CONFLICTING INTEREST IN THE PRODUCTION OF WIND ENERGY: PUBLIC DEMAND FOR SHORES WITHOUT WIND TURBINES

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Abstract

In contrast to countries with longer experience in the field, Estonia has not actively included public opinion into the planning process of new wind farms. Wind farms in Estonia are built mainly on the coast, 90% of which is covered with natural surface. The paper investigates, using the Contingent Valuation Method (CVM), the willingness of Estonian inhabitants to pay for preserving the Estonian coastal zone wind turbines free. Total demand of Estonian adult population for Estonian shores in their natural condition without wind turbines is found to be considerable 23.4 million euro annually. The demand of the population for the preservation of the nature underlines the need for changes in national strategies for the wind power sector.

Keywords: coastal conservation, wind farm planning, contingent valuation, non-market values, visual pollution, demand for environmental goods

JEL Classification: Q2, Q5

Introduction

Wind energy production has been growing rapidly world-wide over the past 30 years. Estonia with its approximately 10 year long experiences in the sector is at an appropriate point of time to assess the outcomes of developments so far and possible new directions in the field for coming years, especially because wind energy is one of the most economical energy production methods in Estonia and furthermore due to large development plans on the narrow coastal area of Estonia. The spatial planning of the large-scale constructions must be well considered to ensure a sustainable development and usage of all natural resources.

Apart from economic benefits from wind power production the negative effects of renewable energy implementation should be assessed. In Estonia most of the development of wind farms takes place in the beautiful, largely undamaged coastal zone. The undamaged nature is not only to be valued for its great wind conditions but also for its aesthetical value. The latter has until now not been considered. Furthermore, the preferences of the public in terms of using the unharmed coastal area have not been studied and therefore there is no record of whether the public agrees with the governmental strategies in the wind energy sector.

The paper addresses the problem of conflicting interests of the Estonian government versus Estonian inhabitants in terms of wind farm construction plans on the Estonian shore. The paper seeks to evaluate the demand of Estonian full age population for

Estonian shores in their natural condition without wind turbines. The authors' hypothesis is that there is high demand for Estonian shores without wind turbines. The governmental strategy for constructing wind farms in the coastal zone without a public discussion is thereby in conflict with the interests of the inhabitants.

A contingent valuation study was conducted via a questionnaire distributed among Estonian adult inhabitants to determine their demand for Estonian shores without wind turbines. The respondents were asked to state their willingness to pay as an annual one-time payment (net, €) for the preservation of the Estonian coast in its natural condition without wind turbines. Based on the gathered data, demand for Estonian coast in its natural condition without wind turbines was computed. Logit regression analysis of the socio-metric indicators of the respondents was used to determine whether these indictors influence the responses of individuals.

In addition to the questionnaire survey results the paper gives a short overview of renewable energy policies in the European Union and Estonia. The externalities of wind energy are being elaborated with the focus on visual pollution of the nature and attitudes of people towards the effect of wind turbines on nature's aesthetic value. To supplement the results of the contingent valuation study an overview of wind energy developments in Estonia is given.

1. Wind Energy Development and Green Energy Policy in the European Union and Estonia

The importance of renewable energy was first introduced to a wide range of public with the Kyoto protocol ratified in 2002, which set the goals for the initial 15 EU member states to lower the amount of their greenhouse gas (GHG) emissions in order to minimize the effects of pollutants on climate change (Kyoto protokoll... 2010).

Additionally, the EU adopted the European Strategy on Climate Change setting a goal to limit global warming to 2° Celsius. The strategy also aims to improve EU's energy efficiency by 20% and to increase the share of renewable energy to 20%, both by 2020 of 1990 levels (Strategy on... 2011). Clear energy targets have been set for all member states to define the share of renewable energy sources in gross final energy consumption by 2020. The goals as well as the share of energy produced from renewable energy from total final energy consumption in the EU member states and Norway are shown in Table 1.

As it is cheaper to use wind energy technologies than other renewable energy sources for so-called green energy production (Saidur et al. 2011), wind energy has been implemented widely worldwide. The first large-scale wind farm with over 16,000 machines with a total capacity of 1.7 GW was put into operation in California in 1990. After 1990, the main market development however shifted to Europe. Today green energy is already able to compete with fossil fuels by price (Kaldellis et al. 2011).

Table 1. Share of renewable energy in gross final energy consumption % (Share of... 2012)

	2006	2007	2008	2009	TARGET
Norway	60.4	60.3	61.9	64.9	:
Sweden	42.4	43.9	44.9	47.3	49
Latvia	31.1	29.6	29.8	34.3	40
Finland	29.2	28.9	30.6	30.3	38
Austria	25.1	27.2	27.9	29.7	34
Portugal	20.8	22.3	23.2	24.5	31
Estonia	16.1	17.1	18.9	22.8	25
Romania	17.2	18.4	20.5	22.4	24
Denmark	16.5	18	18.7	19.9	30
Lithuania	14.6	14.2	15.3	17	23
Slovenia	15.5	15.6	15	16.9	25
Spain	9.4	9.9	11.2	13.3	20
France	9.8	10.5	11.4	12.3	23
Bulgaria	9.3	9.1	9.6	11.6	16
Slovakia	6.6	8.1	8.3	10.3	14
Germany	7.1	9.4	9.3	9.8	18
Italy	5.6	5.5	7	8.9	17
Poland	7	7	7.9	8.9	15.5
Czech Republic	6.4	7.4	7.7	8.5	13
Greece	7.2	8.2	8	8.2	18
Hungary	5.2	6	6.6	7.7	14.6
Ireland	3	3.4	3.8	5	16
Belgium	2.7	3	3.3	4.6	13
Cyprus	2.5	3.1	4.1	4.6	13
Netherlands	2.7	3.2	3.5	4.1	14
United Kingdom	1.5	1.8	2.3	2.9	15
Luxembourg	1.4	2.5	2.6	2.7	11
Malta	0.2	0.2	0.2	0.2	10

