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Social attitude towards wind energy applications in Greece

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Abstract

During the last 3 yr (1999–2002) a significant increase in the utilization of the existing wind power has taken place in Greece, after a long period (1993–1998) of inactivity. Unfortunately, the largest part of new scheduled installations is concentrated in a few geographical regions, in an attempt to take advantage of the existing electrical network capabilities and the acceptable infrastructure situation. This significant concentration of very large size wind turbines, rapidly installed in a few geographical areas, led to serious reactions from the local population, which in some cases even led to the complete cancellation of the wind power projects. In this context, an extensive study is conducted, concerning the public attitude towards wind energy applications, in several island and mainland Greek territories possessing high wind potential and investment interest. The results obtained significantly reveal acceptance of the existing wind parks, being, however, rather against new installations. More specifically, in the Greek islands the public attitude is clearly supportive, while in the Greek mainland the public attitude is either divided or definitely against wind power applications. The most troublesome outcome of this survey is the existence of a specific minority that is strongly against wind energy applications, disregarding any financial benefits. Among the primary conclusions drawn, one may underline the necessity of additional public information regarding the wind energy sector.

Keywords: Wind energy; Social attitude; Nimby; Public survey

1. Introduction

Wind energy is now a mature electricity production technology, constituting not only an economically attractive option to contribute in fulfilling the worldwide constantly increasing energy demand, but also a sustainable energy solution for global development. In this context, wind energy has been a galloping energy sector for electricity production in various European countries (Kaldellis and Zervos, 2002). During the last 5 yr, the development rate of installed capacity in individual countries varied between 15% and 75% per year; while the corresponding E.U. mean value of the last decade exceeded 40%. Thus, the original E.U. target for 4000 MW of wind power by 2000 has been almost doubled, while the new European Wind Energy Association target is 40,000 MW by 2010 and 100,000 MW by 2020. According to the official data (European Wind Energy Association, 2003), another 5870 MW of wind capacity has been added in Europe during 2002, being nearly 1500 MW higher than 2001. Thus the total wind capacity in Europe exceeds the 23,000 MW (Fig. 1), producing almost 55TWh/yr, equivalent to the annual electricity consumption of 40 million typical consumers.

In Greece, after 5 yr of inactivity—once the 2244/94 law came in force—a significant increase in the utilization of the existing wind power has taken place during the last 3 yr (Centre for Renewable Energy Sources, 2003; Kaldellis, 2003; Regulatory Authority of Energy, 2003), pushing the installed wind capacity of our country definitely over 270 MW (see Fig. 2). On top of this, requests for new wind parks above 11,000 MW exist in the Ministry of Development, so as to profit from the project total cost subsidization by 30% up to 50%. According to the official data, the vast majority of the machines proposed belong to the 500 kW to 1 MW scale, in an attempt to manipulate the positive scale economy effects (Kaldellis and Vlachou, 2002a).

Unfortunately, the largest part of new scheduled installations is concentrated in limited geographical regions (Table 1), like Peloponessos and Euboea, in an attempt to take advantage of the existing electrical

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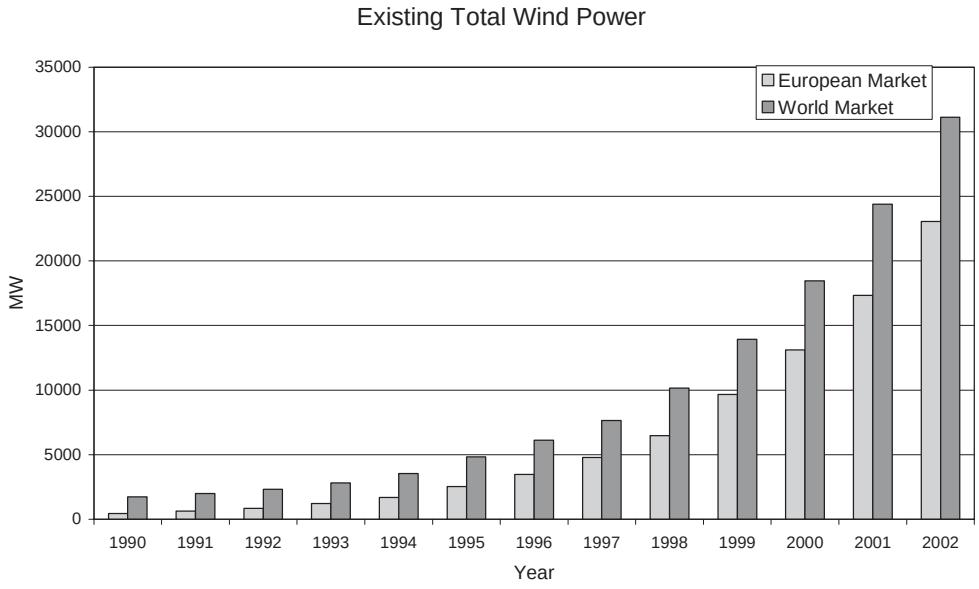

