower price sensitivity.

Another important result of the ECM model is that already existing experience with the hydropower technology, i.e. many hydropower plants near respondent's home, increases the acceptance of hydropower expansion. More specifically, if there are already many hydropower plants near the residence of the respondent, he or she tends to choose one of the expansion alternatives over the opt-out.

Regarding socio-economic characteristics, it was found that older people are less willing to choose one of the hydropower expansion options. Instead they rather tend to choose the opt-out alternative. Gender-related preference differences do not exist. Finally, higher educated people rather vote for an expansion of hydropower than less educated respondents.[39]

The goodness-of-fit of the estimated model can be shown on the basis of various statistical key tests. First, the ECM model is highly significant as shown by the Chi-squared statistic (X^2=3,132.313, p=0.000). Second, as already mentioned above, the ECM model represents the better approach compared to a standard MNL model. This result can also be verified by looking at the Akaike (AIC) and Schwarz (BIC) information criteria. The lower AIC and BIC are, the better the model fit. As shown in Table 15, AIC and BIC are considerably lower in the ECM model. Furthermore, the McFadden Pseudo R-squared of the ECM model is significantly higher compared to the MNL model and amounts to 0.267. This is a pretty good value, since cross-section data are used for estimation.

[39] The educational level may represent a proxy variable for income, since higher education is normally associated with higher incomes. And income is usually a strong determinant of stated choices.

8.2.2 Willingness to pay – CE hydropower

In order to give the estimated coefficients more meaningfulness, we calculated implicit prices respectively willingness to pay (WTP) and the corresponding confidence intervals. Usually (with a standard MNL model) implicit prices are calculated dividing the coefficient of the attribute of interest by the coefficient of the monetary attribute (BENNETT AND BLAMEY, 2001). This is given in equation (6):

$$WTP = -\frac{\beta_{attribute}}{\beta_{\cos t}} \qquad (6)$$

However, with random parameters this approach is not appropriate, since taste differences must be taken into account when calculating WTP. Therefore WTP has been simulated for each respondent using a conditional constrained distribution which ensures that the simulations yield plausible values. Then the means, standard deviations and confidence intervals were taken from these simulations. This approach is in line with HENSHER ET AL. (2005) and the results are shown in Table 16. The calculated WTP measures are based on a ceteris paribus assumption, that is, all other parameters are held constant except the attribute for which the implicit price is being calculated.

Table 16: Estimates of willingness to pay – CE hydropower

Variable	Measurement	WTP
Jobs	per 100 jobs	€ 0.229 [0.227, 0.231]
CO_2 reduction	per 10 % reduction	€ 1.312 [1.274, 1.351]
Impact on nature and landscape	from small to strong	€ -13.462 [-13.805, -13.118]
Distance	per 5 km	€ 0.323 [0.320, 0.327]
95 % confidence intervals in parentheses		

Source: OWN CALCULATIONS

First, not presented in Table 16, people are on average willing to pay € 31.0 in addition to their current electricity bill for the expansion of hydropower independent from the attribute levels. This value reflects to the effect of the positive ASC representing the inherent propensity of respondents to vote in favour of hydropower expansion.[40]

Looking at the attributes, the outcomes reveal that people exhibit a positive WTP for job creation of € 0.2 per month for 100 additional jobs. The reduction of CO_2 emissions is valued with € 1.3 on top of the monthly electricity bill for a 10 % reduction.

[40] Here, WTP was simply calculated dividing ASC by the coefficient of the monetary attribute, since neither ASC nor Cost were treated as random variables in the econometric model.

The implicit price for the nature attribute is negative, reflecting the fact that people do not desire alternatives with a strong environmental impact. Negative values of WTP imply a disutility. So, monthly WTP decreases by € 13.5 when a strong impact on the landscape and natural environment is given. Or the other way round, people expect a compensation of € 13.5 in order to accept a strong impact on nature when new hydropower plants are built.

Finally, people are willing to pay € 0.3 on top of their monthly electricity bill if a new hydropower station is not built in their "backyard" but 5 km further away. The further away the hydropower station, the higher WTP is.

8.2.3 Welfare analysis – CE hydropower

Although implicit prices (i.e. marginal willingness to pay) are useful to policy makers, they do not represent valid welfare measures to be used for instance in Cost-Benefit-Analysis (CBA). In order to estimate overall willingness to pay for different combinations of attribute levels (policy scenarios) we included the alternative specific constant (ASC). The ASC captures systematic but unobserved information of not choosing the opt-out alternative and is therefore unrelated to the choice set attributes (BENNETT AND BLAMEY, 2001).[41]

Based on the statistically best fit models presented in section 8.2.1, a number of policy scenarios were simulated and their welfare implications estimated, that changed the attribute levels simultaneously. Generally, the assessment of economic welfare involves the investigation of utility differences associated with a baseline alternative compared to some other alternative. Accordingly, the economic or compensating surplus (CS) can be written as follows (BENNETT AND BLAMEY, 2001):

$$CS = -\frac{1}{\beta_{\cos t}}(V_1 - V_0) \qquad (7)$$

where β_{cost} is interpreted as the marginal utility of income. V_0 and V_1 represent observed utility associated with linear combinations of attribute levels in the current situation and a new policy scenario respectively. Welfare values and the results of CS comparisons are therefore contingent on the scenarios chosen.

The estimated welfare measures per household and month for six different policy scenarios are presented in Table 17. Due to the fact that the estimated attribute parameters vary across individuals (random parameters), the welfare measures have been simulated for each observation. Then the means, standard deviations and confidence intervals have been calculated on the basis of these simulations.[42]

[41] However, there is a lot of discussion whether the ASC should be included or not since it may represent a yea-saying problematic (KATARIA, 2009).
[42] This procedure is similar to the approach used to calculate WTP.

Scenario (1) represents the “worst case scenario” and yields an economic surplus of € 14.8. In contrast, the “best case” is represented by scenario (4). Here CS is approximately twice as high as in the worst case, namely € 28.3 per household and month. The welfare gain of € 2.6, when going from scenario (1) to (2) is fully attributable to an increased CO_2 emission reduction. Comparing scenario (2) with scenario (3), it can be seen that the creation of 400 additional jobs is valued with € 0.9 per household and month. A major result of welfare analysis is given by the comparison of scenarios (4) and (5). As can be seen from Table 17, everything is held constant except for the impact on nature and landscape which changes from small to strong impact. This change causes a substantial decrease in welfare by € 8.9 per household and month. Finally, the effect of distance on total economic surplus can be shown by looking at scenarios (5) and (7). Reducing the distance of the next hydropower plant from 20 km to 2 km causes a household’s welfare loss of approximately € 1.0 monthly.

Table 17: Welfare measures for different policy scenarios (per household/month)

	Jobs	CO_2 reduction	Nature/landscape	Distance	Welfare (CS)
(1)	10	-10 %	Strong impact	2 km	€ 14.759 [14.320, 15.192]
(2)	10	-60 %	Strong impact	2 km	€ 17.348 [16.814, 17.882]
(3)	100	-40 %	Small impact	8 km	€ 25.697 [25.477, 25.916]
(4)	500	-40 %	Small impact	8 km	€ 26.589 [26.362, 26.815]
(5)	500	-60 %	Small impact	20 km	€ 28.278 [27.931, 28.624]
(6)	500	-60 %	Strong impact	20 km	€ 19.419 [18.867, 19.972]
(7)	500	-60 %	Small impact	2 km	€ 27.299 [26.973, 27.625]
95 % confidence intervals in parentheses					

Source: OWN CALCULATIONS

In order to get a measure of yearly total economic surplus for Austria the calculated welfare measures per household and month can be aggregated according to equation (8):

$$\begin{aligned} Welfare_{lower} &= CS * 12 * Households * response\,rate \\ Welfare_{upper} &= CS * 12 * Households * 1 \end{aligned} \qquad (8)$$

First, CS must be converted into yearly values since the calculated welfare measures in Table 17 represent monthly data. In the second step, yearly CS values are aggregated with the number of private households. In total, there are about 3.6 million households in Austria. However, the survey on hydropower expansion simply referred to the federal states Carinthia, Salzburg, Styria, Tyrol, Vorarlberg and Vienna with a number of 2,257,000 households in total (STATISTIK AUSTRIA, 2011b). Aggregating CS, only these households are taken into account. Yet, a major problem of aggregation represents the treatment of non-responses. As shown in chapter 6.4, the response rate of the hydropower sample was 18.5 %.[43] For this part of the population we can assume a positive willingness to pay with certainty. However, we do not have any reliable information about the population that did not response to the survey. Generally, there are two possibilities. First, non-responses can be treated as zero-bids or second, it can be assumed that they behave like the respondents in the sample. In order to capture both opportunities, a range of aggregated CS was calculated. The lower level corresponds to a conservative estimate assuming that non-responses have a zero WTP. In contrast, the upper threshold value anticipates sample behaviour to total population. The results of these estimations are given in Table 18.

Table 18: Aggregation of welfare measures (in million € per year)

	Jobs	CO_2 reduction	Nature/landscape	Distance	Welfare lower level	Welfare upper level
(1)	10	-10 %	Strong impact	2 km	€ 73.9 mill.	€ 399.7 mill.
(2)	10	-60 %	Strong impact	2 km	€ 86.9 mill.	€ 469.9 mill.
(3)	100	-40 %	Small impact	8 km	€ 128.8 mill.	€ 696.0 mill.
(4)	500	-40 %	Small impact	8 km	€ 133.2 mill.	€ 720.1 mill.
(5)	500	-60 %	Small impact	20 km	€ 141.7 mill.	€ 765.9 mill.
(6)	500	-60 %	Strong impact	20 km	€ 97.3 mill.	€ 525.9 mill.
(7)	500	-60 %	Small impact	2 km	€ 136.8 mill.	€ 739.4 mill.

Source: OWN CALCULATIONS

The "worst case scenario" (1) is associated with an aggregated economic surplus of € 73.9 million referring to the conservative estimate. Assuming that non-responses have the same preferences as responses, the surplus can go up to € 399.7 million. The "true" welfare measure can be expected somewhere between these lower and upper threshold values. In order not to overestimate total economic surplus we refer to the lower welfare levels in the following. The highest economic surplus of € 141.7 million can be attained with scenario (5), which represents the best case of hydropower expansion. A higher CO_2 reduction level (-60 % compared to -10 %) is associated with a welfare gain of € 13.0 million, as can be seen from the comparison of scenarios (1) and (2). Comparing the policy scenarios (3) and (4), it can be seen that 400 additional jobs are worth € 4.4 million per year. The greatest welfare loss is caused by a strong environmental impact. Or the other way round, holding the environmental impact as small as possible when building new hydropower plants, is associated with a welfare gain that amounts to € 44.4 million per year. This result can be obtained by a comparison of scenarios (5) and (6). Finally, Austrian households are willing to pay if the next hydropower plant is far away from their homes. An additional distance of 18 km is worth € 4.9 million per year.

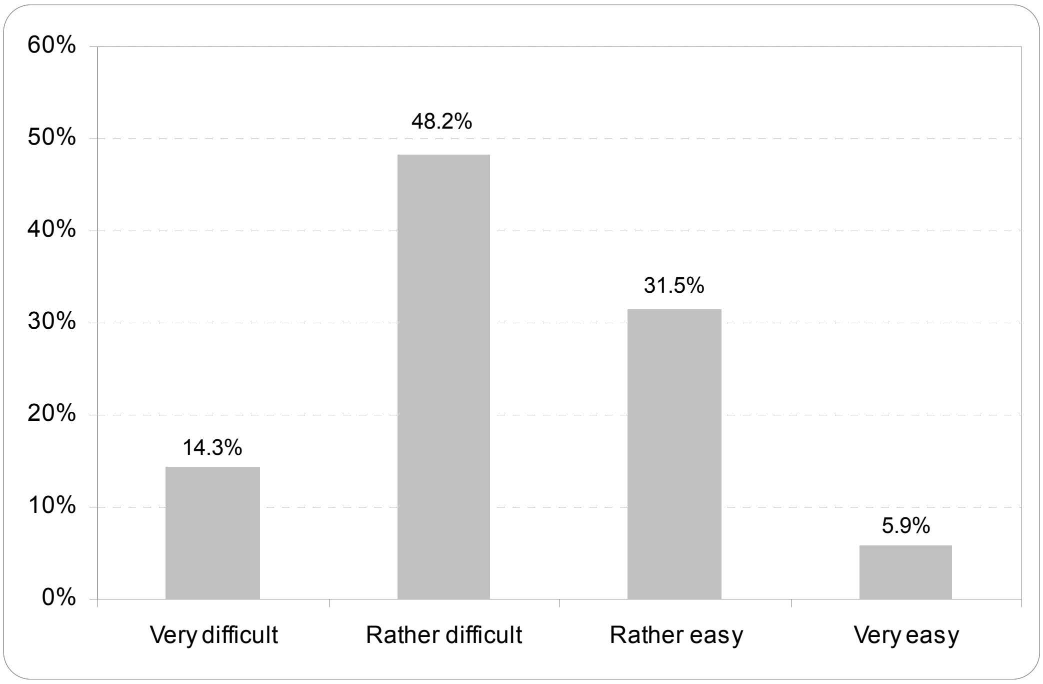
[43] This value represents an average of the response rates attached to subsamples 4 and 5.

To conclude, an expansion of hydropower is in general associated with positive welfare effects, even in the "worst case scenario" with only few generated jobs, a low CO_2 reduction level, a strong environmental impact and a close distance to respondents' homes. Based on that, an increase of generated jobs, CO_2 reduction or distance leads a significant rise of total economic surplus. The effect of differing environmental impacts must be particularly highlighted. A hydropower expansion strategy causing a strong impact on landscape and natural environment is associated with a huge welfare loss compared to a strategy where the environmental impacts are held small. This result illustrates how important it is to hold the environmental impact as small as possible when new hydropower stations are built.

8.2.4 Debriefing evaluation of the CE (hydropower)

The quality of the CE responses was checked with the help of a debriefing question which asked how difficult it had been for respondents in general to select one of the three alternatives in each choice card. 14.3 % found it very difficult, 48.2 % rather difficult, 31.5 % rather easy and 5.9 % very easy to select one of the alternatives in the choice experiment. These outcomes are shown in Figure 39.

Figure 39: Perceived difficulty of the choice experiment (hydropower)



Source: OWN CALCULATIONS

In order to check for protest votes it was necessary to look for respondents selecting the opt-out alternative in all six choice tasks. Altogether 92 respondents were found to act like this. Among them 13 respondents (1.4 %) were identified as protest bidders due to statements like "I am strictly against the expansion of hydropower" or "I won't accept any extra burden". These protest votes were excluded from the previous econometric analysis.

The implicit prices calculated above (section 8.2.2) indeed give an idea about the relative importance of each attribute to the respondents. However, for example, it is not possible to directly compare the implicit price for 1 % CO_2 emission reduction with the implicit price for one created job. This is why the importance of the attributes was elicited directly with a debriefing question asking respondents to indicate for each attribute whether they found it 1 – very important, 2 – rather important, 3 – rather unimportant or 4 – totally unimportant for their choice. With the responses to this question, an index was calculated for each attribute, indicating its importance. The index was calculated by taking the means of the corresponding answers for each attribute. The lower the index, the more important is the attribute. The outcomes are shown in Table 19 starting with the most important attribute.

Table 19: Importance of the attributes – CE hydropower

Attribute	Importance
CO_2 reduction	1.61
Impact on nature and landscape	1.68
Increase in monthly electricity bill	1.88
Generated jobs	1.97
Distance to home	2.66

Source: OWN CALCULATIONS

The table confirms in principal the findings of the choice experiment. The attribute CO_2 emission reduction is seen as the most important attribute by respondents. However, this is not clearly reflected when looking at implicit prices only. The high importance of nature and landscape impacts matches the high implicit price for this attribute found before. Also price increases represent an important factor for respondents' decision making. The attributes jobs and distance are less important for respondents reflecting the relative low implicit prices for these attributes found before.

Finally, the ECM model results can be compared with the result of the open-ended CV question included in the final part of the questionnaire. The mean WTP derived from the open-ended question (€ 15.3) is considerably lower than the implicit price derived from the ASC in the ECM model outcomes, which is € 31.0.[44] Such findings are not unusual and have also been made by other studies that combined an open-ended WTP question with a CE survey (see for instance VAN DER POL ET AL., 2008). Furthermore, the difference can be explained with the assumption that respondents do not give as much attention to the monetary attribute in the CE compared to the CV question, where they only concentrate on the price (ALVAREZ-FARIZO AND HANLEY, 2002).

[44] However, if strong environmental impacts as well as the effects of job creation, CO_2 reduction and distance are taken into account estimated WTP approximates to the value derived from the CV question.

8.2.5 Preferences across Austrian federal states

In a next step it was possible to examine preference heterogeneity across the different federal states, included in the CE, namely Carinthia, Salzburg, Styria, Tyrol, Vorarlberg and Vienna. The question to answer was whether people value hydropower expansion differently depending on the federal state they belong to. In doing so, we had to compare six different datasets with each other. Each dataset corresponds to a federal state and contains about 150 observations (see Table 20).

Table 20: Sub-datasets across Austrian federal states

Federal state	Observations
Carinthia	150
Salzburg	147
Styria	150
Tyrol	150
Vorarlberg	149
Vienna	146

Source: OWN CALCULATIONS

However, comparing two or more datasets with each other is not as trivial as one might think. Especially the role of the scale parameter described below represents a major challenge for the analyst.

***Excursus:* The role of the scale parameter for the comparison of two datasets**

As mentioned in section 8.1, a rationally acting individual will choose the alternative which yields the highest utility. The decision maker will choose the same alternative with $U_{in} > U_{jn}$ as with $\lambda U_{in} > \lambda U_{jn}$. This means that the alternative with the highest utility remains the same no matter how utility is scaled (λ = scale parameter; TRAIN, 2003). However, a comparison of two datasets requires revealing the scale parameter in order to make the results comparable (HENSHER ET AL., 2005). The problem is that the scale parameter cannot be identified directly because the scale parameter and preference parameters are jointly estimated and therefore confounded (SWAIT AND LOUVIERE, 1993). In principle, observed parameter estimate differences between two samples, say A and B, occur due to three reasons:

(1) First, the parameter differences are simply the result of sampling error. The true underlying preference parameters and scale factors do not differ between the two samples, i.e. $\beta_A = \beta_B$, $\lambda_A = \lambda_B$ (where β_A is the preference parameter vector of sample A and β_B the parameter vector of sample B; λ_A represents the scale parameter of sample A and λ_B the scale factor of sample B).