The top 10 countries producing wind energy in the world currently are:

1. China with 26.3% of global wind energy production with a total of 62,733 MW installed capacity
2. United States with 19.7% of global wind energy production with a total of 46,919 MW installed capacity
3. Germany with 12.2% of global wind energy production with a total of 29,060 MW installed capacity
4. Spain with 9.1% of global wind energy production with a total of 21,674 MW installed capacity

5. India with 6.7% of global wind energy production with a total of 16,084 MW installed capacity
6. France with 2.9% of global wind energy production with a total of 6,800 MW installed capacity
7. Italy with 2.8% of global wind energy production with a total of 6,747 MW installed capacity
8. United Kingdom with 2.7% of global wind energy production with a total of 6,540 MW installed capacity
9. Canada with 2.2% of global wind energy production with a total of 5,265 MW installed capacity
10. Portugal with 1.7% of global wind energy production with a total of 4,083 MW installed capacity (10 Leading... 2012).

Next to the above mentioned countries Denmark is the country known for its extensive use of wind energy. The wind industry in Denmark has grown approximately 20% yearly over the last 10 years. Denmark has a 30 year experience in wind energy development. Danish producers are exporting wind turbines to foreign markets. In 2009, the world's largest offshore wind park with a total capacity of 209 MW was completed in Denmark (Statistics 2012).

1.1. Policy Instruments for Wind Energy Development

Strong market growth in the wind energy sector is not induced only by wind resources, as several European countries have great possibilities for wind energy generation. To ensure market growth policy instruments have been adopted at government levels of individual countries as well as international directives have been enacted in the European Union. Experiences of leading regions in wind power utilization, such as Germany and Denmark, have shown that several legislative measures as well as involvement of the public in the planning process are needed to generate both demand for and supply of wind energy (Howatson et al. 2006). Furthermore, the EU as well as single countries have approved subsidies for wind power producers to increase the investments into research and development of new technologies.

A successful implementation of wind parks is mainly dependent on the policy instruments of a country for the planning process. Denmark with a long history in wind energy development, due to the lack of other energy resources and based on the 30 year long experience, has managed to frame a clear planning process for wind power development. The Danish system has a hierarchical structure and thereby accomplishes the clear communication and carrying out the national goals. Local, regional and municipal authorities handle the planning of open land and town areas according to the national planning objectives. The framework leaves no room for local authorities to follow with plans which do not follow the government restrictions (Pettersson 2006).

The public in Denmark as an important stakeholder group has also been successfully involved in the planning process in several stages: before drafting and adopting the regional plan, prior to the proposal making and again before the announcement of a municipal plan and once more prior to the announcement of a local plan (Pettersson 2006).

In Estonia where wind energy has been used for only one decade, the planning process leaves much more room to. The general goal of Estonia is to produce energy from as many different sources, by as many providers, at as low prices and as environmentally sound as possible to secure energy independence and competition on the market (Eesti elektrimajanduse… 2012). There are in total 8 laws and regulations determining wind park development procedures in Estonia:

- Planning Act (*Planeerimisseadus*)
- List of objects of significant spatial impact (*Olulise ruumilise mõjuga objektide nimekiri*, ORMO *nimekiri*)
- Aviation Act (*Lennundusseadus*)
- Environmental Impact Assessment and Environmental Management Act (*Keskkonnamõju hindamise ja keskkonnajuhtimissüsteemi seadus*, KeHJS)
- Specified list of operations, for which the initiation of the Environmental Impact Assessment should be considered (*Tegevusvaldkondade, mille korral tuleb kaaluda keskkonnamõju hindamise algatamise vajalikkust, täpsustatud loetelu* (KMH *kaalumisnõudega tegevusvaldkondade loetelu*))
- Water Act (*Veeseadus*, VeeS)
- Electricity Act (*Elektrituruseadus*, EITS)
- Building Act (*Ehitusseadus*, EhS) (Vaab et al. 2010).

A wind park planning in Estonia can take place based on three types of planning documents: county plan, comprehensive plan and detailed plan. A comprehensive plan is a spatial plan of a city or rural area to determine the development of the territory. With the county plan, the land usage of the whole county territory or a part thereof is determined. The detailed plan is prepared to mark the construction works and land use for a part of the territory of a local authority. Most of these documents are compiled by local authorities thereby assigning small governmental entities the full responsibility for spatial planning.

The comprehensive plan needs an approval from the Ministry of Defence and the Ministry of Internal Affairs. Detailed plans for wind parks need to be approved by the Aviation Office, the Ministry of Defence, Police and Border Guard and also by the Ministry of Internal Affairs. Furthermore all wind parks must apply for appropriate construction permits, whereas the construction permits for onshore wind farms are granted by local authorities. For offshore wind farms the permits are granted only by the national Technical Surveillance Authority (Vaab et al. 2010).

The general planning process as a whole however lacks a clear hierarchical structure given by the government. Also the location selection process and involving public opinion into the planning process are not obligatory for all new wind farm projects in Estonia.

A location selection process for a wind park must be initiated for wind farms with more than 5 wind mills or/and for a wind farm with a total capacity over 7.5 MW. The wind farms exceeding the given size are considered to be objects with significant spatial impact, thus the need for the location selection process (Vaab et al. 2010). Public opinion is however only taken into account where an environmental impact assessment is conducted, which is not the case for all development plans.

Environmental impacts must be assessed where the wind farm may inflict Natura 2000 areas or in the case of planning an offshore wind farm. In the latter case the government will initiate the assessment process. In the case of an environmental impact assessment, the project is made public via a local newspaper informing the public of the spatial planning and giving the opportunity to intervene (Vaab et al. 2010). Public debates are however not initiated by the government or planning companies proactively.

The main concerns in the Estonian environmental policy are the lack of strategic planning on government level as well as lack of information communicated to the public. Developers and local authorities are able to draft and carry out the plans without involving the inhabitants into the process. The process for offshore wind farm planning is more advanced, as the public is informed of the planning process; the location selection process in general, however, is mainly influenced by the statements from the developers. Estonia is in need of a strict legislative framework which would be driving the planning process and gives precise guidelines for developers for implementing new technologies in a way acceptable for all stakeholder groups. Public opinion groups should also be included into the planning process proactively by the government or developers.