Fig. 1. European and worldwide installed wind power.

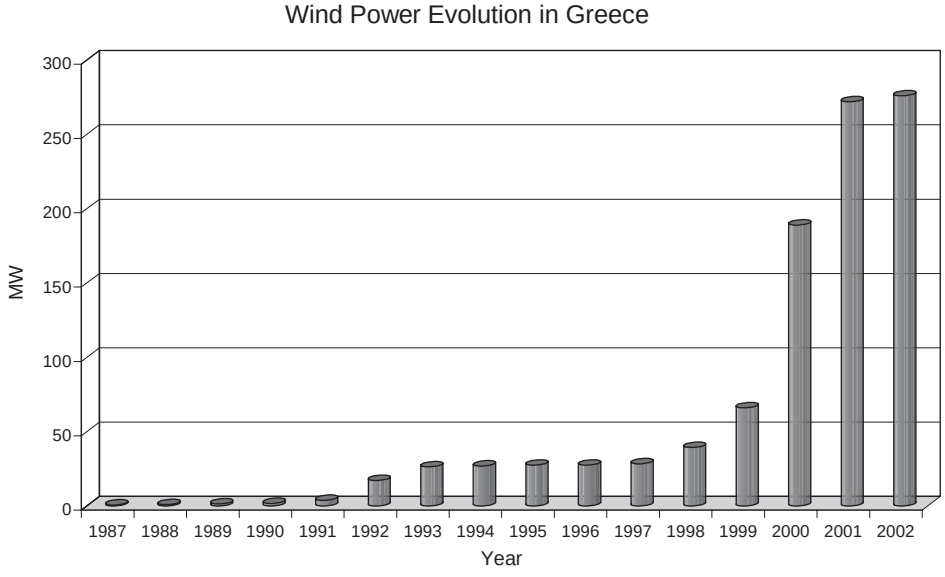

Fig. 2. Time evolution of Greek wind power.

Table 1
New wind power capacity requests in Greece (2002)

Regions of Greece	Requests (in MW)	Regions of Greece	Requests (in MW)
N. Aegean	297	Peloponessos	3215
Dodekanessa	95	Macedonia	518
Crete	364	Ipiros	48
Cyclades	460	Central Greece	561
Attica	730	Euboea	2459

network capabilities and the acceptable infrastructure situation. More specifically, the existing requests are approximately 3200 and 2500 MW in these two areas, respectively. Similarly, as in other European countries, this important concentration of remarkable size contemporary wind turbines, rapidly installed in a few relatively restricted geographical areas, provoked serious reactions from the local population (Kaldellis, 2001). These reactions in some cases even led to the complete cancellation of wind power project (see also Fig. 2), therefore decelerating the current wind energy penetration rate.

2. The status of Greek wind energy market

According to extensive wind potential studies (Centre for Renewable Energy Sources, 2002; Kaldellis and

Kavadias, 2000), Greece possesses one of the best wind potential in Europe, since the local average wind speeds (at hub height) may overpass the 8–11 m/s, especially in the Aegean Archipelago and the mainland coasts. At the same time, the electricity production cost for the majority of the remote Greek islands is extremely high, approaching the value of 0.25 Euro/kWh, while the fuel cost is responsible for almost 50% of the above-mentioned value (Kaldellis et al., 2001a). Additionally, Greek dependency on imported fuel ($\approx$70% of its domestic energy consumption is imported) leads to a considerable exchange loss, especially with countries outside the E.U.