(2) Second, the true underlying parameters are the same but the scale parameters differ between the two samples, i.e. $\beta_A = \beta_B$, $\lambda_A \neq \lambda_B$.

(3) Third, there are real differences between preference and scale parameters of the two samples, i.e. $\lambda_A\beta_A \neq \lambda_B\beta_B$ (SWAIT AND LOUVIERE, 1993).

To identify potential differences in preferences between federal states, a sequential testing procedure is applied in line with SWAIT AND LOUVIERE (1993). In the first step, we test for differences in the preference parameter vector β by allowing for varying scale parameters λ between two samples. Second, a test for scale parameter equality is performed. The latter test can only be conducted if the preference parameters are equal between the two samples, because the confoundedness of preference and scale parameters prevents the attribution of observed differences to parameter vector inequality and scale equality ($\beta_A \neq \beta_B$, $\lambda_A = \lambda_B$) or to both parameter and scale inequality ($\beta_A \neq \beta_B$, $\lambda_A \neq \lambda_B$; SWAIT AND LOUVIERE, 1993). We illustrate this test by comparing two federal states exemplary.

In the first step, we start by estimating a separate ECM model for the two subsamples, which provides us with efficient estimates for $\lambda_A\beta_A$ and $\lambda_B\beta_B$ and a likelihood value for both samples. The scale parameter cannot be identified in any particular dataset, but the ratio of the scale parameter of one dataset relative to another can be identified. Due to this fact, the scale parameter of sample A is normalized to λ_A = 1. This normalization implies that estimates of scale should be interpreted as relative scale parameters to sample A (i.e. λ_B/λ_A). A pooled model is then estimated across the two samples, which has the effect of imposing preference parameter equality ($\beta_{iA} = \beta_{iB}$).[45] A search procedure over a range of relative scale parameters is applied to estimate the combination of scale and (pooled) preference parameters providing the best model fit. At each possible relative scale parameter the data for sample B are rescaled in such a way that an ECM model can be estimated to obtain an estimate for β_i and an associated log likelihood value. After the best model fit has been identified, a chi-square test using the log likelihood (LL) of each estimated model can be used to test the difference in preference parameters for the attributes under the null hypothesis of equality between the two samples. The standard chi-square distributed Likelihood Ratio (LR) test is as follows:

$$-2(LL^{pooled} - (LL^{A} + LL^{B})) \quad \text{with d.f.} \quad |\beta| - 1 \qquad (9)$$

|β| is thereby the number of imposed parameter restrictions. If the LR test concludes that preference parameters are equal across the two samples, it is then possible to test for differences in scale parameters. This second step of the test procedure requires the estimation of an ECM model for the same pooled sample as in step 1, but with equality imposed on both preference and scale parameters this time ($\beta_{iA} = \beta_{iB}$ and $\lambda_A = \lambda_B$). Again a LR test can be applied to compare the log likelihood of the estimated model to the log likelihood of the pooled model with varying scale parameters:

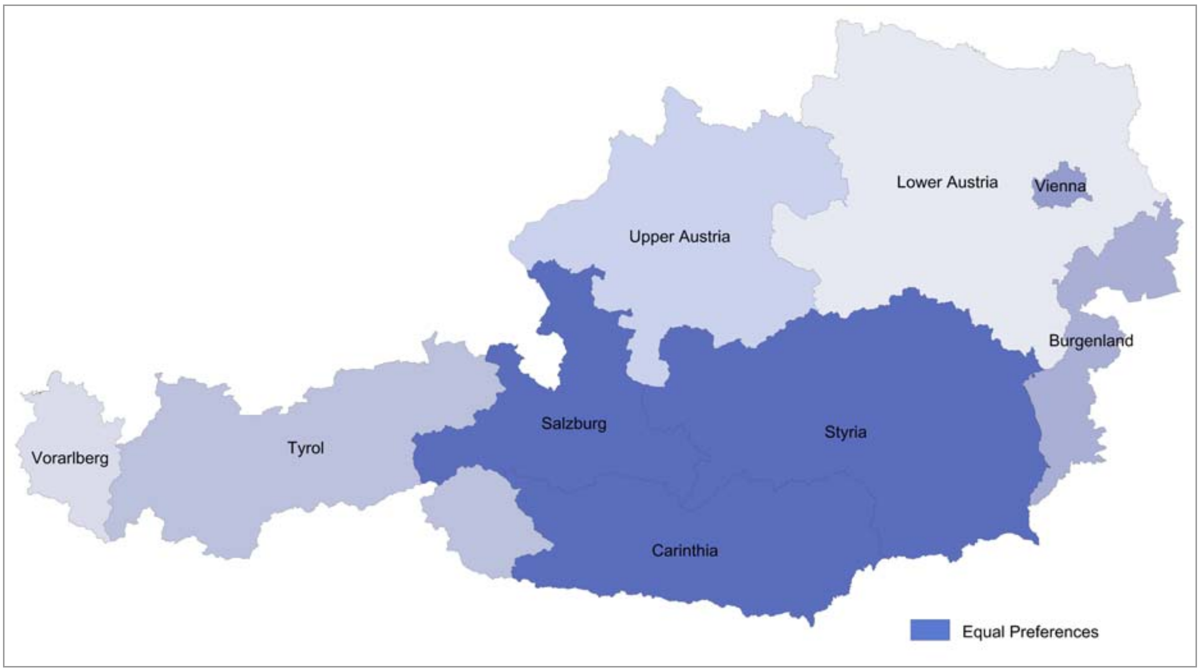
$$-2(LL^{equalscale} - (LL^{pooled})) \quad \text{with d.f.} \quad 1 \qquad (10)$$

[45] Strictly speaking parameter equality also means that the alternative specific constants (ASC) are the same, i.e. $ASC_A = ASC_B$.

A rejection of the null hypothesis would imply that the scale parameters of the two samples are different (BROUWER ET AL., 2010). Due to the fact that the scale parameter is inversely related to the variance of the error term[46] (SWAIT AND LOUVIERE, 1993), an increasing scale would indicate that choice behaviour becomes less random because of reductions in preference uncertainty.

The results of the test procedure described above are illustrated in Table 21.[47] There were 15 different combinations which needed to be tested for preference and scale parameter equality. In the first step we tested for each combination whether preference parameters β are equal between the two subsamples. In case of preference parameter equality (no rejection of the null hypothesis in step 5), a test for scale parameter equality was performed. In the course of this test procedure, we were able to identify one cluster. Thus, preference and scale parameters are equal in Carinthia & Salzburg, Carinthia & Styria and Salzburg & Styria, concluding that preferences are the same in these federal states. No further clusters could be identified. Between the remaining Austrian federal states preferences for hydropower expansion differ, representing the heterogeneity of the country (see Figure 40).

Figure 40: Equality of preferences among Austrian federal states



Source: OWN DEPICTION

[46] This relation is given by the following equation: $\sigma^2 = \frac{\pi^2}{6(\lambda)^2}$

[47] NLogit 4.0 econometric software was used to perform the tests.

Table 21: Sweat and Louviere test procedure comparing Austrian federal states

Federal states	1	2	3	4	5	6	7	8	9	10
	LL Sample 1	LL Sample 2	LL joint[1]	LR-test (11 df)[2]	Reject H_0: $\beta_i = \beta_j$	Rel. scale (λ_j / λ_i)	Rel. var. $(\sigma_j^2 / \sigma_i^2)$	LL joint[3]	LR-test (1 df)[4]	Reject H_0: $\lambda_i = \lambda_j$
Carinthia & Salzburg	-765.53	-686.47	-1459.92	0.147	No	0.88	1.29	-1460.42	0.316	No
Carinthia & Styria	-765.53	-738.25	-1507.13	0.823	No	0.72	1.93	-1508.43	0.106	No
Carinthia & Tyrol	-765.53	-729.97	-1503.07	0.176	No	1.46	0.47	-1507.95	0.002	Yes
Carinthia & Vorarlberg	-765.53	-688.66	-1464.75	0.032	Yes	0.80	1.56	-	-	-
Carinthia & Vienna	-765.53	-668.24	-1442.42	0.099	Yes	1.08	0.86	-	-	-
Salzburg & Styria	-686.46	-738.25	-1430.63	0.376	No	0.94	1.13	-1430.77	0.599	No
Salzburg & Tyrol	-686.46	-729.97	-1427.75	0.020	Yes	1.66	0.36	-	-	-
Salzburg & Vorarlberg	-686.46	-688.66	-1386.43	0.020	Yes	0.98	1.04	-	-	-
Salzburg & Vienna	-686.46	-668.24	-1364.02	0.068	Yes	1.37	0.53	-	-	-
Styria & Tyrol	-738.25	-729.97	-1473.78	0.432	No	1.80	0.31	-1483.35	0.000	Yes
Styria & Vorarlberg	-738.25	-688.66	-1434.04	0.218	No	1.13	0.78	-1434.50	0.335	No
Styria & Vienna	-738.25	-668.24	-1411.16	0.589	No	1.49	0.45	-1416.24	0.001	Yes
Tyrol & Vorarlberg	-729.97	-688.66	-1427.75	0.076	Yes	0.56	3.19	-	-	-
Tyrol & Vienna	-729.97	-668.24	-1407.56	0.067	Yes	0.72	1.93	-	-	-
Vorarlberg & Vienna	-688.66	-668.24	-1361.08	0.679	No	1.30	0.59	-1365.47	0.003	Yes

[1] Pooled ECM model allowing scale parameters to vary
[2] P-value for chi-square test with 11 degrees of freedom
[3] Pooled ECM model keeping scale parameters constant
[4] P-value for chi-square test with 1 degree of freedom

Source: OWN CALCULATIONS

Table 22 shows the outcomes of the ECM models across Austrian federal states.[48] According to the result of the Sweat and Louviere test procedure presented above, Carinthia, Salzburg and Styria were pooled to one subsample. For Tyrol, Vorarlberg and Vienna separate models were estimated due to unequal preferences.

Table 22: Model estimates (attributes only) across federal states

Variable	Pooled sample Carinthia & Salzburg & Styria	Tyrol	Vorarlberg	Vienna
ASC	2.544*** (0.000)	3.341*** (0.000)	2.815*** (0.000)	3.222 (0.000)
Jobs	0.004* (0.055)	0.0002 (0.541)	-0.00002 (0.956)	0.0005 (0.202)
CO_2 reduction	0.015*** (0.000)	0.009** (0.022)	0.023*** (0.000)	0.020*** (0.000)
Nature (strong impact)	-1.659*** (0.000)	-1.109*** (0.000)	-1.902*** (0.000)	-1.574*** (0.000)
Distance	0.002 (0.7686)	-0.009 (0.427)	0.028*** (0.004)	0.014 (0.203)
Cost	-0.147*** (0.000)	-0.089*** (0.000)	-0.125*** (0.000)	-0.109*** (0.000)
Std. Dev. Jobs	0.002*** (0.000)	0.000004 (0.999)	0.0002 (0.907)	0.001* (0.066)
Std. Dev. CO_2	0.019*** (0.000)	0.026*** (0.000)	0.033*** (0.000)	0.021*** (0.002)
Std. Dev. Nature	2.365*** (0.000)	1.953*** (0.000)	2.289*** (0.000)	2.147*** (0.000)
Std. Dev. Distance	0.033** (0.011)	0.049*** (0.005)	0.011 (0.760)	0.044** (0.038)
Std. Dev. Random effect (error comp.)	2.552*** (0.000)	3.800*** (0.000)	2.889*** (0.000)	3.539*** (0.000)
Log-likelihood	-2,199.399	-729.969	-688.655	-668.236
McFadden Pseudo R^2	0.254	0.262	0.299	0.306
Number of respondents	447	150	149	146
Number of observations	2,682	900	894	876

p-values in parentheses

Significance: *** 1 % level ** 5 % level * 10 % level

Source: OWN CALCULATIONS

The choice attributes CO_2 emission reduction, as well as the impact on nature and landscape have statistically significant impacts on choice in all of the subsamples presented above. Job creation, in contrast, is a statistically significant factor only in the pooled sample containing Carinthia, Salzburg and Styria. Furthermore, Vorarlberg is the only federal state showing a

[48] For simplicity ECM models using attributes only were estimated.

significant impact of distance on choice. Price sensitivity is given in all subsamples reflecting the fact that people prefer cheaper hydropower expansion strategies.

Based on the models presented in Table 22, implicit prices were calculated for each subsample including the effect of the alternative specific constant. The outcomes are shown in Table 23. For statistically insignificant attributes WTP is not considered here. First, people have in general a positive WTP for hydropower expansion in all federal states ranging from € 17.3 in the pooled sample (Carinthia, Salzburg and Styria) to € 37.7 in Tyrol.

Table 23: Estimates of willingness to pay across federal states (per household/month)

Variable	Pooled sample (CA, S, ST)	Tyrol	Vorarlberg	Vienna
Hydropower	€ 17.268	€ 37.659	€ 22.542	€ 29.650
Jobs (per 100 jobs)	€ 0.339 [0.334, 0.344]	-	-	-
CO_2 reduction (per 10 %)	€ 1.050 [1.014, 1.087]	€ 1.272 [1.233, 1.311]	€ 1.931 [1.816, 2.045]	€ 1.798 [1.723, 1.873]
Nature (small to strong)	€ -11.037 [-11.424, -10.649]	€ -12.871 [-13.247, -12.496]	€ -14.941 [-15.497, -14.384]	€ -14.654 [-15.147, -14.162]
Distance (per 5 km)	-	-	€ 0.961 [0.941, 0.982]	-
95 % confidence intervals in parentheses				

Source: OWN CALCULATIONS

The creation of 100 additional jobs is worth € 0.3 per household and month. However, this effect only occurs in the pooled sample. Moreover, people exhibit a positive willingness to pay for CO_2 reduction. Here, statistically significant differences between Austrian federal states were identified. First, in the pooled sample average monthly WTP is € 1.1. In Tyrol CO_2 reductions are valued significantly higher with € 1.3 per month.[49] In Vorarlberg and Vienna WTP for a 10 % reduction of CO_2 emissions is € 1.9 respectively € 1.8. However, these values do not differ statistically significant from each other since confidence intervals overlap. Consequently, we can conclude that WTP for CO_2 emission reduction is significantly higher in Vorarlberg and Vienna compared to Tyrol and the pooled sample. The higher valuation of CO_2 reductions in Vienna may reflect the fact that Vienna is an urban area suffering from more air pollution than the mainly rural states. A similar argumentation may apply to Vorarlberg, which is also a small federal state with an urban character and a relative high population density.

Furthermore, strong environmental impacts associated with an expansion of hydropower represent a disutility in all federal states. This disutility shows up in the estimated negative values and amounts to € -11.0 in the pooled sample. In Tyrol a strong impact on landscape

[49] This result can be verified by the non-overlap of confidence intervals.

and natural environment is valued more negatively with € -12.9.[50] In Vorarlberg and Vienna negative nature impacts are valued significantly worse compared to the other states; however, the values do not distinguish between the two states. This result may also be due to the urban character of Vienna and Vorarlberg, where citizens are more sensitive to further deteriorations of nature and landscape.

Finally, people living in Vorarlberg are willing to pay approximately € 1.0 per month for a 5 km further distance between their home and the next hydropower station. As mentioned before, Vorarlberg is the only federal state where distance to home played a significant role for choice.

8.3 The effect of framing hydropower demand

The impact of framing hydropower demand in the context of demand for other renewable energy sources was tested through the development and implementation of a similar labelled choice experiment. The design of this labelled choice experiment was identical to the one used in the unlabelled hydropower choice experiment, except that labels were used to reflect alternative renewable energy sources.[51] Besides hydropower, solar power (photovoltaics), wind power and biomass were used as alternative energy sources between which respondents were asked to choose. As in the unlabelled hydropower choice experiment, possible impacts of each of these alternative renewable energy sources on job creation, CO_2 emission levels, nature and landscape were given, and the distance of the location of the alternative renewable energy source from the respondent's home. The benefits of having more renewable energy sources and their impacts on the above mentioned attributes were as before paid for through an increase in the respondent's monthly electricity bill.

The inclusion of these alternative energy sources as substitutes to hydropower broadened the choice set and was expected to significantly influence the value attached to hydropower by making respondents aware that alternative renewable energy sources could also be used to expand renewable energy demand in Austria (framing bias). Of particular interest was the effect of the inclusion of alternative renewable energy sources on the renewable energy-water trade-off, that is, the value attached to the impact on water status of an expansion of the hydropower capacity in Austria.

[50] Statistical significant difference between the two values is given due to the fact that 95 % confidence intervals do not overlap.
[51] More on the design of the choice experiment can be found in chapter 6.

Table 24: Model estimates (attributes only) for the labelled and unlabelled CE

	Unlabelled CE		Labelled CE	
Variable	**Coefficients**	**MWTP in €**	**Coefficients**	**MWTP in €**
Hydropower	2.727*** (0.156)	21.939 (1.104)	3.834*** (0.350)	27.159 (2.133)
Solar power (PV)			4.106*** (0.354)	29.086 (2.151)
Wind power			3.612*** (0.356)	25.581 (2.180)
Biomass			3.096*** (0.340)	21.929 (2.158)
Jobs	0.0003** (0.0001)	0.002 (0.001)	0.0006*** (0.0002)	0.004 (0.002)
CO_2 reduction	0.016*** (0.002)	0.127 (0.013)	0.016*** (0.003)	0.115 (0.019)
Nature (strong impact)	-1.555*** (0.077)	-12.511 (0.659)	-1.008*** (0.106)	-7.142 (0.733)
Distance	0.007* (0.004)	0.060 (0.031)	0.011* (0.006)	0.081 (0.045)
Cost	-0.124*** (0.005)		-0.141*** (0.009)	
Std. Dev. Jobs	0.0009** (0.0004)		0.0007 (0.0008)	
Std. Dev. CO_2	0.022*** (0.002)		0.025*** (0.004)	
Std. Dev. Nature	2.177*** (0.129)		1.847*** (0.189)	
Std. Dev. Distance	0.033*** (0.009)		0.022 (0.020)	
Std. Dev. Random effect (error component)	2.840*** (0.156)		2.846*** (0.288)	
Log likelihood	-4,331.591		-1,390.523	
Chi-squared (d.f.)	3,096.364 (11)		2,993.617 (14)	
McFadden Pseudo R^2	0.263		0.518	
Number of respondents	892		299	
Number of observations	5,352		1,794	

Standard errors in parentheses

Significance: *** 1 % level ** 5 % level * 10 % level

Source: Own calculations

The results from the labelled choice experiment are presented in the Table 24. The labels for the energy sources are all highly significant and show that solar power is the most preferred option, followed by hydropower, then wind power and finally biomass. This ranking of renewable energy sources was also reflected in descriptive statistics shown in section 7.2.1.[52] The observed differences in the table between the coefficient estimates and the

[52] Moreover, a similar ranking of renewable energy sources with solar power as the most preferred source was found in the studies of Borchers et al. (2007) and Burkhalter et al. (2009).

estimated marginal willingness to pay (MWTP) values are statistically significant at the 5% level (based on the Wald test[53]). This suggests that when considered in combination with other renewable energy sources, hydropower is not the highest valued renewable energy source. Of interest here is the difference between marginal WTP values for the attributes in the unlabelled and labelled experiment.