2. Wind Resource in Estonia

The total potential of wind power in Estonia is 4000MW (Toom et al. 2009, pp. 131-137). By the end of 2011, the total capacity of the wind parks was 184MW. Currently 3 wind parks are under construction, but several more are under planning (Tuuleenergia 2012).

The Estonian wind energy development is illustrated in by Table 2, where the number of wind parks in Estonia is shown across years.

Table 2. Number of wind parks constructed, under planning and under development in Estonia with total capacity of these wind parks (Tuuleenergia 2012)

Construction year	No. of working parks	Total capacity of working wind mills	Comments
2002	2	2.25 MW	
2005	5	31.65 MW	
2007	10	58 MW	
2008	13	77.70 MW	
2009	16	141.70 MW	
2010	17	148.60 MW	
2011	20	183.90 MW	
2012	29	456.98 MW	3 under construction 6 under development
2013	36	729.48 MW	7 under development
2014	57	3823.68 MW	21 under planning 3 thereof offshore

With the fast development of wind technology Estonia is already now close to reaching the renewable energy implementation goals set for 2020. From electricity consumption in 2009 6.2% was produced from renewable energy, which already exceeded the goal of 5.1% set for 2010 (Eesti elektrimajanduse… 2012). With further implementation of new wind parks the main energy policy objectives of Estonia and EU can be reached.

Extensive wind park development in Estonia is possible on the long coastal line. Main areas attractive for the developers are the coastal zones in Pärnumaa, Läänemaa, Saaremaa, Hiiumaa, Ida-Virumaa, Lääne-Virumaa, and some areas in Harjumaa (Vaab et al. 2010).

The coast of Estonia is a suitable place for wind farm development due to its natural conditions. The frequently alternating low-atmospheric cyclones or anti-cyclones over the North-Atlantic and Eurasia as well as the Baltic Sea decide the wind speeds and directions over Estonian coast. Annual average wind velocity over Estonian coastline and West-Estonian islands at the height of 10 m is up to 6-7 m/s. Within 20 km off the coastline of the northern coast the wind velocity however decreases approximately 40%. On the western coast the abatement area is even shorter, only 2 km long (Kull et al. 2005, pp. 159–165). Poor conditions of wind in the inland areas of Estonia make production of wind energy there unfeasible.

2.1. Externalities of Wind Power

Assessment of the externalities of wind power has been placed into the centre of public attention since 1990s, after development of renewable energy resources accelerated. The externalities of wind power include visual disamenities, i.e. effects on aesthetic value of landscape; reductions of wildlife and effects on the power grid. All of these are strongly case specific depending on the location of the park. As studies confirm, people would like to reduce different types of externalities and the above mentioned effects lower the social benefits from wind energy (Ladenburg et al). Hence the externalities of the locations should definitely be investigated.

2.1.1. Effects on Landscape Aesthetics

Landscapes are valued for their natural beauty and historical value. Wind farms alter the appearance of landscapes and are therefore found to be visually intrusive. Several studies have found the visual disamenities of wind parks to be the main reason for opposition to wind energy production from local communities (Barry et al. 2009; Swofford et al. 2010).

A Danish study conducted by Jacob Ladenburg and Alex Dubgaard showed that all respondents in general are willing to pay 46, 96 and 122 Euro/household/year for having future wind farms located offshore further away from the coast: at 12, 18 and 50 km respectively, instead of 8 km. With increasing the distance between living areas and wind farms the visual intrusion is perceived significantly lower (Ladenburg et al.). The visual intrusion of onshore wind farms is perceived to be even stronger than from offshore wind parks (Schleisner 2000).

2.1.2. Effects on Wildlife

Effects of wind parks on wildlife are strongly case specific and can be avoided by choosing the location for wind mills. In each single case the possible areas for wind parks need to be investigated for species living in the area or using the location as migration route.

Wind farms mainly endanger birds who might strike the towers or blades and bats suffering from barotraumas. Some amounts of bird fatalities have been proven in different regions (Sovacool 2009; Meyerhoffa et al. 2009). Barotraumas have been noted to harm high-frequency bats, who fly at night and at the height of the wind mill blades (Palu 2003, pp. 25-30). Public opinion has proven interest in minimizing these by stating a willingness to pay to avoid impacts on wildlife (Ladenburg et al.), especially as these can be avoided by eliminating areas where possible effects on wildlife can be documented from the location choosing process.

2.1.3. Effects on Power Grid

Concerns related to effects from wind farms on power grid include the variability of electricity supply from wind mills, the need for back up capacity in case of low wind speeds and also the endurance of the wind mills in case of power grid failures (Toom et al. 2009, pp. 131-137). The need for back up capacities may be omitted from the discussion at this point, as all power generation methods need back up capacities to support electricity production in case of a failure in a plant.

Concerning the variability of electricity supply generated at wind parks the existing power grid needs to be investigated for its acceptable minimum and maximum capacities. Usually wind farms are located at peripheries where there is sparse population, no industry and therefore no strong power networks either. Grid failures may exist in cases where the energy production from a wind farm exceeds the maximum capacity of the network or if there is no backup generator to keep the grid at its minimum level in case of low wind speeds.

In Estonia currently when the wind park capacity is up to ¼ of the energy system's total capacity no significant effects on the power transmission can be detected (Tomson et al. 2003, pp. 64-71; Palu 2003, pp. 25-30). Until now the maximum output of the wind parks has stayed below 30MW installed capacity and no effects on the power network have been noted. Estonian wind resource however makes it possible to construct wind farms with capacities up to 90-100MW. This would significantly disturb the electricity network (Vaab et al. 2010).

In order to overcome possible problems from power transmission investments into the power network are needed or wind farms with larger capacities cannot be installed.