For all these reasons, the Greek State has activated its renewable development program since 1982, when the State-owned Public Power Corporation (PPC) installed a 5×20 kW pilot wind park on Kithnos Island. Since the first pilot wind park of Kithnos was erected, a remarkable number of wind projects were realized, mainly during the 1990–1993 and 1999–2001 periods. It is important at this point to mention that PPC—the State-owned electricity production and distribution company—had been monopolizing the Greek electricity market, theoretically up to 1994 (law 2244/94) and practically up to February 2001, when the local market liberalization (law 2773/99) officially came into force. In this context, up to mid-1998 the vast majority of the existing wind power—142 machines out of 170—belonged to the Greek PPC. However, once the major application problems related to the 2244/94 law for renewable energy sources installations were solved, the private wind parks capacity scaled to 240 MW, while in the same period PPC added only two new wind parks (10.5 MW), totaling its wind power capacity to 37 MW (Kaldellis et al., 2003b). A supplementary characteristic concerning the new wind parks installed has been their strict concentration in two geographical regions (i.e. East Crete and S. Euboea), while, as it is already mentioned, considerable new installations are being planned for the area of Peloponnesos.

During the last years, the Greek State is strongly subsidizing private investments in the area of wind energy applications (Kaldellis and Gavras, 2000), either via the 2601/98-development law or the "Energy Operation or the Competitiveness Program" of the Ministry of Development. On top of this, according to the existing Renewables' Law 2244/94 and the recent Law on local electrical market Deregulation 2773/99 (see also Tsoutsos et al., 2003), the national electrical grid owner is "obliged" to purchase electricity production by wind parks at 90% of the low voltage tariff on islands and 90% of the medium voltage price on the Greek mainland. In addition, 10-yr electricity purchase contracts (open for a further 10-yr extension) are signed between PPC and the private investors in the wind energy sector.

3. Geographical distribution of public reaction towards wind parks

One of the most important topics of the present study is the selection of the areas (Kaldellis et al., 2001b), where the public survey should be realized. In this context, several geographical regions are proposed for the realization of the public survey (Fig. 3). The first area selected is Crete Island. Since 1993, in Crete there have been operating several PPC owned and private wind parks, totaling the installed wind power of the island up to 70 MW. Due to the gradual wind power increase and taking into account the urging electricity deficit of the island, the vast majority of Cretans warmly support the idea of creating new renewable energy stations in their region. In this direction some municipalities organize guided tours through the wind parks with remarkable success. As it is clear, Crete presents no real scientific interest, since more than 90% of the inhabitants are supporters of both existing and new wind parks.

Exactly the opposite situation appears in S. Peloponnessos, especially in Lakonia area, where a remarkable number of new wind power installations are scheduled (Table 1). For various reasons (e.g. opposite financial interests about land usage and political contradiction between the local authorities and the central government) not examined in detail here (see also Kaldellis, 2001; Marouli and Kaldellis, 2001), local people—motivated by local authorities—are absolutely hostile to wind parks in their territory, expressing in specific cases even dynamic actions versus individuals or authorities who are trying to introduce wind energy in their area (Kaldellis, 2002). Under these circumstances, we have no reason to proceed our study in this region.

The next two cases analyzed concern two different wind energy penetration models applying in Greece. Thus during the last 3 yr many large-scale (at least for the greek environment) wind farms were created, in S. Euboea, pushing the installed capacity of the region to almost 150 MW, which is approximately 50% of the Greek wind power capacity. In this windy area negative attitude towards new wind parks is encountered, mainly due to remarkable wind power concentration in a short time period (Kaldellis, 2001), thus also sending harmful messages to all over the country.