The impact of framing was tested in two different ways:
(1) through direct comparison of the MWTP values from the unlabelled choice experiment results with those derived from the labelled choice experiment (see Table 24),
(2) and by remodelling the choice structure of the labelled choice experiment to a similar structure as the one applied for the unlabelled choice experiment (see Table 26).

In the latter case, the choices were reduced to either a choice for hydropower or a choice for another renewable energy alternative.

Starting with (1), the comparison of the MWTP values in Table 24 shows that the creation of additional jobs is valued more and stronger (higher significance) when framed in the context of alternative renewable energy sources, while especially the negative impact on nature and landscape is considered significantly less of a concern. This seems to suggest that framing the expansion of hydropower in Austria in the context of alternative renewable energy sources reduces the perceived energy-water trade-off. This will be tested further more formally in a second step below. Also the emission of CO_2 is valued a little bit less, but not much. The effect of distance on choice behaviour is slightly higher, but weaker (less significant).

In order to facilitate comparison between the “restricted labelled choice model” and the “original unlabelled choice model” in a second step, the design of the choice experiment was slightly altered by including the hydropower alternative in every choice card instead of randomizing the labels across the choice cards. So, respondents were shown on every card a renewable energy source alternative (solar, wind or biomass) and a hydropower alternative. A sample of almost 300 respondents also received a version of the labelled choice experiment where the labels were randomly assigned to each card and a quarter of the cards did not include a hydropower alternative. We tested (in)equality of the two choice models with the help of the SWAIT AND LOUVIERE (1993) test procedure, which has already been described in chapter 8.2.5. The results from this test show that the null hypothesis of equality of preference parameters cannot be rejected at the 1 % significance level, suggesting that the inclusion of the hydropower alternative in each choice card did not substantially change the preference and variance structure of the estimated choice model (see Table 25).

[53] The Wald test is an opportunity to statistically test for linear restrictions (HENSHER ET AL., 2005).

Table 25: Sweat and Louviere test comparing labelled and restricted labelled CE

Test procedure	Result
LL sample 1	-1,390.52
LL sample 2	-2,834.31
LL pooled sample ($\lambda_1 \neq \lambda_2$)[1]	-4,235.80
LR-test – test statistic (12 d.f.)	21.9
LR-test – p-value (12 d.f.)	0.403
Reject H_0:$\beta_1 = \beta_2$?	No
LL pooled sample ($\lambda_1 = \lambda_2$)[2]	-4,238.08
LR-test – test statistic (1 d.f.)	4.55
LR-test – p-value (1 d.f.)	0.033
Reject H_0: $\lambda_1 = \lambda_2$?	No (at 1 % level)

[1] Pooled mixed logit model allowing scale parameters (λ) to vary.
[2] Pooled mixed logit model keeping scale parameters (λ) constant.

Source: Own calculations

Examining the results presented in Table 26, the coefficient estimates and MWTP values for two utility functions are shown, one specifically for the hydropower alternative and one for the other renewable energy sources. Differences between coefficient estimates are tested with the help of the Wald test. Based on this latter test, we are unable to find any significant differences in the value respondents attach to the attributes creation of jobs, the reduction of CO_2 emission levels or the distance between the respondent's home and the location of the renewable energy source. The distance variable is not statistically significant in none of the utility functions in this reduced choice model. Also the price sensitivity between hydropower and the alternative renewable energy sources does not differ significantly. Although hydropower (as label) is valued somewhat higher than the alternative renewable energy sources, also this difference is not statistically significant. The only significant difference we are able to detect is for the energy-water trade-off. Compared to the alternative energy sources, the expansion of hydropower is at the expense of a significantly higher external cost on nature and landscape, including water status. Hence, respondents value the expansion of hydropower in Austria, but wish to be compensated for the loss of nature and landscape. This effect is initially lower in the labelled experiment, possibly as a result of mixed emotions regarding the different impacts of the different sources on nature and landscape. However, when modelling the labelled choice experiment results as a dichotomous choice between hydropower and alternative renewable energy expansion, respondents appear to value the impact on nature and landscape significantly higher in the case of hydropower.

Table 26: Model estimates (attributes only) for the restricted labelled CE

Variable	Coefficients	Std. Dev. Random variables	MWTP in €	Wald statistic	p-value
Hydropower	4.081*** (0.289)		33.695 (2.481)	0.172 (0.273)	0.529
Other source	3.909*** (0.274)		27.832 (2.111)		
Jobs – hydro	0.0008*** (0.0003)	0.002*** (0.0005)	0.007 (0.002)	-0.0003 (0.0004)	0.426
Jobs – other	0.001*** (0.0003)	0.001*** (0.0005)	0.008 (0.002)		
CO_2 reduction – hydro	0.012*** (0.003)	0.010** (0.004)	0.099 (0.022)	-0.004 (0.004)	0.236
CO_2 reduction – other	0.017*** (0.003)	0.0003 (0.007)	0.118 (0.018)		
Nature (strong) – hydro	-1.198*** (0.178)	1.872*** (0.238)	-9.889 (1.541)	-0.641 (0.315)	0.042
Nature (strong) – other	-0.557*** (0.165)	1.697*** (0.221)	-3.966 (1.179)		
Distance – hydro	0.003 (0.007)	0.003 (0.030)	0.028 (0.057)	0.005 0.011	0.616
Distance – other	-0.002 (0.007)	0.015 (0.018)	0.014 (0.052)		
Cost – hydro	-0.121*** (0.009)			0.019 (0.014)	0.153
Cost – other	-0.140*** (0.009)				
Error component	3.051*** (0.207)				
Log likelihood	-2,844.336				
Chi-squared (d.f.)	2,208.153 (21)				
McFadden Pseudo R²	0.280				
Number of respondents	599				
Number of observations	3,594				

Standard errors in parentheses

Significance: *** 1 % level ** 5 % level * 1 % level

Source: OWN CALCULATIONS

8.4 Regional hydropower case studies

In addition to the CE on hydropower and renewable energy sources, two concrete hydropower projects along the river Mur in the province of Styria have been explored (see Table 27).

Table 27: Regional hydropower projects in Styria

	Graz-Puntigam	Gratkorn
Installed capacity	16 MW	11 MW
Electric power generation	74 GWh per year	54 GWh per year
Investment volume	€ 87 million	€ 66 million
Completion of the project	2016	2016

Source: ENERGIE STEIERMARK (2010); OESTERREICHS ENERGIE (2012); PISTECKY (2010); UMWELTBUNDESAMT (2010a); VERBUND AUSTRIAN HYDROPOWER (2009)

First, the construction of the hydropower station Graz-Puntigam with a total capacity of 16 MW is planned within the city limits of Graz.[54] The overall investment volume is € 87 million. The construction works are scheduled to start in autumn 2013 and will be finished in 2016. The power station will be able to generate an electricity amount of 74 GWh per year. Hence, about 20,000 households can be provided with “green” electricy from the power station (PISTECKY, 2010; DOBROWOLSKI AND SCHLEICH, 2009; ENERGIE STEIERMARK, 2010). The second hydropower project will be realized in Gratkorn, a community situated in the north of Graz. It is planned to be built between two existing river power plants and therefore represents an expansion of the already operating power generation capacities along the Mur. The hydropower station will be finished in 2016 with an installed power plant capacity of 11 MW. Gross electricity production will amount to 54 GWh per year. Thus, about 13,000 households can annually be provided with “green” electricity (VERBUND AUSTRIAN HYDRO POWER, 2009a; VERBUND AUSTRIAN HYDRO POWER, 2009b). The investment volume is € 66 million (UMWELTDACHVERBAND, 2010a).

Hence, the main difference between the two hydropower projects is the geographical location. While Graz-Puntigam is situated in the urban area of Graz, the location of the hydropower plant Gratkorn can be characterized as a rural area. Additionally, the hydropower plants differ in capacity, moreover there is already a significant impact on landscape and natural environment due to the existing hydropower facilities in Gratkorn.

[54] Graz represents the provincial capital of Styria and is situated around 150 km south-west of Vienna. The number of inhabitants amounts to 262,000; hence Graz is the second largest city in Austria.

8.4.1 Socio-economic characteristics of the regional samples

Prior to the presentation of the model results, the following sections aim to depict the representativeness of the regional samples as well as respondents' general perception of the hydropower projects in Styria. In total, 199 people were asked about the hydropower project Graz-Puntigam and 208 respondents got the questionnaire about the project Gratkorn. Both samples consist of people living in Graz and its surrounding communities. For descriptive analysis these two subsamples were pooled (n=407). In addition to that, situations with statistically significant differences between the two subsamples were highlighted.

Table 28 displays the socio-demographic characteristics of the regional sample as well as the distribution in the total population from which the samples were drawn.[55] The gender of respondents is with 50.6 % men and 49.4 % women very close to the Styrian average. The age structure corresponds in principle to the total population in Styria. However, the age category older than 59 years is proportionally low compared to the total population. The same applies to the age group 18-19 years which is also slightly underrepresented in the sample. In contrast, respondents aged between 20 and 29 years are stronger represented in the sample compared to the total population. The mean age is 39.6 years.[56]

Table 28: Gender and age of respondents compared to Styrian population

	Sample (n=407)	in %	Total population
GENDER			
Male	206	50.6 %	48.9 %
Female	201	49.4 %	51.1 %
AGE			
18-19 years	6	1.5 %	3.3 %
20-29 years	118	29.0 %	17.5 %
30-39 years	87	21.4 %	17.8 %
40-49 years	89	21.9 %	22.4 %
50-59 years	65	16.0 %	18.2 %
60-69 years	36	8.8 %	14.6 %
70-75 years	6	1.5 %	6.2 %

Source: OWN CALCULATIONS; STATISTIK AUSTRIA (2011b) and (2011e)

In total, Graz and its surrounding area[57] have about 334,000 inhabitants. 21.7 % of them are living in one of the surrounding communities and 78.3 % have their residence in the city of Graz. This distribution is also roughly reflected in the sample with 75.2 % of the respondents

[55] Due to a lack of reliable data on the characteristics of inhabitants of the area of Graz and surroundings, the sample is compared to data of the whole province of Styria.

[56] Mean age is statistically significant different between the two samples (Graz-Puntigam: 40.9 years, Gratkorn: 38.3 years) as can be shown by an independent sample t-test (t=-1.885, p=0.061).

[57] Graz has in total 19 directly surrounding communities, namely Feldkirchen, Fernitz, Gössendorf, Grambach, Hausmannstätten, Kalsdorf, Raaba and Seiersberg in the south. In the north of Graz are the communities Deutschfeistritz, Eisbach, Gratkorn, Gratwein, Judendorf-Straßengel, Peggau, Stattegg and Weinitzen. Finally in the east and west Graz is surrounded by the communities Hart, Kainbach and Thal.

living within the city limits of Graz and 24.8 % living in one of the surrounding communities (see Table 29). The respondents from the area around Graz are thereby equally allocated among all surrounding communities.

Table 29: Regional distribution of the sample

	Sample (n=407)	in %	Total population
Graz	306	75.2 %	78.3 %
Surrounding communities	101	24.8 %	21.7 %

Source: OWN CALCULATIONS; LAND STEIERMARK (2011)

The distribution of disposable monthly household income shows that 51.0 % of the respondents have a household income less than € 2,000. Median monthly household income falls into the category € 1,501 – 2,000, which is considerably below median household income in Austria of approximately € 2,500 (STATISTIK AUSTRIA, 2011b). Consequently, the income distribution in the regional sample is skewed towards those with lower incomes.

The educational level of the respondents is given in Table 30. It shows that the sample is significantly higher educated than the average Styrian population. Respondents with a higher school certificate as well as respondents with a university degree are considerably overrepresented while lower educated people (compulsory school, apprenticeship and professional school) are significantly underrepresented compared to the total population. First, this result must be seen in light of the difficulty for the survey agency to draw a representative sample from such a small geographical area. Second, the data for total population refer to the whole of Styria[58], while the sample mainly contains people from the capital of Styria, Graz. Usually, people living in urban areas are higher educated, especially since Graz represents a major university town in Austria. This fact may provide an explanation for the overrepresentation of higher educated people in the sample.

Table 30: Educational level of respondents compared to Styrian population

Educational level	Sample (n=407)	in %	Total population
Compulsory school	13	3.2 %	16.7 %
Apprenticeship, professional school	118	29.1 %	57.6 %
Higher school certificate	155	38.2 %	12.3 %
College of education	11	2.7 %	3.5 %
University (of applied sciences)	109	26.8 %	9.9 %

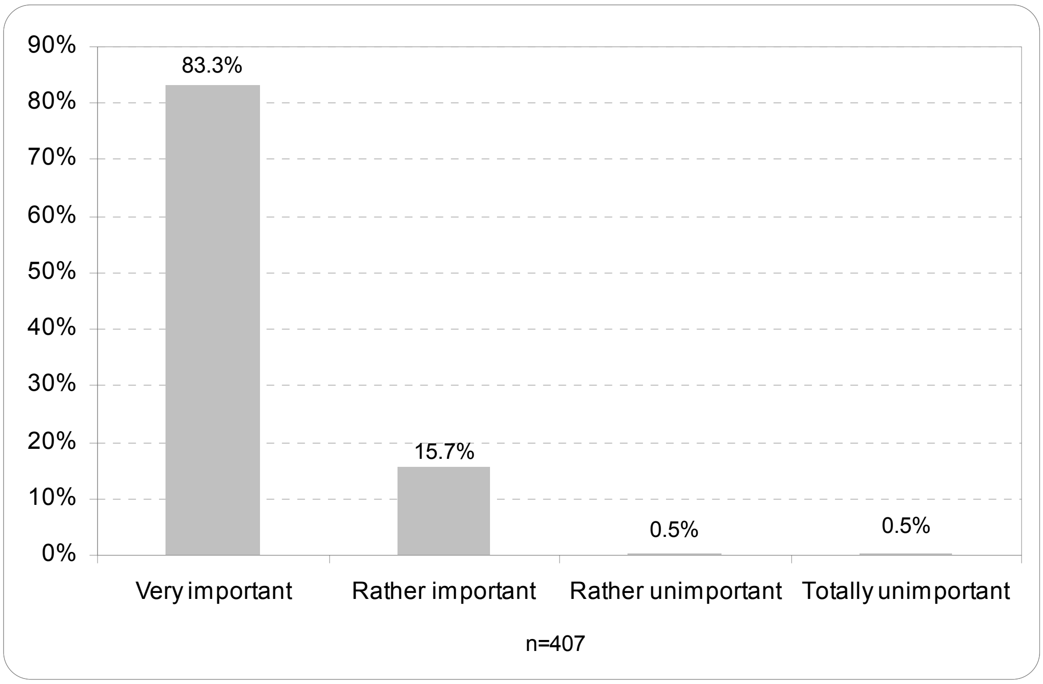
Source: OWN CALCULATIONS; STATISTIK AUSTRIA (2012)

[58] This is due to a lack of data, as mentioned before.

8.4.2 Perception of the hydropower projects

The following section elucidates respondents' general perception towards the use of renewable energy and hydropower in Austria and especially Styria. As in the Austrian sample, a majority of respondents (83.3 %) answered that the use of renewable energy sources is very important to meet future energy-related targets. Moreover, 15.7 % stated that it is rather important to further increase the use of electricity from renewable sources like hydropower, wind power or photovoltaics in the future. Only a minority of 1.0 % found it rather or totally unimportant to expand renewable energy sources prospectively (see Figure 41).

Figure 41: Importance of an intensified use of renewable energies in the future (regional)

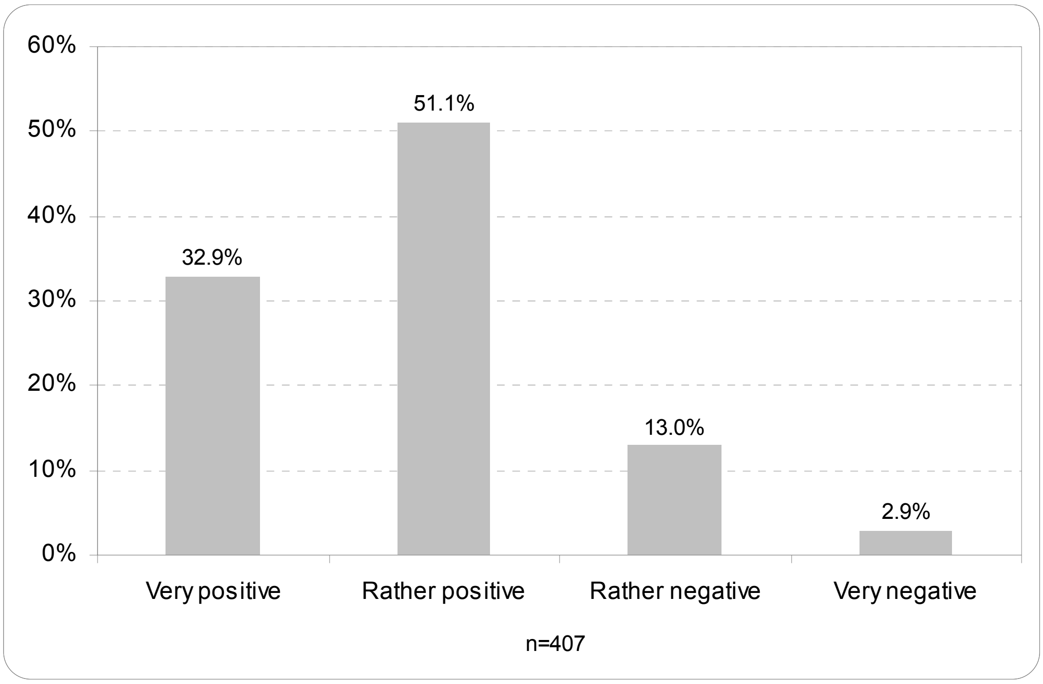


Source: OWN CALCULATIONS

Furthermore, most respondents have a very positive (43.2 %) or rather positive (51.8 %) attitude towards hydropower utilisation in Austria. The share of people with a negative attitude is considerably low with 4.2 % (rather negative) and 0.7 % (very negative). This result is very close to the Austrian sample concluding that people in the regional geographical area have similar perceptions towards hydropower use in Austria.