2.2. Value Conflict

Main wind farm development in Estonia has taken place in a narrow coastal zone. The coastal zone offers great wind conditions for wind energy development, hence vast exploitation. As future wind parks are also intended to be placed on the coast, the constructions impose alterations to the natural environment.

The exploitation of the coastal zone is supported by the government, which has set ambitious goals for development in the sector. Development companies and local authorities can between themselves create the spatial plans for wind farms and follow these through. Public opinion however has not been taken into consideration in the planning process and there is no record of whether the inhabitants agree with these development plans. Informing the public of construction plans is mandatory only if the future wind farm may inflict a Natura 2000 area or if it is located offshore (Vaab, T., Keerberg L., Vaarmari, K. 2010).

Even though several studies have confirmed that people in developed countries generally have a positive attitude towards wind energy (Jerpåsen et al. 2011; Wolsnik 2007), locals still often oppose certain wind farm constructions. Visual intrusion is the main factor causing locals to oppose constructions at naturally beautiful locations (Barry et al. 2009; Swofford et al. 2010; Wolsnik 2007). Would the public however be involved in the planning process suitable locations for the wind farms could be found.

Unfortunately in Estonia the public is usually not involved in the planning process. The demand for unspoiled nature, Estonian shores, is therefore not considered and the opinions of the inhabitants are not taken into consideration in the planning process. Hence the value conflict between the stakeholders.

3. Wind Energy Production and Conflicting Interests in Coastal Zone: A Contingent Valuation Survey

How individuals value nature is revealed in the willingness to pay for preserving or restoring the natural object in question. Willingness to pay as a non-market valuation method quantifies the monetary equivalents of the value of nature (Reimann et al. 2011, pp. 240-245).

A contingent valuation study was performed to determine the willingness to pay of Estonian adult population for preserving the natural coastline. The data used in the analysis was gathered via a willingness to pay survey conducted among Estonian adult inhabitants. In total the responses of 505 persons were investigated and generalized for the whole Estonian adult population. In the survey the respondents also replied a series of attitude questions. Socio-metric indicators such as sex, education, income and age were also stated by the respondents within the questionnaire.

The questionnaire consisted of two photographs illustrating the impact of wind generators on nature's aesthetic value, as well as seven questions. The first photo presented a coastal view from the Virtsu-Kuivastu ferry on the coast of Virtsu without wind turbines. The second photo shows the same location with wind generators.

3.1. Results of the Survey

In a questionnaire respondents were asked questions concerning their attitudes towards wind farms as so-called green energy sources as well as their attitudes towards preserving the natural beauty of Estonian coastline. In addition, the willingness to pay for preserving the natural look of the coast was investigated.

The results of the survey show that 56% of all respondents are disturbed by wind mills in the place of scenic beauty, whereas 44% are not disturbed. A binary logit model created based on the responses to the first question "Are you disturbed by windmills in the places of scenic beauty?" proved only age to be a significant factor in determining the responses of the people surveyed (Table 3). People older than 50 years of age were found to be most likely disturbed by the windmills at places of natural beauty.

Logit and tobit models were created to determine which of the following socio-metric factors influence the attitudes and responses: age, education, income and sex. The questionnaire was answered by a representative sample of the working age population of Estonia, 505 respondents in total.

Table 3. Dependence of answers on respondents' sociometric indicators

		Variable	Constant	Sex	Education	Age	Income
Q1	Logit Yes=1 No=0	Coeff	-0.2406	0.2214	-0.0468	0.1451	-0.0321
		Prob	0.6437	0.2895	0.7087	0.0118	0.5654
Q2	Logit Yes=1 No=0	Coeff	-0.1153	-0.3278	0.1359	-0.1202	-0.0504
		Prob	0.8395	0.1410	0.3193	0.0565	0.3939
Q3	Logit Yes=1 No=0	Coeff	-0.3895	-0.6343	0.0554	-0.0653	0.0860
		Prob	0.5104	0.0062	0.7025	0.3223	0.1702
Q4	OLS Yes=2 Partly=1 No=0	Coeff	1.4823	-0.0594	0.0398	-0.0047	-0.0039
		Prob	0.0000	0.3138	0.2622	0.7704	0.8051

The second question of the survey asked the respondents „What do you think, is it justified to use places of natural beauty for producing so-called green energy if this inflicts damage on the nature and recreational value of the place?". Only 27% of all respondents found wind mills at scenic locations acceptable and a clear majority of 61% found them unacceptable. 12% of the respondents stated that they are not sure if the windmills in the beautiful locations should be accepted. For the second question a tobit model again proved only age to be a significant factor in influencing the responses (Table 3). The answers per age group are presented in Figure 1.

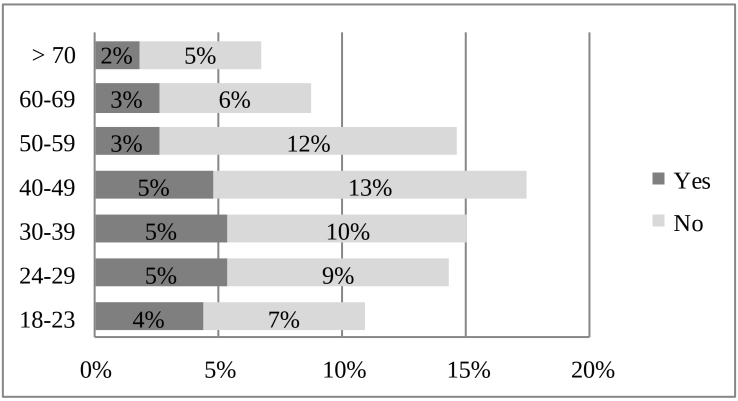

Figure 1. Structure of answers to question 2 "What do you think, is it justified to use places of natural beauty for producing so-called green energy if this inflicts damage on the nature and recreational value of the place?" per age group as percentage of total respondents.