On the other hand, Samos Island is selected (Kaldellis et al., 2002b) as a representative of the gradual and low-intensity wind power penetration strategy. Samos is a medium-sized island of East Aegean Sea, possessing excellent wind potential. In the island, since 1991, there exist two relatively small PPC wind parks, while quite recently private investors created and have been operating another two medium-sized installations. Although the existing wind parks represent more than 15% of the

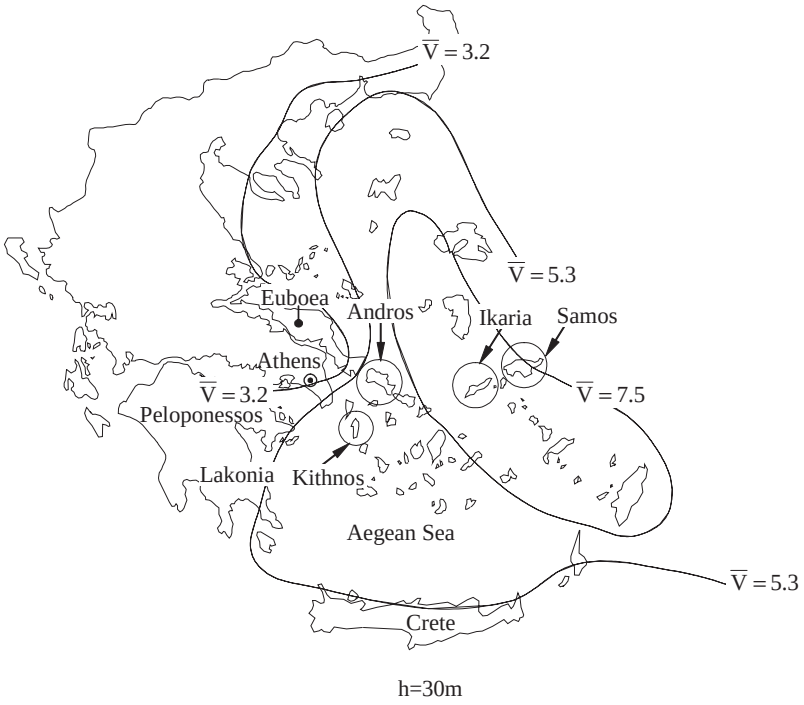

Fig. 3. Selected Greek regions for the public survey realization.

island peak load, the geographical dispersion of the turbines does not seem to disturb the local population.

Finally, the third part of the present survey took place in various small islands of central Aegean Archipelago (e.g. Andros, Ikaria and Kithnos) where at present moderate wind energy related activity exists. In all these areas possessing excellent wind potential there is a strong interest for new wind power applications, possibly in collaboration with energy storage systems (Kaldellis et al., 2001a; Kaldellis et al., 1999) (e.g. wind–hydro, battery storage, etc.) or desalination plants.

4. Development of the methodology

In order to investigate the public attitude towards wind energy applications in depth, the Soft Energy Applications and Environmental Protection Laboratory of TEI Piraeus has first scheduled and subsequently conducted (Kaldellis, 2001; Kaldellis et al., 2001b, 2002b) a public survey in several representative Greek territories, presenting wind energy development interest. During the planning phase, emphasis was laid on the following topics:

- The degree of public knowledge regarding wind energy applications.
- The public awareness about the environmental and macroeconomic impacts of wind energy (Kaldellis et al., 2003a). Personal annoyance is also recorded.
- The public attitude towards existing and new wind parks, in view of the NIMBY syndrome (Kaldellis, 2001; Kaldellis et al., 2001b).

The second subject to be clarified is the preparation of this research. According to the existing literature (Simon, 1996; Krohn and Damborg, 1999; Yaxas et al., 2001) there are several ways of conducting similar studies, like telephonic interviews, written questionnaires being mailed to a random sample, personal named or unnamed interviews, etc. For increasing reliability and due to the country idiosyncrasy this last technique was selected. More specifically, during this survey the questionnaires were completed in the interviewer's sight, while the respondents filled in their name and phone, for confirmation purposes. It is also important to note that all the respondents were living near the existing wind parks (maximum distance 20 km), and they belonged to groups of various professions and education status, while 278 of them were men. A preselected number of anonymous questionnaires were also completed in specific regions for statistical comparison purposes. The public response was encouraging, since almost one out of two of the persons asked answered the questions eagerly.

The last point to be arranged was the number of interviews needed to draw safe conclusions (Gilbert, 1987). As it is obvious, the reliability of the results derived is strongly dependent on the size of approved sample used, since the outcome uncertainty is normally

decreasing with the square root of the sample size (Kaldellis and Kavadias, 2000). Due to the geographical diversity of the study and the manpower needed, a sample number in the range 100–150 questionnaires was assumed acceptable, while 50 interviews were set as the lower limit.