When respondents were asked if they heard about the plan to construct new hydropower plants along the river Mur, 86.0 % answered this question with "yes". In addition, slightly more than half of the respondents (51.1 %) have a rather positive attitude towards the construction of new hydropower plants along the Mur. The share of people with a very positive attitude is 32.9 %. Only a minority of 15.9 % is in principle against the construction of new hydropower plants along the Mur (see Figure 42). Compared to the general attitude towards hydropower use in Austria shown before, the share of people with a very positive attitude is significantly lower while people with a negative attitude are stronger represented. So, respondents are in general pro hydropower. However, if hydropower plants are built along a nearby river people's agreement diminishes.

Figure 42: Attitude towards the expansion of hydropower use along the Mur



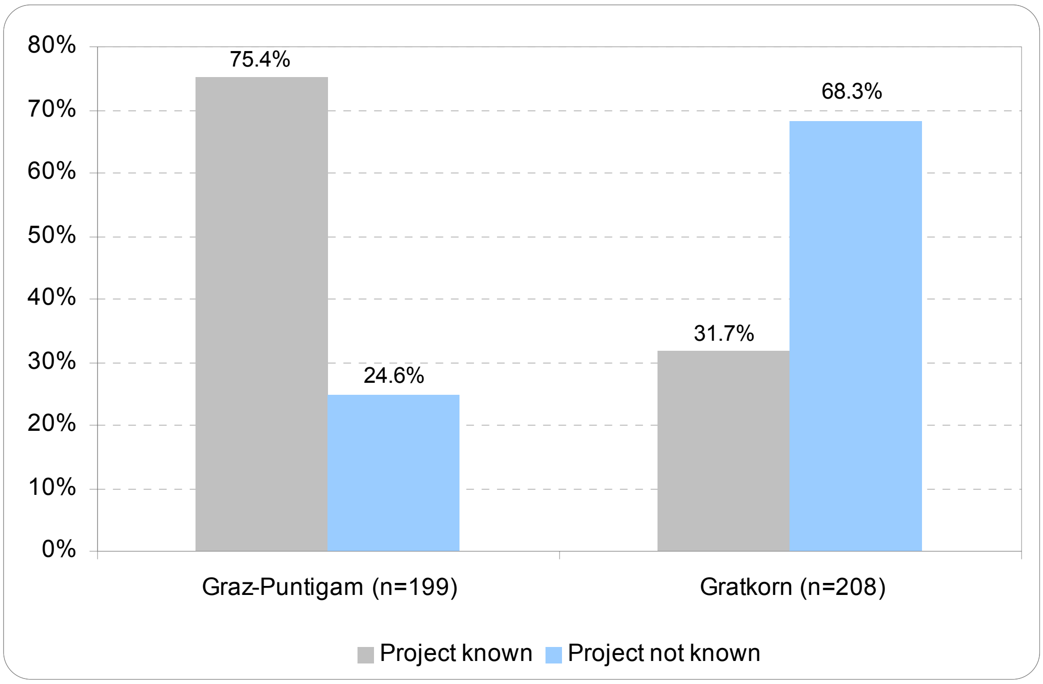
Source: OWN CALCULATIONS

Generally, the survey results show that the project Graz-Puntigam is considerably better known than the project Gratkorn. About three quarter (75.4 %) of respondents in the sample regarding the project Graz know that there are plans to build a new hydropower station. In contrast, less than a third of the respondents in the Gratkorn sample are informed about the construction of the hydropower plant (see Figure 43).[59]

People who heard about the two hydropower projects were asked to state the approximate distance (as the crow flies) between the location of the hydropower plant and their home. In the sample referring to the project Graz-Puntigam this distance is on average 10.6 km, in the Gratkorn sample the mean distance is statistically significant (t=1.378, p=0.085) higher and amounts to 12.8 km. 5.1 % of the respondents are living in close proximity (till 2 km) to the hydropower project. The major part lives at a distance between 2 and 10 km and the remaining 35.0 % at a distance of more than 10 km from the regarding hydropower station (see Figure 44).

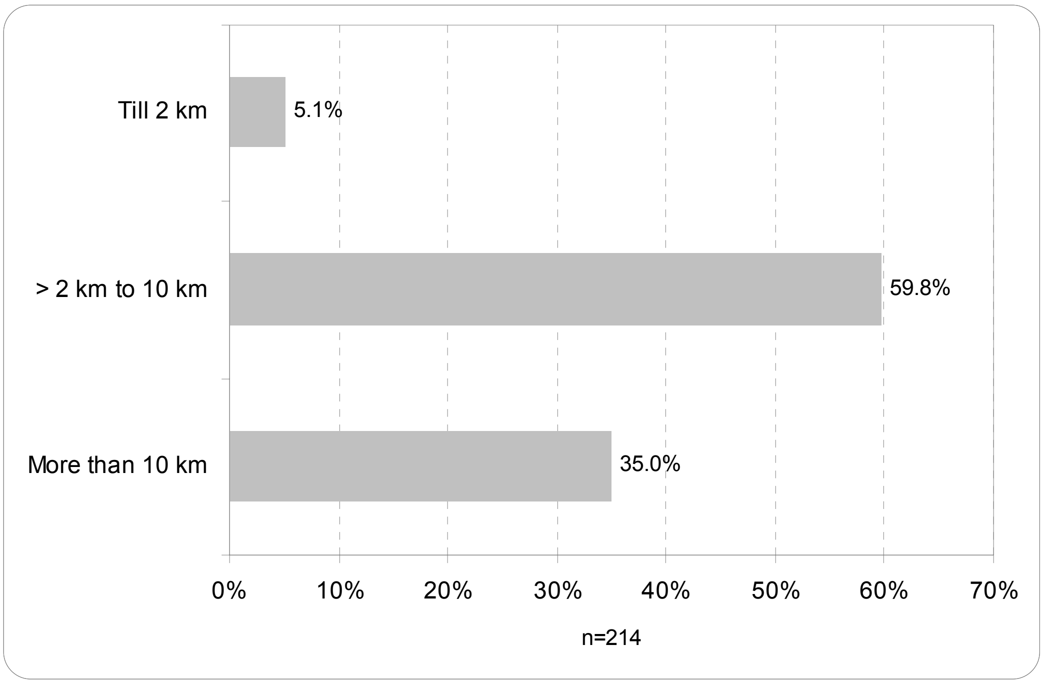
[59] Statistical significant difference between the two samples was found at the 1 %-level (z=-8.809, p=0.000) using the Wilcoxon rank-sum test.

Figure 43: Share that heard of the hydropower projects



Source: OWN CALCULATIONS

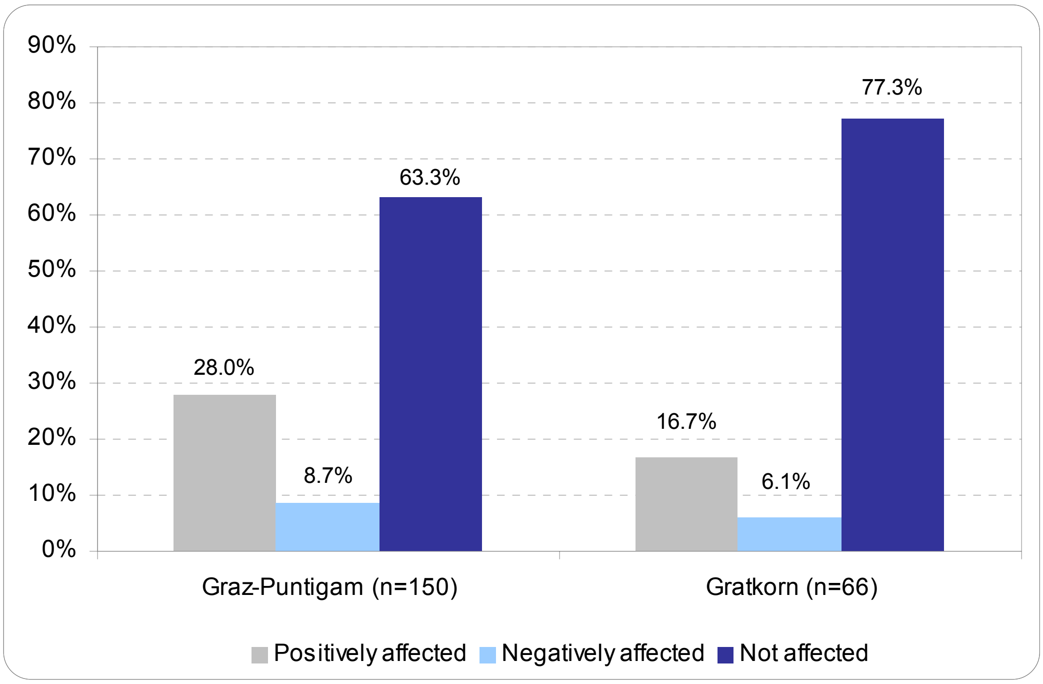
Figure 44: Distance between the hydropower project and respondent's home



Source: OWN CALCULATIONS

Furthermore, a relatively high number of respondents (sample Graz: 63.3 %, sample Gratkorn: 77.3 %) reported not to be affected by the new hydropower projects. At the same time 8.7 % (Graz) and 6.1 % (Gratkorn) of the sample population indicated to feel negatively affected. The share of people feeling positively affected by the hydropower project in Graz-Puntigam is 28.0 %, while only 16.7 % are positively affected by the project in Gratkorn.[60]

Figure 45: Individual concernment by the hydropower projects



Source: OWN CALCULATIONS

One of the main reasons for a positive concernment is the fact that people can obtain electricity from a highly reliable and renewable energy source. Furthermore, people think that the hydropower projects will facilitate new recreational activities and finally, respondents are generally pro hydropower.

Regarding negative concernments associated with the new hydropower projects, a consistent outcome is given showing that people are principally against the new hydropower stations due to negative effects on landscape as well as flora and fauna.

8.4.3 Model results – CE regional case studies

In order to examine public preferences for the two hydropower projects in Styria as well as the trade-off between attributes, an econometric model was estimated. Thereby we also addressed differences in public preferences between the planned hydropower stations (rural versus urban project). Moreover, implicit prices (WTP) were estimated and finally, we used the model results to calculate total economic surplus for different policy scenarios.

[60] Statistical significant difference between the two samples was found at the 5 %-level (z=2.019, p=0.043).

Prior to the estimation of the choice models, a split-sample test was conducted in line with SWEAT AND LOUVIERE (1993) revealing differences between the two samples. The test procedure has already been elucidated in chapter 8.2.5. This is why we solely report the results of the test procedure at this point of the report (see Table 31). Sample A refers to the urban hydropower project Graz-Puntigam and sample B to the rural project in Gratkorn. In the first step we tested whether preference parameters *β* are equal between the two samples. The likelihood ratio test revealed that the preference parameters of sample A (Graz) and B (Gratkorn) are statistically significant different from each other, i.e. the null hypothesis (H_0) of preference parameter equality can be rejected at the 1 % confidence level. The second step of the sequential testing procedure, namely the test for scale parameter equality cannot be performed due to the rejection of the null hypothesis in step 1. Thus, we can conclude that the models are different but we cannot attribute this difference to preference or scale parameter inequality. As a consequence the two samples are considered separately in the following remarks. It would not be appropriate to estimate the econometric model on the pooled data set.

Table 31: Sweat and Louviere test procedure comparing the regional samples

Test procedure	Result
LL Graz (sample A)	-876.465
LL Gratkorn (sample B)	-873.625
LL pooled sample[61]	-1761.993
LR-test – test-statistic (9 df)	23.805
LR-test – *p-value* (9 df)	0.005
Relative scale (λ_B/λ_A)	1.030
Relative variance (σ_B^2/σ_A^2)	0.943
Reject H_0: $\beta_A = \beta_B$?	Yes

Source: OWN CALCULATIONS

The statistically best fit models were found in the course of multi-stage model estimations including a variety of socio-economic characteristics like sex, income or educational level as well as interaction terms between these characteristics and choice attributes in the model specifications. However, a major part of these variables did not show up to be statistically significant leaving the following best fit econometric model:

$$U_{in} = \alpha + \beta_1 \text{Households}_{in} + \beta_2 \text{Nature}_{in} + \beta_3 \text{Recreation}_{in} + \beta_4 \text{Cost}_{in} + \beta_5 \text{Epay} * \text{Cost} + \beta_6 \text{Donator} * \text{Nature} + \beta_7 \text{Age} + \varepsilon_{in} \quad (11)$$

In equation (11) *α* represents the alternative specific constant (ASC) and β_1 to β_4 refer to the coefficients of the choice attributes, namely the number of households that can be provided

[61] Pooled mixed logit error component model allowing scale parameters to vary.

with electricity from the new power station (Households), the impact on landscape and natural environment (Nature), the impact on recreational activities (Recreation) as well as the additional electricity payment per month (Cost). The attributes Households and Cost represent linear effects, while Nature and Recreation are dummy coded. The baseline category of Nature is small impact. In case of Recreation the base consists of no recreational activities. Furthermore two interaction terms were included in the choice model. The dummy variable Epay indicates whether the electricity bill in the respondent's household is paid by another person and was interacted with the monetary attribute. The variable Donator is also dummy coded and shows whether the respondent (or someone else in his or her household) is a donator to environmental organisations. Together with the nature attribute this variable represents the second interaction term. Finally, Age was included in the econometric model as the only socio-demographic characteristic. No other socio-economic characteristics were found to be statistically significant. This includes household income which is usually a strong predictor of stated willingness to pay. A detailed description of the variables used in the econometric analysis is shown in the following table.

Table 32: Description of the variables used for estimation (CE regional case studies)

Variable	Description	Levels/Coding
Households	Number of households that can be provided with "green" electricity from the new hydropower plant.	5,000, 10,000, 15,000 households
Nature	Impact of the new hydropower plants on the landscape and the natural environment.	1 = strong impact, 0 = small impact
Recreation	Creation of new possibilities for recreational activities.	1 = yes, 0 = no
Cost	Increase in the respondent's monthly electricity bill.	3, 6, 9, 12, 15, 18 €
Donator	The respondent or someone else in his or her household is a donator to environmental organisations.	1 = yes (32.9 %) 0 = no (67.1 %)
Epay	The respondent's electricity bill is paid by another household member.	1 = yes (19.2 %) 0 = no (80.8 %)
Age	Age of the respondent in years	metric scaled variable

Source: OWN DEPICTION

The statistically best fit models are presented in Table 33. For each sample the results of a standard multinomial logit (MNL) model as well as the model estimates of a mixed logit model with error components (ECM) are reported. Looking at the MNL estimates all coefficients are indeed significant at least at the 5 % confidence level and have the expected signs but ignore so-called taste differences, which are captured by the ECM model. As can be seen from Table 33, the derived standard deviations of random parameter distributions are all statistically significant at least at the 10 % level justifying that we stick to the more complex ECM models.[62] Thus, looking at the ECM model estimates it can be seen that the coefficients of the four choice attributes, the interaction terms and age have the expected signs and are all statistically significant. The positive alternative specific constant (ASC) in both samples indicates that the respondents have some inherent propensity to choose for one of the power plant alternatives over the opt-out (none of the two alternatives) for reasons that are not captured in the estimated model.

The attributes Households and Recreation have positive signs which imply that respondents have preferences for alternatives where more households can be supplied with electricity from the new hydropower stations and where recreational activities are possible.

In contrast, alternatives with a strong impact on landscape and natural environment are less preferred compared to those with only a small impact. This relationship is captured by the negative sign of the coefficient on the attribute Nature. Furthermore, the effect of the strong nature impact is enhanced if the respondent (or someone else in his or her household) is a donator to environmental organisations, reflecting environmental affinity.

The negative sign of the cost attribute indicates that respondents prefer lower electricity bills. However, if the electricity bill is not paid by the respondent himself but by another household member instead the negative effect of cost diminishes, that suggests a lower price sensitivity. Finally, older people are less willing to choose one of the hydropower plant options. Instead they rather tend to choose the opt-out alternative.

The goodness-of-fit of the estimated models can be examined on the basis of various statistical key figures. First, the ECM models are highly significant as shown by the Chi-squared statistic shown in Table 33. Second, the ECM model represents the better approach compared to a standard MNL model as can be seen by looking at the Akaike (AIC) and Schwarz (BIC) information criteria which are significantly lower in the ECM models. Furthermore, the McFadden Pseudo R-squared of the ECM model is significantly higher compared to the MNL model and amounts to 0.338 in the sample referring to Graz-Puntigam and 0.373 in the other sample. These are pretty good values, since cross-section data are used for estimation.

[62] Although the Hausman tests showed that IIA assumption is not violated in both samples (Graz-Puntigam: X^2=10.460, p=0.234, Gratkorn: X^2=5.533, p=0.699).