While all age groups stated a clear opposition to constructing wind mills at places of scenic beauty, older age groups showed a stronger opposition. From younger age groups, 18-23, 24-29 and 30-39, approximately 62% stated an opposition. From older age groups, 40-49, 60-69 and over 70, approximately 72% stated an opposition to wind mills at places of natural beauty. The age group that stated the strongest opposition to wind mills at places where these harm the nature was 50-59 with 82% of the respondents answering “No” to the second question.

The third question investigated people’s attitudes towards so-called green energy in general. To the question „What do you think, is it possible to regard energy that has a negative impact on the nature, landscape and recreational value as a green energy?” only 23% respondents answered “yes” stating that energy production that exerts negative impact on the nature, landscape and recreational value can be green. 14% of the respondents gave no clear answer and 63% find energy production with negative effects on the nature is not green.

The logit model of the socio-metric factors in this case interestingly showed that instead of age and gender of the respondents are significant in determining whether energy which has a negative impact on nature can be considered green (Table 3). Men and respondents with higher incomes are more likely to agree that energy with negative externalities on nature can be considered green. People who agreed that negative effects on nature can be part of the so-called green energy production stated that harming the nature to some extent is an acceptable result of human activity and purely focusing on nature preservation would hinder technological innovation.

The fourth question „What do you think, is wind energy green energy?” furthermore investigated people’s perception on green energy and wind parks. The fourth question was answered “Yes” by a small majority of respondents, 53%. A significant share of 39% respondents acknowledges the importance of externalities of wind power stating that wind energy is partly green. From all respondents only 5% find wind energy not to be “green”. No notable differences between the socio-metric groups were found concerning the fourth question (Table 3).

The fifth question „What do you think, should the natural appearance of Estonian coast be preserved?” surveyed attitudes towards preservation of the Estonian coast. A clear majority of 86% answered “Yes”, showing a very high demand for naturally beautiful coast and defining it as an environmental good.

Women and older persons were again found to be most supportive of preserving the coast. 90% of all women responded „Yes“ to the question „What do you think, should the natural appearance of Estonian coast be preserved?“. From men 78% responded „Yes“ to the same question.

The answers to the fifth question per age group are illustrated in Figure 2. Older age groups, 50-59, 60-69 and over 70, stated a stronger demand for a coastline in its natural condition.

Interestingly, among younger age groups the group 24-29 shows a slightly stronger demand for the natural coast than age groups 18-23, 30-30 and 40-49. From the age group 24-29 approximately 87% of the respondents support preservation of the coastline in its natural condition. From age groups 18-23, 30-30 and 40-49 approximately 83% support the preservation of the coast.

Answers to the questions in the survey in general show that wind mills in places of natural beauty are not acceptable for a clear majority. The government should take these results into account when formulating the national environmental strategies and giving guidelines to wind farm developers for the planning process. Assessment of the externalities and public involvement cannot be omitted from the processes.

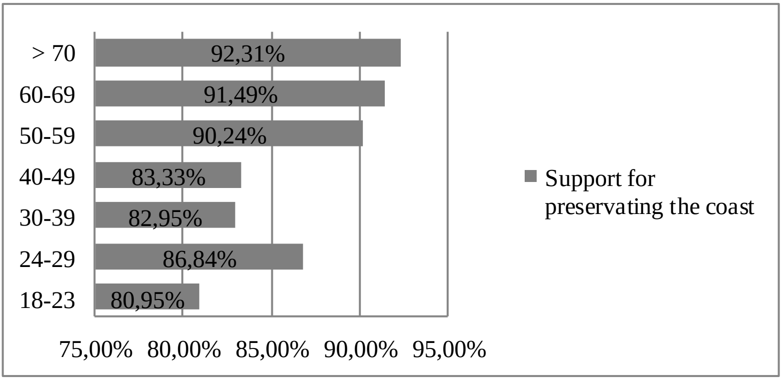

Figure 2. Share of respondents answering “Yes” to question 5 „What do you think, should the natural appearance of Estonian coast be preserved?“ per age group.

3.2. Willingness to Pay for the Coast as Environmental Good in Its Natural Condition

The willingness to pay for preserving the Estonian coast was investigated to compute the demand of Estonian working-age population for the coast as an environmental good in its natural condition without wind turbines. The respondents were asked:„If you want that Estonian coasts stay without wind turbines and keep their natural appearance, then how much are you willing to pay for this annually?“. 60% of the respondents stated a willingness to pay. The average WTP is 27 euro annually. In accordance with the results from previous questions women were found to have higher WTP than men, 31 euro and 22 euro, respectively.

Age interestingly proved to have no significant effect on determining the WTP. The age group 50-59 has the largest WTP with 49 euro annually, whereas the group 70 and older has the smallest WTP with 8 euro annually. Respondents from the age group 70 and older probably also have less possibilities to support the preservation of the coast as their main income is the governmental pension. Surprisingly the age groups 30-39 and 40-49 have a fairly moderate WTP of 21.6 euro annually.

WTP was also found not be dependent on income. People with a monthly income of 701-960 euro have the highest WTP of 42 euro annually. The smallest WTP, 7 euro annually, was found to be in the group who earn 131-260 euro monthly whereas the group of respondents earning less than 130 euro monthly stated a WTP of 18 euro annually.

WTP did increase with education. The average WTP of respondents with basic education is 16 euro annually and the average WTP of respondents with higher education is 33 euro annually.

The tobit model of socio-econometric factors (Table 4) indicates that the amount of payment depends only on sex. Other sociometric factors are statistically insignificant.

Table 4. The tobit model of socio-econometric factors

Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-77.95912	25.03967	-3.113424	0.0018
AGE	0.521043	2.604542	0.200052	0.8414
EDUCATION	8.109820	5.709245	1.420472	0.1555
INCOME	4.162247	2.591839	1.605905	0.1083
SEX	20.80065	9.690668	2.146462	0.0318
Error Distribution				
SCALE:C(6)	87.44476	3.957252	22.09734	0.0000

Mean dependent var	28.58102	S.D. dependent var	66.08014
S.E. of regression	66.38385	Akaike info criterion	8.100643
Sum squared resid	1793574.	Schwarz criterion	8.159202
Log likelihood	-1662.732	Hannan-Quinn criter.	8.123806
Avg. log likelihood	-4.035758		
Left censored obs	147	Right censored obs	0
Uncensored obs	265	Total obs	412

3.3. Total Demand for Coast in Its Natural Condition

The results of the questionnaire provided the authors with data for calculating the aggregated WTP. In order to do so the WTP obtained from the sample was multiplied. Furthermore the demand curve was fitted to ensure more reliable results. The results from this study are used for aggregating the demand curve and for drawing generalized conclusions for Estonian working age population.