For the preparation of the questionnaire a large number of scientists have collaborated, including statistics experts, sociologists and market survey experts. The relative questions to the subject investigated are summarized in Table 2, along with the possible answers. As it is obvious from Table 2, the first two questions asked guaranteed that the people being interviewed were familiar with the subject examined. According to the entire sample analyzed (417 questionnaires), 94% of the people interviewed were familiar with the basic wind energy principles (question 1), while only 2% were not sure about the contribution of wind parks in the electrification effort (question 2). Recapitulating, one may clearly state that the samples used have the necessary size to be statistically sound and credible, while the vast majority ($\approx$95%) of the people questioned had a quite good idea about wind energy basic principles and wind power applications. The rest 5% were excluded from further analysis.

Table 2
Demonstration of the questionnaire used in the present public opinion survey

Question 1	*What do you know about wind energy?*	
Possible answers	a	It is obtained from the waves of the sea
	b	It is used in the solar heaters
	c	It is obtained from the wind
	d	It is obtained from nuclear plants
	e	I do not know
Question 2	*The wind converters or wind turbines are usually used:*	
Possible answers	a	In producing electric energy
	b	In marking regions
	c	For aesthetic reasons
	d	For televising purposes
	e	For other reasons
Question 3	*Do you actually agree with the installation of wind turbines in your territory?*	
Possible answers	a	YES, I do
	b	NO, I don't
	c	I would agree if only I had proof of their usefulness
	d	I am not interested in this matter
	e	I have no formed opinion
Question 4	*In case of a new wind park installation in your territory:*	
Possible Answers	a	I would not care
	b	I would react on this installation
	c	I might agree, after examining all available data
	d	I have no formed opinion
	e	I would happily agree, being aware of their effectiveness
Question 5	In case of a new wind park installation in your territory:	
Possible answers	a	I would not wish to participate, even when it is financially profitable
	b	I would not wish to participate, as I hear it is financially unprofitable
	c	I would ask for further financial data regarding this project
	d	I would wish to participate at any rate, realizing all financial benefits
	e	I am not interested in this matter

5. Results presentation

After the arrangement of the necessary preconditions, the Soft Energy Applications & Environmental Protection Laboratory staff conducted the above-described public survey in three stages. The first stage was executed in two separate phases (during the 1st and 2nd semester of 2001) and it was focused on the S. Euboea area. The sample of 128 interviews—taken during the period examined—is a representative size to extract statistically safe conclusions. Accordingly, the second stage was concentrated in Samos Island, where almost 200 (196) local people were interviewed during 2001 in two separate attempts. Finally, the third stage of the public survey was realized in three different islands of central Aegean Archipelago, the islands of Ikaria, Andros and Kithnos. In these three selected cases the total sample was almost 100 (93 respondents) while the period examined was between June 2001 and June 2002.

In the present paper emphasis was primarily laid on the analysis of public attitude towards existing and operating wind parks. Using the available information (total sample of 417 respondents) the public attitude was more or less supportive for existing wind turbines, since 51% of the sample was positive and 17% was positive under conditions (Fig. 4). This result is in accordance with various public opinion surveys on both sides of the Atlantic (Bosley and Bosley, 1988; Rehfeldt, 1999). More specifically, in all these studies, two-thirds of people polled supported the existing wind power stations, which is exactly the case of the local market. On the other hand, 16% of the respondents disagreed with the existence of wind turbines in their neighborhood, while another 16% (11% + 5%) had either no opinion or were not interested in the subject.

The situation is fairly changing in cases where new wind parks are scheduled (Fig. 5). Although the majority of the respondents were still in favor of new wind parks (39%) and another 20% were positive under conditions, there is an almost 10% difference in comparison with the supporters of existing wind parks.