Table 33: Model estimates – CE regional case studies

	Graz-Puntigam		Gratkorn	
Variable	*MNL Model*	*ECM Model*	*MNL Model*	*ECM Model*
ASC	1.972*** (0.000)	3.537*** (0.000)	1.931*** (0.000)	3.265*** (0.000)
Households	0.035*** (0.002)	0.055*** (0.001)	0.074*** (0.000)	0.106*** (0.000)
Nature (strong impact)	-1.339*** (0.000)	-2.405*** (0.000)	-1.722*** (0.000)	-3.494*** (0.000)
Recreational activities (yes)	0.646*** (0.000)	1.040*** (0.000)	0.574*** (0.000)	0.929*** (0.000)
Cost	-0.150*** (0.000)	-0.253*** (0.000)	-0.137*** (0.000)	-0.219*** (0.000)
Donator*Nature	-0.529*** (0.007)	-1.445*** (0.004)	-0.930*** (0.000)	-1.349*** (0.007)
Epay*Cost	0.027** (0.045)	0.059** (0.029)	0.035** (0.010)	0.083*** (0.000)
Age	-0.017*** (0.000)	-0.026* (0.070)	-0.027*** (0.000)	-0.042*** (0.003)
Std. dev. Households		0.087*** (0.001)		0.054* (0.099)
Std. dev. Nature		3.772*** (0.000)		4.261*** (0.000)
Std. dev. Leisure		1.767*** (0.000)		0.953** (0.021)
Std. dev. Random Effects (error component)		2.309*** (0.000)		2.186*** (0.000)
Log likelihood	-1,038.690	-868.042	-1,013.284	-859.802
McFadden Pseudo R^2	0.198	0.338	0.238	0.373
Chi-squared (d.f.)	-	870.556 (9)	-	994.887 (9)
AIC	1.753	1.474	1.637	1.397
BIC	1.787	1.525	1.670	1.446
Number of respondents	199	199	208	208
Number of observations	1,194	1,194	1,248	1,248

p-values in parentheses

Significance: *** 1 % level ** 5 % level * 10 % level

Source: OWN CALCULATIONS

8.4.4 Willingness to pay – CE regional case studies

Although we know from the split-sample test introduced in the previous remarks that preferences between the two samples differ, the estimated coefficients cannot be compared directly because preference and scale parameters are confounded. The calculation of implicit prices (WTP) makes it possible to compare respondents' valuation for specific attributes.

As before, simply dividing the coefficient of the attribute of interest by the coefficient of the monetary attribute does not represent an appropriate approach to calculate WTP due the presence of random parameters. Consequently, WTP for the choice attributes was simulated for each respondent using a conditional constrained distribution. Based on these simulations mean, standard deviations and confidence intervals were calculated. The outcome of this procedure is shown in Table 34.

Table 34: Estimates of willingness to pay – CE regional case studies

Variable	Measurement	WTP Graz-Puntigam	WTP Gratkorn
Households	per 1,000 households	€ 0.246 [0.234, 0.258]	€ 0.415 [0.391, 0.440]
Impact on nature and landscape	from small to strong	€ -9.811 [-10.352, -9.269]	€ -15.432 [-16.288, -14.577]
Recreational activities	from no recreation to recreation	€ 4.200 [4.065, 4.335]	€ 4.206 [4.099, 4.312]
95 % confidence intervals in parentheses			

Source: OWN CALCULATIONS

The estimated WTP values are based on a ceteris paribus assumption, meaning that all other parameters are held constant except the attribute for which the implicit price is being calculated. First, not presented in Table 34, people generally exhibit a positive WTP for the construction of the new hydropower station independent from attribute levels. This general WTP is € 14.0 per household and month in the sample referring to the project in Graz-Puntigam and € 14.9 in the sample referring to Gratkorn.

The willingness to pay estimates for the three choice attributes differ substantially between the two samples except for recreational activities. First, respondents of the Graz sample are willing to pay around € 0.2 on top of their monthly electricity bill for the supply of 1,000 additional households with electricity from the hydropower plant. In the other sample by contrast the willingness to pay is much higher and amounts to € 0.4 per 1,000 households.

The implicit price for the nature attribute is negative, reflecting the fact that people do not desire alternatives with a strong environmental impact. Negative values of WTP imply a reduction in utility. So, WTP decreases with a strong impact on the landscape and natural environment. People wish to get compensated for the loss of nature and landscape. Negative WTP is much lower in one sample compared to the other. Thus, when referring to the urban hydropower project Graz people's WTP amounts to € -9.8 per month. Conversely, in the other sample which regards to the planned hydropower station Gratkorn, WTP decreases by € 15.4 per month with a strong environmental impact. Moreover, it was found that in both samples the negative WTP is highly random fluctuating substantially around its mean.

Yet, we cannot say anything with certainty about the reasons for these WTP differences. No significant indications were found in respondents' attitudes towards the new hydropower plants that can help to explain the considerable WTP differences. Instead we can only make assumptions about the significant difference in WTP for the nature and landscape attribute. First, the high negative WTP in the sample referring to the Gratkorn project may reflect the fact that due to the already existing hydropower plants people are more sensitive to further environmental deteriorations compared to the location of Graz where there are no existing hydropower plants. Second, we can argue the other way round. In the city centre of Graz, where the project Graz-Puntigam is planned to be built, the river Mur is already heavily modified. Thus, the strong environmental impact is not valued as negatively as in the case of the hydropower project Gratkorn, which is planned in a rural area where the Mur is still less modified and in a near-natural state. However, there may be other confounding and un-controllable factors playing a role in explaining the differences in respondents' preferences.

Another important factor for respondents is the creation of recreational activities. Leisure activities play an important role for the respondents due to the fact that they are living near the river Mur. The most frequent recreational activities are walking along the riverbank, sportive activities and enjoying the landscape, while swimming, boating and fishing do not play a significant role along the Mur. Generally, 35.9 % of the respondents think that the construction of the new hydropower plant leads to an improvement of possible recreational activities. Hence, respondents' are willing to pay € 4.2 per month for such an improvement, whereas WTP does not differ between the two samples.[63]

8.4.5 Welfare analysis – CE regional case studies

Implicit prices (WTP) for the individual attributes are in fact useful for policy makers; however, these values do not represent valid welfare measures. This is why we estimated overall economic welfare for different policy scenarios including the alternative specific constant (ASC). Similar to the calculation of implicit prices, the welfare measures were simulated for each respondent based on the statistically best fit models presented before in order to account for random parameters, i.e. preference heterogeneity. Then means, standard deviations and the corresponding confidence intervals were drawn from these simulations. The outcomes for four different policy scenarios for the project Graz-Puntigam are presented in Table 35.[64] The first scenario represents the worst case, meaning that a small hydropower plant is built with a strong impact on landscape and natural environment and no additional possibilities for recreation. Such a situation is associated with a very low

[63] Statistically significant differences between WTP estimates can be tested by looking at the confidence intervals. For the household and nature attributes the corresponding 95 % confidence intervals do not overlap. So WTP is significantly different between the two samples. In contrast, the confidence intervals of recreational activities overlap underpinning the conclusion that WTP for recreational activities does not differ.

[64] According to the project plan, the hydropower station Graz-Puntigam will be able to provide 20,000 households with green electricity. In order to generate realistic policy scenarios this value was used in welfare analysis.

compensating surplus (CS) amounting to merely € 1.0 per household and month. Improving all attributes leads to a substantial increase of welfare amounting to monthly € 18.2 per household. This value is associated with 20,000 households able to be provided with electricity from the hydropower plant, a small environmental impact and the presence of new recreational activities. Starting from this scenario, a change of the environmental impact from small to strong is associated with a significant decrease in total economic welfare going from € 18.2 in scenario (2) to € 8.5 in scenario (3). The effect of the creation of leisure activities can be shown by looking at scenarios (2) and (4), which indicate that CS increases from € 14.0 to € 18.2 when recreational activities are possible.

Table 35: Welfare measures– Graz-Puntigam (per household/month)

	Households	Nature/landscape	Recreation	Welfare (CS)
(1)	5,000	strong impact	no	€ 1.008 [0.117, 1.899]
(2)	20,000	small impact	yes	€ 18.173 [17.580, 18.765]
(3)	20,000	strong impact	yes	€ 8.520 [7.459, 9.581]
(4)	20,000	small impact	no	€ 14.013 [13.577, 14.449]
95 % confidence intervals in parentheses				

Source: OWN CALCULATIONS

The estimated welfare measures shown in Table 35 were aggregated across the area of investigation (Graz and surrounding communities) using the number of households living in this area.[65] Furthermore, CS measures were converted to yearly values. Due to the fact that we do not have any information about the preferences of non-responses a range of total economic surplus was calculated. Within the lower bound non-responses are assumed to have zero WTP, while the upper threshold supposes that people who did not response to the survey have the same preferences as the people in the sample. In order to ensure that overall welfare is not overestimated, we stick to the lower welfare levels in the following remarks.

[65] Due to a lack of data, the number of households used to aggregate CS was calculated manually. The average household size in Graz and surroundings is 2.25 persons. This value is a weighted average of the household sizes in the districts of “Graz” and “Graz-Umgebung”. Then the number of inhabitants living in the city of Graz and the directly surrounding communities was divided by the average household size yielding a number of 148,447 households.

Table 36: Aggregation of welfare measures – Graz-Puntigam (in million € per year)

	Households	Nature/landscape	Recreation	Welfare lower level	Welfare upper level
(1)	5,000	strong impact	no	€ 0.4 mill.	€ 1.8 mill.
(2)	20,000	small impact	yes	€ 7.1 mill.	€ 32.4 mill.
(3)	20,000	strong impact	yes	€ 3.3 mill.	€ 15.2 mill.
(4)	20,000	small impact	no	€ 5.5 mill.	€ 25.0 mill.

Source: OWN CALCULATIONS

First, the worst case scenario yields a very low value of total economic surplus amounting to solely € 0.4 million. Going to the best case (scenario 2) welfare rises substantially to € 7.1 million. A strong environmental impact is associated with a welfare burden of € 3.8 million, as can be seen from the comparison of scenarios (2) and (3). In contrast, the creation of new possibilities for leisure activities is totally worth € 1.6 million.

Approximately the same policy scenarios were simulated for the hydropower project in Gratkorn, only deviating with respect to the number of households from the estimates before. In order to generate realistic scenarios, we used the number of households stated to be provided by the new hydropower station; this is 13,000 households. Scenario (1) is identical with the first scenario referring to the project in Graz-Puntigam. However, here the worst case scenario even yields a negative welfare measure which is € -6.1 per household and month. Going from scenario (1) to (2), which is an improvement of all attributes, CS rises tremendously to € 17.8. The effect of the environmental impact is very strong in the sample referring to the hydropower project in Gratkorn, as can be seen from scenario (3). Compared to scenario (2) CS decreases from monthly € 17.8 per household to € 1.9. This decline is fully attributable to the strong impact on nature and landscape. Finally, overall willingness to pay increases from € 13.6 (scenario 4) to € 17.8 (scenario 2) when recreational activities are possible.

Table 37: Welfare measures – Gratkorn (per household/month)

	Households	Nature/landscape	Recreation	Welfare gain (CS)
(1)	5,000	strong impact	no	€ -6.110 [-7.186, -5.033]
(2)	13,000	small impact	yes	€ 17.813 [17.622, 18.004]
(3)	13,000	strong impact	yes	€ 1.953 [0.867, 3.038]
(4)	13,000	small impact	no	€ 13.609 [13.468, 13.751]
95 % confidence intervals in parentheses				

Source: OWN CALCULATIONS

The aggregated welfare measures over the area of investigation containing Graz and its directly surrounding communities are shown in Table 38. Scenario (1) is associated with a negative value ranging from € -2.4 million to € -10.9 million dependent on how non-responses are treated. As already mentioned before, the hydropower station Gratkorn can provide electricity for 13,000 households. In combination with a small environmental impact and new possibilities for recreation the hydropower plant yields a total economic surplus of € 6.9 million (using the conservative estimate). Starting from this policy scenario, a strong environmental impact nearly evaporates economic surplus which goes down to € 0.8 million. The absence of new possibilities for recreation also leads a decrease in welfare. However, the effect is not as sharp as in the case of a strong environmental impact. Accordingly, overall welfare declines from € 6.9 million to € 5.2 million when recreational activities are not possible.

Table 38: Aggregation of welfare measures – Gratkorn (in million € per year)

	Households	Nature/landscape	Recreation	Welfare lower level	Welfare upper level
(1)	5,000	strong impact	no	€ -2.4 mill.	€ -10.9 mill.
(2)	13,000	small impact	yes	€ 6.9 mill.	€ 31.7 mill.
(3)	13,000	strong impact	yes	€ 0.8 mill.	€ 3.5 mill.
(4)	13,000	small impact	no	€ 5.2 mill.	€ 24.2 mill.

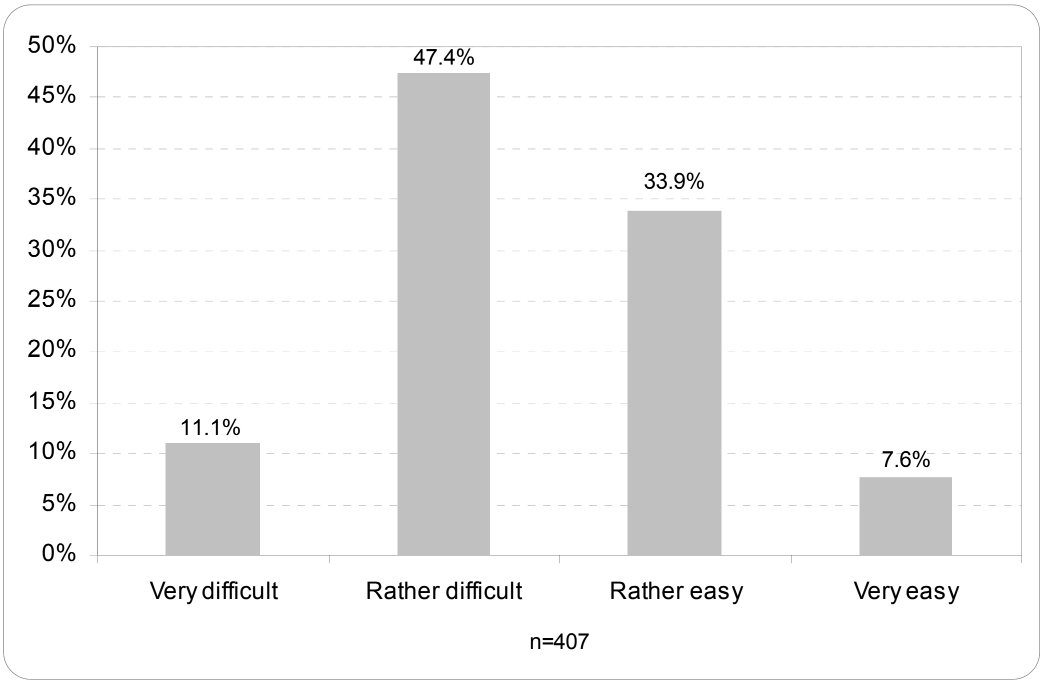
Source: OWN CALCULATIONS

The simple aggregations of the estimated CS across the population are often critical to arrive at a valid and reliable estimation of total economic surplus. As BATEMAN ET AL. (2006) points out, the aggregated total economic surplus can differ enormously depending on area size and population density. However, in this study we consider a quite small geographical area consisting of only one city (Graz) and its suburbs. Furthermore, we were not able to detect a distance decay effect in the econometrical model. This may also be due to the fact that just a very limited geographical area is regarded. Hence, the aggregated CS estimates may represent a good approximation of overall economic surplus in the region of Graz.

8.4.6 Debriefing evaluation of the CE (regional case studies)

The consistency of the CE results can be checked by the analysis of various debriefing questions. First, people were asked how difficult they found it to choose one of the alternatives in the choice cards. For 11.1 % of the respondents it was very difficult to make their decisions in the choice experiment and 47.4 % found it rather difficult. The share of people perceiving the choice experiment as rather or very easy is 33.9 % respectively 7.6 % (see Figure 46). Compared the CE on hydropower expansion strategies, the share of respondents who found the decision situations in the CE to be easy, is slightly higher. This may be due to the lower complexity of the CE using only four instead of five attributes.

Figure 46: Perceived difficulty of the choice experiment (regional case studies)



Source: OWN CALCULATIONS

Another debriefing question aimed to identify protest votes. In total, 18 respondents in the sample referring to the project in Graz-Puntigam and 17 respondents in the Gratkorn sample were found to have chosen the opt-out alternative (none of the two alternatives) in each of the choice situations. However, not all of them can be categorised as protest votes. In the first sample (Graz-Puntigam) 12 people (5.7 %) were identified as protest bidders being strictly against the construction of the new hydropower plant. In the other sample only 5 (2.4 %) protest votes were found. The observations identified as protest votes were excluded from the previous analysis in order to avoid biased results.

The relative importance of the attributes for respondents' choices was evaluated by a question asking directly how important the specific attributes were for the decision making process, ranging from 1 – very important to 4 – totally unimportant. Taking the mean of the answers for each attribute yields an indicator for the importance of attributes. Low values indicate high importance and vice verse. The outcomes are presented in Table 39 revealing that the impact on nature and landscape was by far the most important attribute for the respondents. The price (increase in monthly electricity bill) was the second important attribute followed by the number of households that can be supplied with electricity from the hydropower station. Finally, the attribute describing the impact on recreational activities is ranked at the end of the range, not reflecting the result of the choice experiment where people exhibit a higher WTP for recreational activities than for the provision of households with electricity.