The WTP is presented in an exponential model

$$WTP = ae^{-bx} \quad (1)$$

where WTP is the amount of willingness to pay and x is the number of people willing to pay at least the amount. The estimated parameters are marked α and β. Parameters α (163.8) and β (0.007) are both statistically significant and the coefficient of determination (R^2=0.94) indicates a high goodness of fit of the model.

The equation of the demand curve is based on the estimated parameters:

$$WTP = 163.8e^{-0.007x} \quad (2)$$

The demand curve for the Estonian coast in its natural condition is fitted graphically based on the above equation on Figure 3. The WTP in euro is presented on the vertical axis and the number of people willing to pay the given amounts on the horizontal axis.

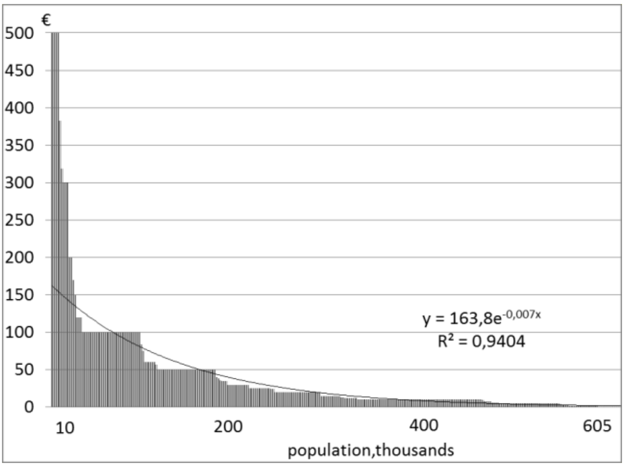

Figure 3. Estimated demand curve.

To compute the consumer surplus (CS) the area under the demand curve is estimated by a definite integral:

$$CS = \int_{x_1}^{x_2} WTP(x)dx = \int_{x_1}^{x_2} \alpha e^{-\beta x} dx = -\frac{\alpha}{\beta}(e^{-\beta x_2} - e^{-\beta x_1}) \cong \frac{\alpha}{\beta} \quad (3)$$

where x_1=0 and x_2 represent the number of people with positive WTP.
The estimated CS is computed by replacing the values of a and b.

$$CS = \frac{\alpha}{\beta} = \frac{163.8}{0.007} \approx 23.4 \, million \, € \quad (4)$$

The demand of Estonian working-age population for the Estonian coast in its natural condition is 23.4 million euro annually. These results clearly once again prove that nature is a public good in high demand and therefore decisions which inflict nature cannot be made without consulting the public, as people determine the need for different goods.

Conclusions

The European Union has been a key player in spreading the application of renewable energy sources in Europe and world-wide. The energy strategy of the EU sets clear energy targets for all member states for the application of renewable energy sources.

Estonia has made remarkable steps for achieving the goals. Today already 22.8% of final energy consumed in Estonia is produced from renewable energy sources. Wind energy is the main renewable energy source which has been implemented for achieving these goals as Estonia with its long windy coastline offers great possibilities for wind farm development. Due to the fact that the wind resources on the inland areas are scarce, the main development takes place on the coast.

Externalities from wind farms include effects on wildlife, aesthetic value of the nature and power grid. Over 90% of Estonia's long coastline is covered by natural surfaces. There the extensive wind farm development has severe negative effects on the aesthetic value of the nature.

A contingent valuation study was conducted to determine the demand of Estonian working-age population for the coast in its natural condition without wind farms. The results show that while older age groups and women state a stronger support for preserving the natural look of the coast, a clear majority, 86% of the Estonian population agrees that the natural look of the Estonian coast should be preserved. The demand for a coastline in its natural condition without wind farms of the Estonian working-age population is 23.4 million euro annually.

Results of the study show that even though the coast of Estonia is a good location for wind energy development due to the good weather conditions, the population feels the need to preserve the authentic look of the coast. Here the support from government is needed to give the wind energy developers clear guidelines for further implementation of strategies, as currently a clear governmental strategy and a hierarchical structure for the planning process is missing. Furthermore, the public opinion should play a significant role in the planning process. Informing the public of new possible projects is inevitable.

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HUVIDE KONFLIKT TUULEENERGIA TOOTMISES: NÕUDLUS TUULEGENERAATORITE VABA RANNIKU JÄRELE

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Tuuleparke rajatakse laialdaselt nende väidetava keskkonnasõbralikkuse tõttu, võrreldes energia tootmisega fossiilsetest kütustest. Riiklikul tasandil on taastuvate energiaallikate rakendamine oluline energiatootmises teistest riikidest sõltumatuse tagamiseks ning ka energiaturul hindade reguleerimiseks. Negatiivseid mõjusid (näit. looduse esteetilise jt. psühho-sotsiaalsete väärtuste kahjustamine, negatiivsed välismõjud liikidele ja ökosüsteemi teenustele), mis kaasnevad alternatiivsete energiaallikate rakendamisega, ei teadvustata, uurita ega avalikustata sama tihti, kui eeldatavaid positiivseid tulemusi.

Edukaimad riigid tuuleenergia tootmises omavad ligi 30 aastast kogemust nimetatud valdkonnas, samal ajal, kui vaid paarkümmend aastat tagasi taasiseseisvunud Eesti omab vaevu kümneaastast kogemust. Tuuleenergia on üks ökonoomsematest energia tootmisviisidest Eestis. Arenguplaanid selles valdkonnas lähiaastateks on aga ambitsioonikad. Seniste saavutuste ning riikliku poliitika uurimine ning kohandamine on vajalik, et tagada jätkusuutlik ning efektiivne areng.