Table 39: Importance of the attributes – CE regional case studies

Attribute	Importance
Impact on nature and landscape	1.51
Increase in monthly electricity bill	1.75
Households	1.78
Recreational activities	2.37

Source: OWN CALCULATIONS

9 Concluding remarks

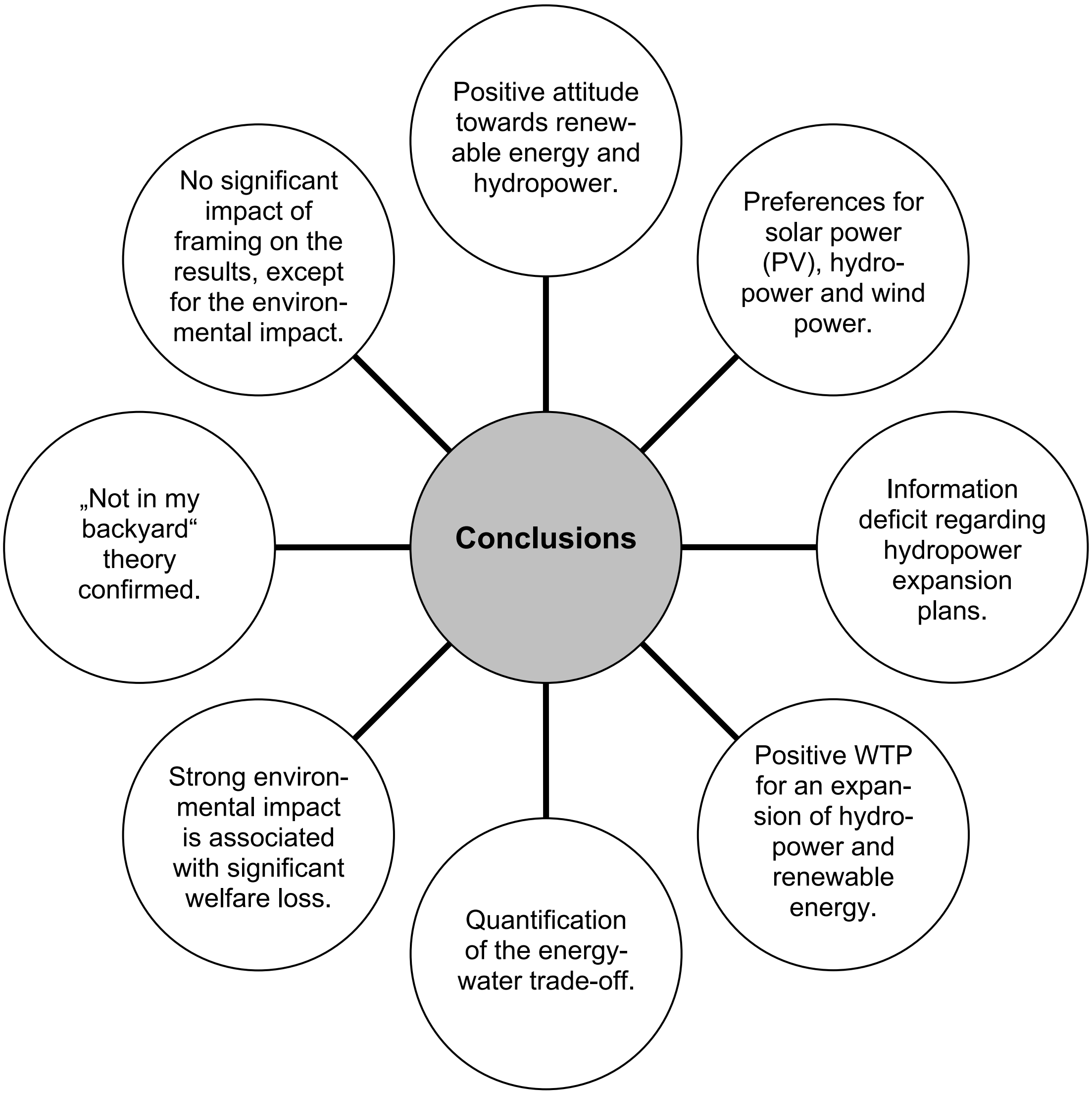
The aim of this study was to assess future hydropower energy development in Austria, considering the multiple costs and benefits associated with the construction of new hydropower stations. These are for instance impacts on CO_2 emissions, the local economy or the ecosystem of the water body. Using a web-based survey, a clear insight into people's preferences for hydropower and renewable energy expansion in Austria was gained. The main conclusions from the research project are summarized in Figure 47.

(1) First, the statistical analysis of attitudinal questions showed that the intensified use of renewable energy sources for future electricity generation is considered as an important part of a sustainable and future-oriented energy policy. However, there are preferences for certain renewable technologies. Solar power (photovoltaics) is ranked first, followed by hydropower and wind power. Biomass is, by contrast, the least preferred renewable energy source. Furthermore, people's general attitude towards hydropower use and the construction of new hydropower plants is very positive, whereas a significant lack of information could be identified.

(2) Principally, people exhibit a positive willingness to pay (WTP) for an expansion of renewable energy sources and hydropower. This is the result of a direct WTP question, asking people how much they are willing to pay on top of their monthly electricity bill in order to get green electricity for their household. In relation to current electricity costs, the surcharge people are willing to accept for an increased use of renewable energy is 15 %. This value approximately corresponds to the existing markups for the promotion of green electricity in Austria.

(3) The main findings were gained from the econometric models estimated within the scope of this research project. First, the much discussed "trade-off" between the advantages of hydropower expansion (e.g. CO_2 reduction, employment effects) and the negative accompanying effects (impact on the ecosystem) was identified and quantified with the help of a complex choice model.

Figure 47: Main conclusions from the research project



Source: OWN DEPICTION

(4) A strong impact on nature and landscape is associated with a considerable welfare loss. This result showed up in each of the econometric models for hydropower, renewable energy and the regional case studies. Referring to a specific hydropower project, the major loss of landscape and nature can even lead to a negative economic welfare. Hence, respondents value the expansion of hydropower in Austria, but wish to be compensated for the loss of nature and landscape. Additionally, a strong environmental impact is perceived even more negatively by people living close to a river.

(5) Another important result of the econometric analysis is that people have in general a positive attitude towards hydropower use in Austria. If somebody lives near hydropower stations, i.e. has experience with the technology, this increases the acceptance of hydropower expansion.

(6) Finally, a statistically significant distance decay effect was found, meaning that people are in general for an expansion of hydropower capacities, but not close to their homes. This result provides a confirmation of the “Not in my backyard” theory.

(7) The framing of hydropower demand in the context of demand for other renewable energy sources yields further important results. Generally, no framing effects could be identified, except for the impact on nature and landscape. Accordingly, the negative impact on nature and landscape is considered significantly less of a concern in the sample also referring to alternative renewable energy sources. This suggests that framing the expansion of hydropower in Austria reduces the perceived energy-water trade-off. This result may reflect mixed emotions regarding the different impacts of the different sources on nature and landscape.

(8) Generally, the HYDROVAL project delivers information on non-use values, which are not traded on commercial markets, like for instance environmental impacts or the creation of possibilities for recreation. The literature overview showed that just a few studies provide data for non-use values in the context of renewable energy. The monetary valuation of the benefits and disutilities associated with hydropower use in Austria therefore improves the state of knowledge. It is an important contribution to broaden the strategic basis of decision making for the Austrian plan to expand hydropower capacity. Given the fact that just a few scientific papers are available using stated preference methods to assess non-market values for hydropower use, the HYDROVAL project makes a significant contribution to the scientific discussion in this field of research.

(9) Conclusively, data gained within the scope of this research project can be used to carry out cost benefit analyses for hydropower projects in Austrian taking into account use values as well as non-use values. This may be a task for future research activities.

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Appendix A

Questionnaire – Renewable energy

FRAGEBOGEN – Erneuerbare Energien

Einleitungstext

Wir führen eine Umfrage zum Thema „Erneuerbare Energien in Österreich“ durch. Wir würden Sie daher bitten, sich ca. 20 Minuten Zeit zu nehmen, um die folgenden Fragen zu diesem Thema zu beantworten. Alle Ihre Angaben sind anonym und werden streng vertraulich behandelt!

ALLGEMEINE FRAGEN ZU ERNEUERBAREN ENERGIEN

1. Von welchem Anbieter beziehen Sie aktuell Ihren Strom?

☐ BEWAG Burgenland
☐ KELAG Kärnten
☐ Energie Klagenfurt
☐ EVN AG Niederösterreich
☐ Energie AG Oberösterreich
☐ Linz AG
☐ Salzburg AG
☐ Energie Steiermark
☐ Energie Graz
☐ Tiroler Wasserkraft
☐ Innsbrucker Kommunalbetriebe
☐ Vorarlberger Kraftwerke AG
☐ Wien Energie
☐ Verbund
☐ AAE Naturenergie
☐ EVN Naturkraft
☐ Ökostrom AG
☐ WEB Windenergie
☐ Sonstiges: ....

2. Ist es Ihnen wichtig, dass Ihr Strom aus erneuerbaren Energiequellen wie zum Beispiel Wasserkraft, Windkraft oder Sonnenstrom (Photovoltaik) stammt?

☐ Ja ⇨ Weiter mit Frage 3!
☐ Nein ⇨ Weiter mit Frage 5!

3. Beziehen Sie Ihren Strom <u>bewusst</u> von einem Anbieter, der nur Strom aus erneuerbaren Energiequellen liefert?

☐ Ja ⇨ Weiter mit Frage 4!
☐ Nein ⇨ Weiter mit Frage 5!

4. Nehmen Sie dafür einen höheren Strompreis in Kauf?

☐ Ja
☐ Nein
☐ Weiß nicht

5. Aus welchen Energiequellen sollte Ihrer Meinung nach der in Zukunft in Österreich benötigte Strom vermehrt erzeugt werden? *(Mehrfachnennungen möglich)*

☐ Erdgas
☐ Biomasse
☐ Erdöl
☐ Sonnenstrom (Photovoltaik)
☐ Kohle
☐ Wasserkraft
☐ Windkraft
☐ Atomenergie
☐ Sonstiges: ....

6. Für wie wichtig halten Sie im Allgemeinen das Ziel, die Energiegewinnung aus erneuerbaren Energiequellen wie Wasserkraft, Windkraft oder Sonnenstrom (Photovoltaik) in Zukunft zu erhöhen?

1 – Sehr wichtig	2 – Eher wichtig	3 – Eher unwichtig	4 – Vollkommen unwichtig
☐	☐	☐	☐

7. Welche zwei erneuerbaren Energiequellen sollten Ihrer Meinung nach in Österreich am stärksten ausgebaut werden? *(Bitte ordnen Sie jene zwei Energiequellen von 1 bis 2.)*

.... Biomasse
.... Sonnenstrom (Photovoltaik)
.... Wasserkraft
.... Windkraft
.... Sonstiges: ....

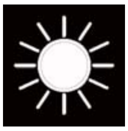
8. Bitte beurteilen Sie folgende Aussagen.

	1 –Stimme voll zu	2 –Stimme eher zu	3 –Stimme eher nicht zu	4 –Stimme gar nicht zu
Die verstärkte Nutzung erneuerbarer Energiequellen ist wichtig für die Deckung der steigenden Stromnachfrage in Österreich.	☐	☐	☐	☐
Die verstärkte Nutzung erneuerbarer Energiequellen ist wichtig für die Reduktion von klimaschädlichen CO_2-Emissionen.	☐	☐	☐	☐
Die verstärkte Nutzung erneuerbarer Energiequellen ist wichtig, um die Notwendigkeit von Stromimporten zu reduzieren.	☐	☐	☐	☐

ENTSCHEIDUNGSFRAGEN

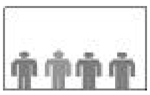
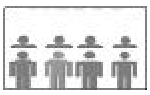
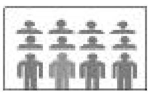
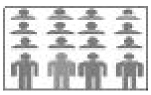
Die folgenden Erläuterungen dienen zur Erklärung von Begriffen, die für die Beantwortung der Entscheidungsfragen benötigt werden.

Derzeit werden in Österreich rund 65 % des Stroms aus erneuerbaren Energiequellen (Ökostrom) erzeugt. Um die Stromerzeugung aus erneuerbaren Energiequellen weiter auszubauen, gibt es die folgenden vier Ausbaustrategien:

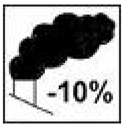
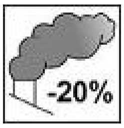
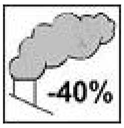
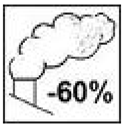
Ausbau BIOMASSE	Ausbau SONNENSTROM	Ausbau WASSERKRAFT	Ausbau WINDKRAFT
			

Für jede dieser Ausbaustrategien gibt es verschiedene Gestaltungsmöglichkeiten, die sich nach folgenden Eigenschaften unterscheiden:

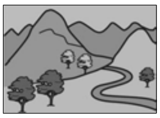
Zusätzliche Arbeitsplätze:

Durch den Ausbau erneuerbarer Energiequellen können in Ihrer Region zusätzliche Arbeitsplätze geschaffen werden, und zwar im Ausmaß von...			
10 Arbeitsplätzen 	50 Arbeitsplätzen 	100 Arbeitsplätzen 	500 Arbeitsplätzen 

Reduktion der CO_2-Emissionen:

Durch den Ausbau erneuerbarer Energiequellen können die CO_2-Emissionen im Elektrizitätssektor gesenkt werden, und zwar um...			
			

Eingriff in Natur und Landschaftsbild: Der Ausbau erneuerbarer Energiequellen stellt einen Eingriff in die Natur und das Landschaftsbild dar, jedoch kann dieser Eingriff unterschiedlich stark ausfallen.

	Wasserkraft	**Windkraft/Sonnenstrom/Biomasse**
Gering 	Die Kraftwerke werden so gebaut, dass sie sich gut in das Landschaftsbild einfügen. Die Lebensräume der Tiere und Pflanzen werden nur leicht beeinträchtigt.	Errichtung einzelner kleiner Anlagen mit geringem Einfluss auf das Landschaftsbild. Die Lebensräume der Tiere und Pflanzen werden nur leicht beeinträchtigt.
Stark 	Die Kraftwerke beeinflussen das Landschaftsbild stark. Die Lebensräume der Tiere und Pflanzen werden stark beeinträchtigt.	Errichtung großer Anlagen mit starkem Einfluss auf das Landschaftsbild. Die Lebensräume der Tiere und Pflanzen werden stark beeinträchtigt.

Entfernung zum Wohnsitz:

Der Ausbau erneuerbarer Energiequellen erfordert den Bau neuer Stromerzeugungsanlagen (z.B. Wasserkraftwerke, Windparks). Dabei kann auch in Ihrer Umgebung eine neue Anlage errichtet werden, und zwar in einer Entfernung von...			
2 km	4 km	8 km	20 km

Zusätzliche Stromkosten pro Monat:

Der Ausbau erneuerbarer Energiequellen ist mit Kosten verbunden, die teilweise von den Stromkunden getragen werden sollen. Monatlich erhöht sich Ihre Stromrechnung daher um...					
€ 3	€ 6	€ 9	€ 12	€ 15	€ 18

Wir würden nun gerne wissen, welche Ausbaustrategien zur Erhöhung des Anteils erneuerbarer Energiequellen Ihnen am meisten zusagen. Zu diesem Zweck stellen wir Ihnen nun 6 Entscheidungsfragen. Bitte betrachten Sie jede Entscheidungsfrage separat und wählen Sie jeweils die Möglichkeit aus, die Sie bevorzugen.

9. Entscheidung 1

10. Entscheidung 2

11. Entscheidung 3

12. Entscheidung 4

13. Entscheidung 5

14. Entscheidung 6

FOLGEFRAGEN

15. Wie schwierig empfanden Sie es, sich bei den vorangegangenen Entscheidungsfragen für eine der Ausbaustrategien zu entscheiden?

1 – Sehr schwierig	2 – Eher schwierig	3 – Eher leicht	4 – Sehr leicht
☐	☐	☐	☐

16. Wie wichtig waren die folgenden Eigenschaften für die Wahl einer Ausbaustrategie bei den vorangegangenen Entscheidungsfragen?

	1 – Sehr wichtig	2 – Eher wichtig	3 – Eher unwichtig	4 –Vollkommen unwichtig
Art der erneuerbaren Energiequelle	☐	☐	☐	☐
Zusätzliche Arbeitsplätze	☐	☐	☐	☐
Reduktion der CO_2-Emissionen	☐	☐	☐	☐
Eingriff in Natur und Landschaftsbild	☐	☐	☐	☐
Entfernung zum Wohnsitz	☐	☐	☐	☐
Zusätzliche monatliche Zahlung	☐	☐	☐	☐

Die folgende Frage ist nur zu beantworten, wenn in allen Entscheidungen keine der beiden Ausbaustrategien gewählt wurde.

17. Warum haben Sie bei jeder Ihrer Entscheidungen keine der beiden Ausbaustrategien gewählt? *(Mehrfachnennungen möglich)*

- ☐ Ich bin strikt gegen den Ausbau erneuerbarer Energiequellen.
- ☐ Ich interessiere mich nicht für die Sache.
- ☐ Der derzeitige Zustand ist bereits zufriedenstellend (kein Ausbau nötig).
- ☐ Ich kann mir keine zusätzlichen Zahlungen leisten.
- ☐ Die zusätzlichen Zahlungen sind zu hoch.
- ☐ Ich halte andere Sachen für wichtiger.
- ☐ Sonstige Gründe: ....

PERSONENBEZOGENE FRAGESTELLUNGEN

18. Wie viele Personen leben in Ihrem Haushalt (einschließlich Ihnen selbst)?

.... Personen

19. Wie viele Kinder leben in Ihrem Haushalt?

.... Kinder

20. Wie lässt sich Ihre derzeitige berufliche Situation beschreiben?

- ☐ Selbstständig beschäftigt
- ☐ Vollzeitbeschäftigt (mindestens 38 Stunden/Woche)
- ☐ Teilzeitbeschäftigt (weniger als 38 Stunden/Woche)
- ☐ Geringfügig beschäftigt
- ☐ In Ausbildung (Student/in, Schüler/in)
- ☐ Arbeitslos und Bezieher/in von Arbeitslosengeld
- ☐ Hausfrau/-mann
- ☐ Pensionist/in
- ☐ Sonstiges: ....

21. Was ist Ihre höchste abgeschlossene (formale) Schulbildung? *(Wenn Sie weiterhin in Ausbildung sind, dann geben Sie bitte den höchsten Schulabschluss vor Beginn dieser Ausbildung an.)*

☐ Höchstens Pflichtschule
☐ Lehre/Fachschule
☐ Matura
☐ Pädagogische Hochschule
☐ Universität/Fachhochschule
☐ Sonstiges: ....

22. Wie hoch ist Ihr monatliches <u>Netto-Haushaltseinkommen</u> (nach Steuern und Abgaben)?

☐ bis € 1.000
☐ € 1.001 bis € 1.500
☐ € 1.501 bis € 2.000
☐ € 2.001 bis € 2.500
☐ € 2.501 bis € 3.000
☐ € 3.001 bis € 3.500
☐ € 3.501 bis € 4.000
☐ € 4.001 bis € 4.500
☐ € 4.501 bis € 5.000
☐ mehr als € 5.000

23. Wie hoch ist derzeit Ihre <u>monatliche</u> Stromrechnung?

☐ bis € 20
☐ € 21 bis € 30
☐ € 31 bis € 40
☐ € 41 bis € 50
☐ € 51 bis € 60
☐ € 61 bis € 70
☐ € 71 bis € 80
☐ € 81 bis € 90
☐ € 91 bis € 100
☐ mehr als € 100, nämlich: ....

24. Wie genau wissen Sie über die Höhe Ihrer monatlichen Stromrechnung Bescheid?

☐ Ich weiß ganz genau wie hoch meine monatliche Stromrechnung ist.
☐ Ich kann die Höhe meiner monatlichen Stromrechnung nur grob abschätzen.

25. Wer zahlt in Ihrem Haushalt die Stromrechnung?

☐ Ich selbst
☐ Eine andere im Haushalt lebende Person
☐ Die Kosten werden aufgeteilt

26. Welchen Aufschlag zu Ihrer monatlichen Stromrechnung würden Sie maximal für den weiteren Ausbau erneuerbarer Energiequellen bezahlen, damit Ihr Haushalt Ökostrom bekommt?

..........................Euro pro Haushalt und Monat

27. Spenden Sie oder irgendjemand anderer in Ihrem Haushalt für Umweltorganisationen?

☐ Ja
☐ Nein

28. Bitte geben Sie die Postleitzahl Ihres Wohnortes an.

PLZ: ....

SCREENING FRAGEN MARKETAGENT

29. Bitte nennen Sie uns Ihr Geschlecht.

☐ Männlich
☐ Weiblich

30. Wie alt sind Sie?

.... Jahre

31. Bitte geben Sie das Bundesland an, in dem Sie Ihren Hauptwohnsitz haben.

☐ Burgenland
☐ Kärnten
☐ Niederösterreich
☐ Oberösterreich
☐ Salzburg
☐ Steiermark
☐ Tirol
☐ Vorarlberg
☐ Wien

Vielen Dank für Ihre Mitarbeit!

Appendix B

Questionnaire – Hydropower

FRAGEBOGEN – Wasserkraft

Einleitungstext

Wir führen eine Umfrage zum Thema „Wasserkraft in Österreich" durch. Wir würden Sie daher bitten, sich ca. 20 Minuten Zeit zu nehmen, um die folgenden Fragen zu diesem Thema zu beantworten. Alle Ihre Angaben sind anonym und werden streng vertraulich behandelt!

ALLGEMEINE FRAGEN ZUR WASSERKRAFT

1. Von welchem Anbieter beziehen Sie aktuell Ihren Strom?

- ☐ BEWAG Burgenland
- ☐ KELAG Kärnten
- ☐ Energie Klagenfurt
- ☐ EVN AG Niederösterreich
- ☐ Energie AG Oberösterreich
- ☐ Linz AG
- ☐ Salzburg AG
- ☐ Energie Steiermark
- ☐ Energie Graz
- ☐ Tiroler Wasserkraft
- ☐ Innsbrucker Kommunalbetriebe
- ☐ Vorarlberger Kraftwerke AG
- ☐ Wien Energie
- ☐ Verbund
- ☐ AAE Naturenergie
- ☐ EVN Naturkraft
- ☐ Ökostrom AG
- ☐ WEB Windenergie
- ☐ Sonstiges: ....

2. Ist es Ihnen wichtig, dass Ihr Strom aus erneuerbaren Energiequellen wie zum Beispiel Wasserkraft, Windkraft oder Sonnenstrom (Photovoltaik) stammt?

- ☐ Ja ⇨ Weiter mit Frage 3!
- ☐ Nein ⇨ Weiter mit Frage 5!

3. **Beziehen Sie Ihren Strom <u>bewusst</u> von einem Anbieter, der nur Strom aus erneuerbaren Energiequellen liefert?**

☐ Ja ⇨ Weiter mit Frage 4!
☐ Nein ⇨ Weiter mit Frage 5!

4. **Nehmen Sie dafür einen höheren Strompreis in Kauf?**

☐ Ja
☐ Nein
☐ Weiß nicht

5. **Aus welchen Energiequellen sollte Ihrer Meinung nach der in Zukunft in Österreich benötigte Strom vermehrt erzeugt werden?** *(Mehrfachnennungen möglich)*

☐ Erdgas
☐ Biomasse
☐ Erdöl
☐ Sonnenstrom (Photovoltaik)
☐ Kohle
☐ Wasserkraft
☐ Windkraft
☐ Atomenergie
☐ Sonstiges: ....

6. **Für wie wichtig halten Sie im Allgemeinen das Ziel, die Energiegewinnung aus erneuerbaren Energiequellen wie Wasserkraft, Windkraft oder Sonnenstrom (Photovoltaik) in Zukunft zu erhöhen?**

1 – Sehr wichtig	2 – Eher wichtig	3 – Eher unwichtig	4 – Vollkommen unwichtig
☐	☐	☐	☐

7. **Welche zwei erneuerbaren Energiequellen sollten Ihrer Meinung nach in Österreich am stärksten ausgebaut werden?** *(Bitte ordnen Sie jene zwei Energiequellen von 1 bis 2.)*

.... Biomasse
.... Sonnenstrom (Photovoltaik)
.... Wasserkraft
.... Windkraft
.... Sonstiges: ....

8. Wie gut fühlen Sie sich im Allgemeinen über das Thema „Wasserkraft in Österreich“ informiert?

1 – Sehr gut	2 – Eher gut	3 – Eher schlecht	4 – Sehr schlecht
☐	☐	☐	☐

9. Wie ist Ihre generelle Einstellung zur Wasserkraftnutzung in Österreich?

1 – Sehr positiv	2 – Eher positiv	3 – Eher negativ	4 – Sehr negativ
☐	☐	☐	☐

10. Haben Sie von dem Plan gehört, die Wasserkraft in Österreich auszubauen, das heißt neue Wasserkraftwerke zu errichten?

☐ Ja
☐ Nein

11. Wie ist Ihre generelle Einstellung zum Bau weiterer Wasserkraftwerke?

1 – Sehr positiv	2 – Eher positiv	3 – Eher negativ	4 – Sehr negativ
☐	☐	☐	☐

12. Wohnen Sie in maximal 10 km Entfernung zu einem Fließgewässer?

☐ Ja ⇨ Weiter mit Frage 13!
☐ Nein ⇨ Weiter mit Frage 14!

13. Bitte geben Sie an, wie oft Sie den folgenden Freizeitaktivitäten an dem zu Ihrem Wohnsitz nächstgelegenen Fließgewässer nachgehen.

	Häufig	Manchmal	Nie
Fischen/Angeln	☐	☐	☐
Schwimmen/Baden	☐	☐	☐
Boot fahren	☐	☐	☐
Spazieren/Wandern entlang des Ufers	☐	☐	☐
Sportliche Aktivitäten (laufen, Rad fahren etc.)	☐	☐	☐
Erholen/die Landschaft genießen	☐	☐	☐
Tierbeobachtung	☐	☐	☐
Picknick am Wasser	☐	☐	☐
Restaurant- oder Cafébesuch	☐	☐	☐
Ausflug mit der Familie	☐	☐	☐

14. Wie viele Wasserkraftwerke gibt es Ihrer Einschätzung nach in Ihrer Umgebung?

☐ Keine
☐ Einige
☐ Viele
☐ Weiß nicht

15. Wie weit (Luftlinie) ist das nächste Wasserkraftwerk von Ihrem Wohnsitz entfernt?

Entfernung: ca. .... km

16. Fühlen Sie sich von diesem Wasserkraftwerk positiv, negativ oder gar nicht betroffen?

☐ Positiv betroffen	⇨ Weiter mit Frage 17!
☐ Negativ betroffen	⇨ Weiter mit Frage 18!
☐ Gar nicht betroffen	⇨ Weiter mit Frage 19!

17. Warum fühlen Sie sich von dem Wasserkraftwerk positiv betroffen?
(Bitte nur eine Möglichkeit ankreuzen!)

☐ Weil ich durch das Wasserkraftwerk Strom aus einer sauberen Energiequelle beziehen kann.
☐ Weil sich die Landschaft durch das Wasserkraftwerk zum Positiven verändert hat.
☐ Weil das Wasserkraftwerk bzw. der Stauraum diverse Freizeitaktivitäten ermöglicht.
☐ Weil ich grundsätzlich für die Nutzung der Wasserkraft bin.
☐ Sonstiges: ....

18. Warum fühlen Sie sich von dem Wasserkraftwerk negativ betroffen?
(Bitte nur eine Möglichkeit ankreuzen!)

☐ Weil ich mich durch das Wasserkraftwerk bei der Ausübung meiner Freizeitaktivitäten gestört fühle.
☐ Weil das Wasserkraftwerk das Landschaftsbild verunstaltet.
☐ Weil das Wasserkraftwerk negative Auswirkungen auf die Natur (Tier- und Pflanzenwelt) hat.
☐ Weil ich grundsätzlich gegen die Nutzung der Wasserkraft bin.
☐ Sonstiges: ....

19. Wird in der Nähe Ihres Wohnsitzes (in einem Umkreis von ca. 10 km) ein neues Wasserkraftwerk gebaut oder ist ein neues Wasserkraftwerk in Planung?

☐ Ja
☐ Nein
☐ Weiß nicht

20. Welche Auswirkung hat Ihrer Meinung nach der Bau eines Wasserkraftwerks auf die möglichen Freizeitaktivitäten (z.B. Schimmen/baden, Boot fahren)?

☐ Die Möglichkeiten für Freizeitaktivitäten werden durch den Bau eines Wasserkraftwerks verbessert.
☐ Die Möglichkeiten für Freizeitaktivitäten werden durch den Bau eines Wasserkraftwerks verschlechtert.
☐ Weiß nicht.

21. Bitte beurteilen Sie folgende Aussagen.

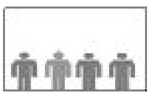
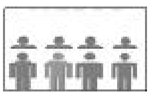
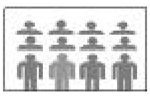
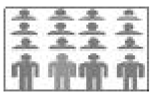
	1 –Stimme voll zu	2 –Stimme eher zu	3 –Stimme eher nicht zu	4 –Stimme gar nicht zu
Die verstärkte Wasserkraftnutzung ist wichtig für die Deckung der steigenden Stromnachfrage in Österreich.	☐	☐	☐	☐
Die verstärkte Wasserkraftnutzung ist wichtig für die Reduktion von klimaschädlichen CO_2-Emissionen.	☐	☐	☐	☐
Die verstärkte Wasserkraftnutzung ist wichtig, um die Notwendigkeit von Stromimporten zu reduzieren.	☐	☐	☐	☐
Ein Wasserkraftwerk verunstaltet die Landschaft.	☐	☐	☐	☐
Ein Wasserkraftwerk gefährdet die Lebensräume von Tieren und Pflanzen.	☐	☐	☐	☐

ENTSCHEIDUNGSFRAGEN

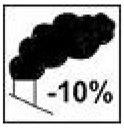
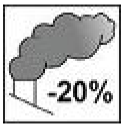
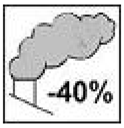
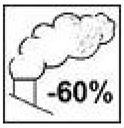
Die folgenden Erläuterungen dienen zur Erklärung von Begriffen, die für die Beantwortung der Entscheidungsfragen benötigt werden.

Die verstärkte Nutzung erneuerbarer Energiequellen ist ein wichtiges energiepolitisches Ziel. Derzeit stammen rund 60 % des heimischen Stroms aus Wasserkraft. Trotzdem besteht noch weiteres Ausbaupotenzial. Für den Fall des Baus neuer Wasserkraftwerke, stellen Sie sich bitte vor, dass es für diesen Wasserkraftausbau verschiedene Gestaltungsmöglichkeiten gibt, die sich nach folgenden Eigenschaften unterscheiden:

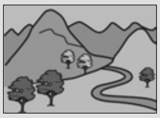
Zusätzliche Arbeitsplätze:

Durch den Ausbau der Wasserkraft können in Ihrer Region zusätzliche Arbeitsplätze geschaffen werden, und zwar im Ausmaß von...			
10 Arbeitsplätzen 	50 Arbeitsplätzen 	100 Arbeitsplätzen 	500 Arbeitsplätzen 

Reduktion der CO_2-Emissionen:

Durch den Ausbau der Wasserkraft können die CO_2-Emissionen im Elektrizitätssektor gesenkt werden, und zwar um...			
			

Eingriff in Natur und Landschaftsbild: Der Bau neuer Wasserkraftwerke stellt einen Eingriff in die Natur und das Landschaftsbild dar, jedoch kann dieser Eingriff unterschiedlich stark ausfallen.

Gering 	**Stark** 
Die Kraftwerke werden so gebaut, dass sie sich gut in das Landschaftsbild einfügen. Die Lebensräume der Tiere und Pflanzen werden nur leicht beeinträchtigt.	Die Kraftwerke beeinflussen das Landschaftsbild stark. Die Lebensräume der Tiere und Pflanzen werden stark beeinträchtigt.

Entfernung zum Wohnsitz:

Ein Ausbau der Wasserkraft erfordert den Bau neuer Wasserkraftwerke. Dabei kann auch in Ihrer Umgebung ein neues Kraftwerk errichtet werden, und zwar in einer Entfernung von...			
2 km	4 km	8 km	20 km

Zusätzliche Stromkosten pro Monat:

Der Bau neuer Wasserkraftwerke ist mit Kosten verbunden, die teilweise von den Stromkunden getragen werden sollen. Monatlich erhöht sich Ihre Stromrechnung daher um...					
€ 3	€ 6	€ 9	€ 12	€ 15	€ 18

Wir würden nun gerne wissen, welche Wasserkraft-Ausbaustrategien Ihnen am meisten zusagen. Zu diesem Zweck stellen wir Ihnen nun 6 Entscheidungsfragen. Bitte betrachten Sie jede Entscheidungsfrage separat und wählen Sie jeweils die Möglichkeit aus, die Sie bevorzugen.

22. Entscheidung 1

23. Entscheidung 2

24. Entscheidung 3

25. Entscheidung 4

26. Entscheidung 5

27. Entscheidung 6

FOLGEFRAGEN

28. Wie schwierig empfanden Sie es, sich bei den vorangegangenen Entscheidungsfragen für eine der Ausbaustrategien zu entscheiden?

1 – Sehr schwierig	2 – Eher schwierig	3 – Eher leicht	4 – Sehr leicht
☐	☐	☐	☐

29. Wie wichtig waren die folgenden Eigenschaften für die Wahl einer Ausbaustrategie bei den vorangegangenen Entscheidungsfragen?

	1 – Sehr wichtig	2 – Eher wichtig	3 – Eher unwichtig	4 – Vollkommen unwichtig
Zusätzliche Arbeitsplätze	☐	☐	☐	☐
Reduktion der CO_2-Emissionen	☐	☐	☐	☐
Eingriff in Natur und Landschaftsbild	☐	☐	☐	☐
Entfernung zum Wohnsitz	☐	☐	☐	☐
Zusätzliche monatliche Zahlung	☐	☐	☐	☐

Die folgende Frage ist nur zu beantworten, wenn in allen Entscheidungen keine der beiden Ausbaustrategien gewählt wurde.

30. Warum haben Sie bei jeder Ihrer Entscheidungen keine der beiden Ausbaustrategien gewählt? *(Mehrfachnennungen möglich)*

☐ Ich bin strikt gegen den Ausbau der Wasserkraft.
☐ Ich interessiere mich nicht für die Sache.
☐ Der derzeitige Zustand ist bereits zufriedenstellend (keine neuen Kraftwerke nötig).
☐ Ich kann mir keine zusätzlichen Zahlungen leisten.
☐ Die zusätzlichen Zahlungen sind zu hoch.
☐ Ich halte andere Sachen für wichtiger.
☐ Sonstige Gründe: ....

PERSONENBEZOGENE FRAGESTELLUNGEN

31. Wie viele Personen leben in Ihrem Haushalt (einschließlich Ihnen selbst)?

.... Personen

32. Wie viele Kinder leben in Ihrem Haushalt?

.... Kinder

33. Wie lässt sich Ihre derzeitige berufliche Situation beschreiben?

☐ Selbstständig beschäftigt
☐ Vollzeitbeschäftigt (mindestens 38 Stunden/Woche)
☐ Teilzeitbeschäftigt (weniger als 38 Stunden/Woche)
☐ Geringfügig beschäftigt
☐ In Ausbildung (Student/in, Schüler/in)
☐ Arbeitslos und Bezieher/in von Arbeitslosengeld
☐ Hausfrau/-mann
☐ Pensionist/in
☐ Sonstiges: ....

34. Was ist Ihre höchste abgeschlossene (formale) Schulbildung? *(Wenn Sie weiterhin in Ausbildung sind, dann geben Sie bitte den höchsten Schulabschluss vor Beginn dieser Ausbildung an.)*

☐ Höchstens Pflichtschule
☐ Lehre/Fachschule
☐ Matura
☐ Pädagogische Hochschule
☐ Universität/Fachhochschule
☐ Sonstiges: ....

35. Wie hoch ist Ihr monatliches Netto-Haushaltseinkommen (nach Steuern und Abgaben)?

☐ bis € 1.000
☐ € 1.001 bis € 1.500
☐ € 1.501 bis € 2.000
☐ € 2.001 bis € 2.500
☐ € 2.501 bis € 3.000
☐ € 3.001 bis € 3.500
☐ € 3.501 bis € 4.000
☐ € 4.001 bis € 4.500
☐ € 4.501 bis € 5.000
☐ mehr als € 5.000

36. Wie hoch ist derzeit Ihre monatliche Stromrechnung?

☐ bis € 20
☐ € 21 bis € 30
☐ € 31 bis € 40
☐ € 41 bis € 50
☐ € 51 bis € 60
☐ € 61 bis € 70
☐ € 71 bis € 80
☐ € 81 bis € 90
☐ € 91 bis € 100
☐ mehr als € 100, nämlich: ....

37. Wie genau wissen Sie über die Höhe Ihrer monatlichen Stromrechnung Bescheid?

☐ Ich weiß ganz genau wie hoch meine monatliche Stromrechnung ist.
☐ Ich kann die Höhe meiner monatlichen Stromrechnung nur grob abschätzen.

38. Wer zahlt in Ihrem Haushalt die Stromrechnung?

☐ Ich selbst
☐ Eine andere im Haushalt lebende Person
☐ Die Kosten werden aufgeteilt

39. Welchen Aufschlag zu Ihrer monatlichen Stromrechnung würden Sie maximal für den weiteren Ausbau der Wasserkraft bezahlen, damit Ihr Haushalt Ökostrom bekommt?

...........................Euro pro Haushalt und Monat

40. Spenden Sie oder irgendjemand anderer in Ihrem Haushalt für Umweltorganisationen?

☐ Ja
☐ Nein

41. Bitte geben Sie uns zum Schluss noch die Postleitzahl Ihres Wohnortes an.

PLZ: ....