Taastuvate energiaallikate kasutamise olulisust tutvustas laiemale avalikkusele Kyoto protokoll, mis ratifitseeriti 2002. aastal. Kyoto protokolliga leppisid Euroopa Liidu (EL) 15 asutajariiki kokku kasvuhoonegaaside piiramises, eesmärgiga vähendada kahjulike ainete emissioonist tingitud väidetavat kliima soojenemist. Lisaks on EL-is kinnitatud kliima muutuste vähendamise strateegia (*Strategy on Climate Change*), mille meetmete abil loodetakse piirata kliima soojenemist 2°C-ga. Strateegiaga on seatud eesmärgiks suurendada energia efektiivsust EL-is 20 protsendi võrra ja suurendada taastuvate energiaallikate kasutamist energiatootmises 20 protsendini 2020. aastaks, võrreldes 1990. aasta tasemega.

Tuuleenergia turumahu suurendamist ei saavutata üksnes ressursikasutuse optimeerimisega. Erinevate riikide kogemus on näidanud, et edu nimetatud valdkonnas saavutatakse erinevate strateegiliste tegevuste koosmõjul. Seadusandluse kohandamine, selge riiklik strateegia ja legislatiivne raamistik, rahaline toetus ning avalikkuse kaasamine planeerimisprotsessi on olulisteks teguriteks nii edu tagamisel kui vastava pakkumise ja nõudluse loomisel.

Taani 30 aastane kogemus antud valdkonnas tõstab esile selgete riiklike eesmärkide seadmise, legislatiivse raamistiku loomise kohalikele omavalitsustele ja arendusfirmadele ning elanike kaasamise planeerimisse. Hierarhiline planeerimisprotsess loob keskkonna, kus uute projektide elluviimine on võimalik vaid silmas pidades riiklikke eesmärke. Kohalikele omavalitsustele ning eraettevõtjatele on ette antud ranged piirangud, milledest mööda hiilimine on raskendatud. Avalikkus on kaasatud tuuleparkide planeerimisse mitmes etapis: enne maakasutusplaneeringu koostamist, esitamist ja kinnitamist regionaalsel, maakondlikul ning kohalikul tasemel.

Eestis seevastu jätab seaduslik raamistik palju otsustusruumi just kohalikele omavalitsustele. Koostöö omavalitsuste ja arendusfirmade vahel on määravaks maakasutuse määramisel. Riik on kaasatud protsessi seeläbi, et load tuuleparkide rajamiseks väljastatakse riiklike asutuste poolt. Planeeringuid koostavad aga kohalikud omavalitsused oma parema äranägemise järgi. Puudub konkreetne riiklik arengustrateegia, mis suunaks regionaalseid üksusi koos töötama.

Vajaka jääb ka avalikkuse teadvustamisest tuuleparkide planeerimise eel, jooksul ja enne plaanide kinnitamist. Avalikkuse informeerimine uutest rajatavatest tuuleparkidest on kohustuslik vaid juhul, kui rajatav tuulepark võib ohustada Natura 2000 ala või kui tuuleparki soovitakse rajada avamerele. Viimastel juhtudel infomeeritakse avalikkust rajatavast tuulepargist kohaliku ajalehe kaudu. Elanikke ei kaasata aga planeerimisprotsessi proaktiivselt ning seetõttu ei ole arvestatud ega arvestata jätkuvalt tuuleparkide rajamisel nende potentsiaalsete negatiivsete mõjudega elanike heaolule.

Ka tuuleenergia arendamise mõjusid loodusele ei ole planeerimisprotsessis praktiliselt arvestatud. Samuti ei ole kaasatud avalikkust planeerimisprotsessi. Nimetatud kaks puudujääki planeerimisprotsessis on omavahel tihedalt seotud, sest just elanike kaasamise abil on võimalik määrata Eesti rannikute looduse väärtust ning määrata inimeste seisukohalt tuuleparkide rajamiseks sobivad alad.

Seni on Eestis tuuleparke rajatud peamiselt rannikule. Eesti suhtelisest väiksusest ja piisava tuuleenergia ebaühtlasest jaotusest tingituna on tuuleparkide rajamiseks sobilik vaid piiratud ala: läänerannikul ca. 20 kilomeetrine ning põhjarannikul ca. 2-kilomeetrine maariba. Eesti ambitsioonikad eesmärgid antud valdkonnas avaldavad suurt survet maakasutusele rannikutsoonis.

Eesti kogu tuuleenergia potentsiaal on hinnatud 4000 MW-le. 2011. aasta lõpuks rajatud tuuleparkide kogutoodangu potentsiaal oli 184 MW. Hetkel on ehitamisel 3 tuuleparki. 2014. aasta lõpuks on planeeritud rajada tuuleparke, mille koguvõimsus oleks 3824 MW. Sedavõrd märkimisväärne arendustegevus avaldab suurt survet Eesti suure loodusväärtusega ja seni negatiivsetest antropogeensest mõjust suhteliselt rikkumata rannikule.

Inimtegevusest rikkumata või vähemõjutatud loodust kui keskkonnakaupa hinnatakse kõrgelt nii ökoloogiliste kui psühho-sotsiaalsete (näit. kultuuriline, rekreatiivne, esteetiline) väärtuste poolest. Eesti rannikust on ligikaudu 90% inimtegevusest puutumata ning omab nii kõrget esteetilist kui ka ökoloogilis-bioloogilist väärtust. Tuuleparkide rajamine looduskaunile rannikule vähendab lisaks ökoloogilis-bioloogilisele ka märgatavalt ranniku esteetilist ja rekreatiivset väärtust. Käesoleva uuringu eesmärk on hinnata Eesti täisealise elanikkonna nõudlust Eesti loodusliku, ilma tuulikuteta ranniku järele. Autorite hüpoteesi kohaselt esineb Eesti täisealise rahvastiku hulgas suur nõudlus looduslikus ranniku kui väärtusliku keskkonnakauba järele.