SCREENING FRAGEN MARKETAGENT

42. Bitte nennen Sie uns Ihr Geschlecht.

☐ Männlich
☐ Weiblich

43. Wie alt sind Sie?

.... Jahre

44. Bitte geben Sie das Bundesland an, in dem Sie Ihren Hauptwohnsitz haben.

☐ Burgenland
☐ Kärnten
☐ Niederösterreich
☐ Oberösterreich
☐ Salzburg
☐ Steiermark
☐ Tirol
☐ Vorarlberg
☐ Wien

Vielen Dank für Ihre Mitarbeit!

Appendix C

Questionnaire – Regional case studies

FRAGEBOGEN – WASSERKRAFT
Regionale Fallstudie Graz-Puntigam

Einleitungstext

Wir führen eine Umfrage zum Thema „Wasserkraft an der Mur“ durch. Wir würden Sie daher bitten, sich ca. 20 Minuten Zeit zu nehmen, um die folgenden Fragen zu diesem Thema zu beantworten. Alle Ihre Angaben sind anonym und werden streng vertraulich behandelt!

ALLGEMEINE FRAGEN ZUR WASSERKRAFT

1. Von welchem Anbieter beziehen Sie aktuell Ihren Strom?

☐ BEWAG Burgenland
☐ KELAG Kärnten
☐ Energie Klagenfurt
☐ EVN AG Niederösterreich
☐ Energie AG Oberösterreich
☐ Linz AG
☐ Salzburg AG
☐ Energie Steiermark
☐ Energie Graz
☐ Tiroler Wasserkraft
☐ Innsbrucker Kommunalbetriebe
☐ Vorarlberger Kraftwerke AG
☐ Wien Energie
☐ Verbund
☐ AAE Naturenergie
☐ EVN Naturkraft
☐ Ökostrom AG
☐ WEB Windenergie
☐ Sonstiges: ....

2. Ist es Ihnen wichtig, dass Ihr Strom aus erneuerbaren Energiequellen wie zum Beispiel Wasserkraft, Windkraft oder Sonnenstrom (Photovoltaik) stammt?

☐ Ja ⇨ Weiter mit Frage 3!
☐ Nein ⇨ Weiter mit Frage 5!

3. Beziehen Sie Ihren Strom bewusst von einem Anbieter, der nur Strom aus erneuerbaren Energiequellen liefert?

☐ Ja ⇨ Weiter mit Frage 4!
☐ Nein ⇨ Weiter mit Frage 5!

4. Nehmen Sie dafür einen höheren Strompreis in Kauf?

☐ Ja
☐ Nein
☐ Weiß nicht

5. Aus welchen Energiequellen sollte Ihrer Meinung nach der in Zukunft in Österreich benötigte Strom vermehrt erzeugt werden? *(Mehrfachnennungen möglich)*

☐ Erdgas
☐ Biomasse
☐ Erdöl
☐ Sonnenstrom (Photovoltaik)
☐ Kohle
☐ Wasserkraft
☐ Windkraft
☐ Atomenergie
☐ Sonstiges: ....

6. Für wie wichtig halten Sie im Allgemeinen das Ziel, die Energiegewinnung aus erneuerbaren Energiequellen wie Wasserkraft, Windkraft oder Sonnenstrom (Photovoltaik) in Zukunft zu erhöhen?

1 – Sehr wichtig	2 – Eher wichtig	3 – Eher unwichtig	4 – Vollkommen unwichtig
☐	☐	☐	☐

7. Welche zwei erneuerbaren Energiequellen sollten Ihrer Meinung nach in Österreich am stärksten ausgebaut werden? *(Bitte ordnen Sie jene zwei Energiequellen von 1 bis 2.)*

.... Biomasse
.... Sonnenstrom (Photovoltaik)
.... Wasserkraft
.... Windkraft
.... Sonstiges: ....

8. Wie gut fühlen Sie sich im Allgemeinen über das Thema „Wasserkraft in Österreich“ informiert?

1 – Sehr gut	2 – Eher gut	3 – Eher schlecht	4 – Sehr schlecht
☐	☐	☐	☐

9. Wie ist Ihre generelle Einstellung zur Wasserkraftnutzung in Österreich?

1 – Sehr positiv	2 – Eher positiv	3 – Eher negativ	4 – Sehr negativ
☐	☐	☐	☐

10. Bitte beurteilen Sie folgende Aussagen.

	1 –Stimme voll zu	2 –Stimme eher zu	3 –Stimme eher nicht zu	4 –Stimme gar nicht zu
Die verstärkte Wasserkraftnutzung ist wichtig für die Deckung der steigenden Stromnachfrage in Österreich.	☐	☐	☐	☐
Die verstärkte Nutzung der Wasserkraft ist wichtig für die Reduktion von klimaschädlichen CO_2-Emissionen.	☐	☐	☐	☐
Die verstärkte Wasserkraftnutzung ist wichtig, um die Notwendigkeit von Stromimporten zu reduzieren.	☐	☐	☐	☐
Ein Wasserkraftwerk verunstaltet die Landschaft.	☐	☐	☐	☐
Ein Wasserkraftwerk gefährdet die Lebensräume von Tieren und Pflanzen.	☐	☐	☐	☐

11. Haben Sie von dem Plan gehört, die Wasserkraft an der Mur auszubauen, das heißt neue Wasserkraftwerke an der Mur zu errichten?

☐ Ja
☐ Nein

12. Wie ist Ihre generelle Einstellung zum Bau weiterer Wasserkraftwerke an der Mur?

1 – Sehr positiv	2 – Eher positiv	3 – Eher negativ	4 – Sehr negativ
☐	☐	☐	☐

13. Bitte geben Sie an, wie oft Sie den folgenden Freizeitaktivitäten an der Mur nachgehen.

	Häufig	Manchmal	Nie
Fischen/Angeln	☐	☐	☐
Schwimmen/Baden	☐	☐	☐
Boot fahren	☐	☐	☐
Spazieren/Wandern entlang des Ufers	☐	☐	☐
Sportliche Aktivitäten (laufen, Rad fahren etc.)	☐	☐	☐
Erholen/die Landschaft genießen	☐	☐	☐
Tierbeobachtung	☐	☐	☐
Picknick am Wasser	☐	☐	☐
Restaurant- oder Cafébesuch	☐	☐	☐
Ausflug mit der Familie	☐	☐	☐

14. Ist Ihnen bekannt, dass in Graz-Puntigam ein neues Wasserkraftwerk gebaut werden soll?

☐ Ja ⇨ Weiter mit Frage 15!
☐ Nein ⇨ Weiter mit Frage 19!

15. Wie weit (Luftlinie) wäre dieses geplante Wasserkraftprojekt von Ihrem Wohnsitz entfernt?

Entfernung: ca. .... km

16. Fühlen Sie sich von diesem Kraftwerksprojekt positiv, negativ oder gar nicht betroffen?

☐ Positiv betroffen ⇨ Weiter mit Frage 17!
☐ Negativ betroffen ⇨ Weiter mit Frage 18!
☐ Gar nicht betroffen ⇨ Weiter mit Frage 19!

17. Warum fühlen Sie sich von diesem Kraftwerksprojekt positiv betroffen?
(Bitte nur eine Möglichkeit ankreuzen!)

☐ Weil ich durch das Wasserkraftwerk Strom aus einer sauberen Energiequelle beziehen kann.
☐ Weil die Landschaft durch das Wasserkraftwerk zum Positiven verändert wird.
☐ Weil das Wasserkraftwerk bzw. der Stauraum diverse neue Freizeitaktivitäten ermöglichen wird.
☐ Weil ich grundsätzlich für die Nutzung der Wasserkraft bin.
☐ Sonstiges: ....

18. Warum fühlen Sie sich von diesem Kraftwerksprojekt negativ betroffen?
(Bitte nur eine Möglichkeit ankreuzen!)

☐ Weil ich mich durch das geplante Kraftwerk bei der Ausübung meiner Freizeitaktivitäten gestört fühle.
☐ Weil das Kraftwerk das Landschafts- bzw. Stadtbild verunstalten wird.
☐ Weil das Kraftwerk negative Auswirkungen auf die Natur (Tier- und Pflanzenwelt) haben wird.
☐ Weil ich grundsätzlich gegen die Nutzung der Wasserkraft bin.
☐ Sonstiges: ....

19. Welche Auswirkung hätte Ihrer Meinung nach der Bau dieses Wasserkraftwerks auf die möglichen Freizeitaktivitäten (z.B. Boot fahren, Radfahren, Spazieren gehen, Fischen)?

☐ Die Möglichkeiten für Freizeitaktivitäten werden durch den Bau des Wasserkraftwerks verbessert.
☐ Die Möglichkeiten für Freizeitaktivitäten werden durch den Bau des Wasserkraftwerks verschlechtert.
☐ Weiß nicht.

ENTSCHEIDUNGSFRAGEN

Die folgenden Erläuterungen dienen zur Erklärung von Begriffen, die für die Beantwortung der Entscheidungsfragen benötigt werden.

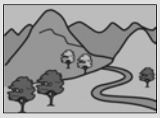
Die verstärkte Nutzung erneuerbarer Energiequellen ist ein wichtiges energiepolitisches Ziel. Derzeit stammen rund 60 % des heimischen Stroms aus Wasserkraft. Trotzdem besteht noch weiteres Ausbaupotenzial und es sollen neue Wasserkraftwerke errichtet werden, darunter auch das besagte Kraftwerk Graz-Puntigam.

Stellen Sie sich vor, dass es für das geplante Wasserkraftprojekt Graz-Puntigam verschiedene Gestaltungsmöglichkeiten gibt, die sich nach folgenden Eigenschaften unterscheiden können.

Stromerzeugung:

Wenn das Kraftwerk Graz-Puntigam gebaut wird, können in Ihrer Region zusätzliche Haushalte mit Strom versorgt werden, und zwar		
5.000 Haushalte	10.000 Haushalte	15.000 Haushalte

Eingriff in Natur und Landschaftsbild: Der Bau des Kraftwerks stellt einen Eingriff in die Natur und das Landschaftsbild dar, jedoch kann dieser Eingriff unterschiedlich stark ausfallen.

Gering 	**Stark** 
Das Kraftwerk wird so gebaut, dass es sich gut in das Landschaftsbild einfügt (z.B. Staumauer zum Großteil unter Wasser). Die Lebensräume der Tiere und Pflanzen werden nur leicht beeinträchtigt.	Das Kraftwerk beeinflusst das Landschaftsbild stark (z.B. zur Gänze sichtbare Staumauer). Die Lebensräume der Tiere und Pflanzen werden stark beeinträchtigt.

Freizeitmöglichkeiten:

Erweiterte Freizeitmöglichkeiten 	**Eingeschränkte Freizeitmöglichkeiten** 
Im Zuge des Kraftwerksbaus wird ein für die Stadtbewohner nutzbarer Naherholungsraum geschaffen, der viele Möglichkeiten für die Freizeitgestaltung bietet (z.B. Radwege, Paddelschule, Mur-Schifffahrt, Café-Besuch an der Mur,...).	Die durch den Kraftwerksbau veränderte Flusslandschaft kann nicht als Naherholungsraum für die Stadtbewohner genutzt werden. Dadurch sind die Möglichkeiten der Freizeitgestaltung (z.B. Radfahren, Spazieren gehen, Boot fahren,...) eingeschränkt.

Zusätzliche Stromkosten pro Monat:

Der Bau des neuen Wasserkraftwerks ist mit Kosten verbunden, die teilweise von den Stromkunden getragen werden sollen. Monatlich erhöht sich Ihre Stromrechnung daher um...					
€ 3	€ 6	€ 9	€ 12	€ 15	€ 18

Wir würden nun gerne wissen, welche Gestaltungsmöglichkeiten des Kraftwerks Ihnen am meisten zusagen. Zu diesem Zweck stellen wir Ihnen nun 6 Entscheidungsfragen. Bitte betrachten Sie jede Entscheidungsfrage separat und wählen Sie jeweils die Möglichkeit aus, die Sie bevorzugen.

20. Entscheidung 1

21. Entscheidung 2

22. Entscheidung 3

23. Entscheidung 4

24. Entscheidung 5

25. Entscheidung 6

NACH DEM CHOICE EXPERIMENT

26. Wie schwierig empfanden Sie es, sich bei den vorangegangenen Entscheidungsfragen für eine der Möglichkeiten zu entscheiden?

1 – Sehr schwierig	2 – Eher schwierig	3 – Eher leicht	4 – Sehr leicht
☐	☐	☐	☐

27. Wie wichtig waren die folgenden Eigenschaften für die Wahl einer Möglichkeit bei den vorangegangenen Entscheidungsfragen?

	1 – Sehr wichtig	2 – Eher wichtig	3 – Eher unwichtig	4 – Vollkom-men unwichtig
Anzahl der Haushalte, für die Strom erzeugt werden kann.	☐	☐	☐	☐
Eingriff in Natur und Landschaftsbild	☐	☐	☐	☐
Freizeitmöglichkeiten	☐	☐	☐	☐
Zusätzliche Stromkosten pro Monat	☐	☐	☐	☐

Die folgende Frage ist nur dann zu beantworten, wenn in allen Entscheidungen keine der beiden Möglichkeiten gewählt wurde.

28. Warum haben Sie bei jeder Ihrer Entscheidungen keine der beiden Möglichkeiten gewählt? *(Mehrfachnennungen möglich)*

☐ Ich bin strikt gegen den Bau des Kraftwerks.
☐ Ich interessiere mich nicht für die Sache.
☐ Der derzeitige Zustand ist bereits zufriedenstellend (kein neues Kraftwerk nötig).
☐ Ich kann mir keine zusätzlichen Zahlungen leisten.
☐ Die zusätzlichen Zahlungen sind zu hoch.
☐ Ich halte andere Sachen für wichtiger.
☐ Sonstige Gründe: ....

PERSONENBEZOGENE FRAGESTELLUNGEN

29. Wie viele Personen leben in Ihrem Haushalt (einschließlich Ihnen selbst)?

.... Personen

30. Wie viele Kinder leben in Ihrem Haushalt?

.... Kinder

31. Wie lässt sich Ihre derzeitige berufliche Situation beschreiben?

- ☐ Selbstständig beschäftigt
- ☐ Vollzeitbeschäftigt (mindestens 38 Stunden/Woche)
- ☐ Teilzeitbeschäftigt (weniger als 38 Stunden/Woche)
- ☐ Geringfügig beschäftigt
- ☐ In Ausbildung (Student/in, Schüler/in)
- ☐ Arbeitslos und Bezieher/in von Arbeitslosengeld
- ☐ Hausfrau/-mann
- ☐ Pensionist/in
- ☐ Sonstiges: ....

32. Was ist Ihre höchste abgeschlossene (formale) Schulbildung? *(Wenn Sie weiterhin in Ausbildung sind, dann geben Sie bitte den höchsten Schulabschluss vor Beginn dieser Ausbildung an.)*

- ☐ Höchstens Pflichtschule
- ☐ Lehre/Fachschule
- ☐ Matura
- ☐ Pädagogische Hochschule
- ☐ Universität/Fachhochschule
- ☐ Sonstiges: ....

33. Wie hoch ist Ihr monatliches Netto-Haushaltseinkommen (nach Steuern und Abgaben)?

☐ bis € 1.000
☐ € 1.001 bis € 1.500
☐ € 1.501 bis € 2.000
☐ € 2.001 bis € 2.500
☐ € 2.501 bis € 3.000
☐ € 3.001 bis € 3.500
☐ € 3.501 bis € 4.000
☐ € 4.001 bis € 4.500
☐ € 4.501 bis € 5.000
☐ mehr als € 5.000

34. Wie hoch ist derzeit Ihre <u>monatliche</u> Stromrechnung?

☐ bis € 20
☐ € 21 bis € 30
☐ € 31 bis € 40
☐ € 41 bis € 50
☐ € 51 bis € 60
☐ € 61 bis € 70
☐ € 71 bis € 80
☐ € 81 bis € 90
☐ € 91 bis € 100
☐ mehr als € 100, nämlich: ....

35. Wie genau wissen Sie über die Höhe Ihrer monatlichen Stromrechnung Bescheid?

☐ Ich weiß ganz genau wie hoch meine monatliche Stromrechnung ist.
☐ Ich kann die Höhe meiner monatlichen Stromrechnung nur grob abschätzen.

36. Wer zahlt in Ihrem Haushalt die Stromrechnung?

☐ Ich selbst
☐ Eine andere im Haushalt lebende Person
☐ Die Kosten werden aufgeteilt

37. Welchen Aufschlag zu Ihrer monatlichen Stromrechnung würden Sie <u>maximal</u> für den weiteren Ausbau der Wasserkraft bezahlen, damit Ihr Haushalt Ökostrom bekommt?

...........................Euro pro Haushalt und Monat

38. Spenden Sie oder irgendjemand anderer in Ihrem Haushalt für Umweltorganisationen?

- ☐ Ja
- ☐ Nein

39. Bitte geben Sie die Postleitzahl Ihres Wohnortes an.

PLZ: ....

SCREENING FRAGEN MARKETAGENT

40. Bitte nennen Sie uns Ihr Geschlecht.

- ☐ Männlich
- ☐ Weiblich

41. Wie alt sind Sie?

.... Jahre

42. Bitte geben Sie das Bundesland an, in dem Sie Ihren Hauptwohnsitz haben.

- ☐ Burgenland
- ☐ Kärnten
- ☐ Niederösterreich
- ☐ Oberösterreich
- ☐ Salzburg
- ☐ Steiermark
- ☐ Tirol
- ☐ Vorarlberg
- ☐ Wien

43. In welcher der folgenden Gemeinden wohnen Sie?

- ☐ Graz
- ☐ Feldkirchen bei Graz
- ☐ Fernitz bei Graz
- ☐ Gössendorf
- ☐ Grambach
- ☐ Hausmannstätten
- ☐ Kalsdorf bei Graz
- ☐ Raaba
- ☐ Seiersberg
- ☐ Deutschfeistritz
- ☐ Eisbach
- ☐ Gratkorn
- ☐ Gratwein
- ☐ Judendorf-Straßengel
- ☐ Peggau
- ☐ Stattegg
- ☐ Weinitzen
- ☐ Hart bei Graz
- ☐ Kainbach bei Graz
- ☐ Thal

Vielen Dank für Ihre Mitarbeit!