Mitmete uuringute raames on selgitatud välja tegurid, mis põhjustavad elanike hulgas negatiivset hoiakut tuuleparkide rajamise suhtes. Visuaalne reostus on peamine tegur, miks kohalikud on vastu vaatevälja jäävate tuuleparkide rajamisele. Kohalikud toetavad pigem tuuleparkide rajamist avamerele kui rannikule. Samuti toetatakse tuuleparkide rajamist pigem juba inimeste poolt rikutud aladele, mitte looduskaunitesse kohtadesse, nagu näiteks hüljatud militaaraladele.

Eestis on tuulepargid rajatud looduskaunile rannikule, kuna sisemaal ei ole tuult energia efektiivseks tootmiseks piisavalt. Tuuleparkide püstitamist soosivat maakasutust rannikualadel on toetanud riik, kohalikud omavalitsused ja arendusfirmad. Uuringud elanike suhtumisest tuuleparkidesse on aga näidanud, et inimesed ei pruugi toetada loodusväärtuslike alade kasutamist energia tootmiseks. Suured konstruktsioonid, nagu tuulepargid, rikuvad lisaks ökoloogilis-bioloogilistele väärtustele ka looduse psühho-sotsiaalseid väärtusi (näit esteetilist väärtust) ning seeläbi vähendavad inimeste heaolu. Heaolu vähenemine seisneb rahuldamata jäävas nõudluses looduslikus seisundis (ilma tuulikuteta) alade kui keskkonnakauba järele.

Uurimuses „Huvide konflikt tuuleenergia tootmises: nõudlus tuulegeneraatorite vaba ranniku järele“ on arvutatud Eesti täisealise elanikkonna nõudluseks loodusliku tuulegeneraatoritevaba ranniku järele 23,4 miljonit eurot aastas. Nõudluse suurus tõestab avalikkuse kaasamise vajalikkust tuulikute planeerimisprotsessi. Eesti elanike vähene kaasatus tuulikute asukohavaliku protsessi on päevakajaline: 86% vastanutest kinnitab, isiklikku maksevalmidust Eesti loodusliku ranniku säilitamise eest ja seega ka nõudlust tuulegeneraatoritevaba ranniku kui keskkonnakauba järele.

Käesoleva uuringu tegemisel kasutasid autorid tingimusliku hindamise metoodikat (*Contingent Valuation Method* – CVM) ja selle alusel rakendatud maksevalmiduse tehnikat (*willingness to pay*, WTP). Uuringus paluti koostatud küsimustikule vastanutel nimetada summa, mida nad on valmis maksma ühekordse maksena (€, neto) aastas Eesti loodusliku ranniku säilitamise eest tuulikutevabana. Lisaks maksevalmiduse määramisele uuriti vastanute suhtumist tuuleenergiasse, roheliste energiaallikate rakendamisesse ja looduskaunite kohtade visuaalsesse reostamisse, paludes uuringus osalenutel vastata kuuele sissejuhatavale küsimusele.

Tuulikute mõju looduskaunitele kohtadele illustreerisid küsitletava jaoks küsimustikku lisatud kaks fotot. Esimesel fotol on esitatud vaade Virtsu rannikule Virtsu-Kuivastu praamilt ilma tuulepargita. Teisel fotol on esitatud sama vaade tuulegeneraatoritega.

Uuringus kasutati 505 täisealise Eesti elaniku vastuseid. Küsitletutel paluti vastata ka oma sotsiomeetriliste näitajate kohta, nagu sissetulek, vanus, haridus ning sugu. Regressioonanalüüsi abil tuvastati maksevalmiduse sõltuvust sotsiomeetrilistest näitajatest. Nõudlus loodusliku, ilma tuulikuteta ranniku kui keskkonnakauba järele selgitati välja ekstrapoleerides uuringus kogutud andmeid kogu Eesti täisealisele elanikkonnale. Saadud andmete põhjal arvutati ja joonistati täisealise rahvastiku maksevalmidust kirjeldav nõudluskõver. Kasutades nõudluskõverat leiti tarbija lisakasu nimetatud keskkonnakauba tarbimisest ning seeläbi ka nõudlus kauba enda järele.

Uuringus tuuakse välja, et enamus vastanutest ei pea õigeks looduskaunite kohtade kahjustamist rohelise energia tootmise eesmärgil (61% vastanutest). Lisaks kinnitas 63% küsitletutest, et energia tootmisviise, mille läbi kahjustatakse loodust, ei tohiks kategoriseerida roheliseks energiaks. Vastuoluliselt eelmainitud tulemustele leidis napp enamus vastanutest (53%), et tuuleenergia kuulub siiski roheliste energiaallikate hulka. Samuti mainis märkimisväärselt suur osa vastanutest, 44%, et neid ei häiri tuulikute rajamine looduskaunitesse kohtadesse.

Regressioonanalüüs kinnitab, et vanemad inimesed ja naised pooldavad statistiliselt tõenäolisemalt tuulikutevaba ranniku e säilitamist kui nooremad inimesed ja mehed. Maksevalmiduse summa sõltub aga vastanute soost ja haridustasemest: naised ja kõrgema haridusega inimesed kinnitasid statistiliselt suuremat maksevalmidust.

Uuringu tulemused kinnitavad Eesti täisealise elanikkonna suurt nõudlust looduslikus seisundis, ilma tuulikuteta Eesti ranniku järele. Edasist uurimist vajab vastuolu: mis põhjustab positiivset suhtumist tuuleenergiasse, samas, kui looduse esteetika hoidmist peetakse olulisemaks, kui taastuvate energiaallikate rakendamist energia tootmises. Vajadus riikliku sekkumise järele planeerimisprotsessi on aga ilmne, ka avalikkust tuleks kaasata tuuleparkide asukohavaliku protsessi suuremal määral, kui seda on tehtud seni.