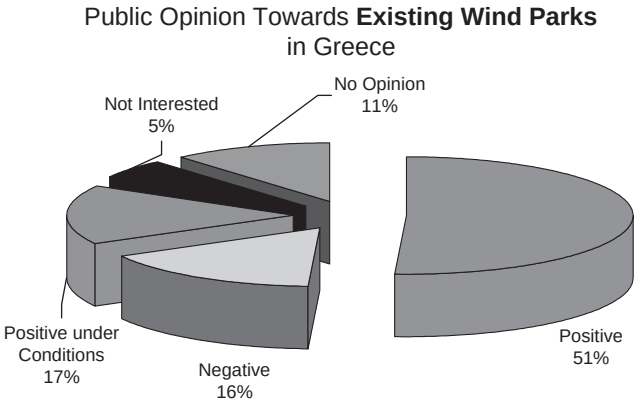

Fig. 4. Public opinion results towards existing wind parks.

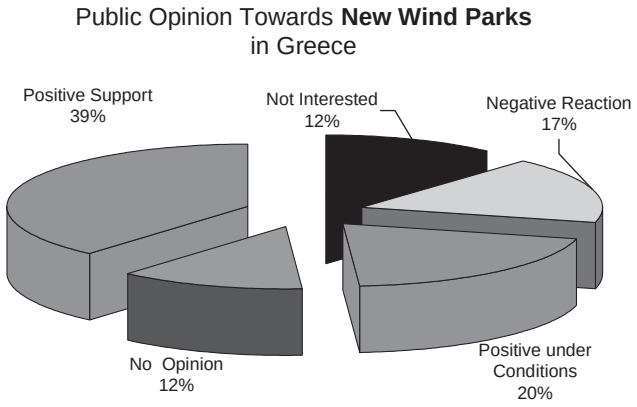

Fig. 5. Public opinion results towards new wind parks.

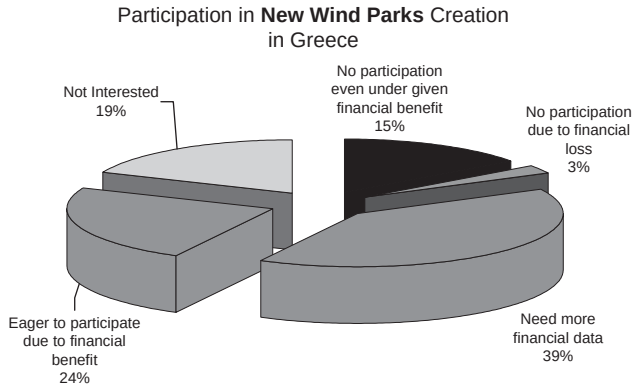

Fig. 6. Public attitude towards participation in new wind parks creation.

Keeping in mind that an almost constant minority (17%) remains negatively expressing versus any wind energy exploitation activity.

This situation is fully supported by the analysis outcome of the answers concerning the last question asked (Fig. 6). According to the assessed results 24% of the respondents were eager to participate in new wind energy projects due to expected monetary gains. However, the majority (39%) of the local people required more information about the financial behavior of similar projects, since PPC administration claims (Kaldellis et al., 2002a) that wind power installations are not economically viable! People disliking wind turbines in their area represented 18% of the sample, while the vast majority (5/6) of them did not want to participate in new wind parks even under proved financial benefits. Lastly, almost one out of five was not interested in new wind power investments.

6. Discussion of the results

As already mentioned, the present public survey was conducted in various selected regions, where representative public attitudes were encountered, using information from the local press and the media. Thus, on top of the results demonstrated it was interesting to investigate the geographical distribution of wind energy acceptability degree in Greece.

According to the information collected there is a great diversity of the acceptability degree of existing wind parks among the windiest territories of the country (Fig. 7). Thus, in almost all islands the existing wind parks are welcome, since the acceptability degree exceeds 80%. On the other hand, in Greek mainland the degree of acceptability of operating wind farms was very low, being less than 40% in almost all regions examined.

The situation was getting worse in case where new wind parks are scheduled (Fig. 8). In this specific case the wind energy supporters in Greek mainland were hardly one-half to one-third of people claiming negative reaction against new installations. In the Aegean Archipelago area the degree of acceptability of new wind parks was slightly lower ($\approx$10%) than the one of existing wind parks, a difference that is in accordance with the appearance of NIMBY (Not In My Back Yard) phenomenon (Wolsink, 2000).

Taking a closer inspection of the results gathered, one may explain the different attitude between island and mainland territories by considering the following topics:

- In most islands there is a remarkable electricity production deficit (Kaldellis and Konstantinidis, 2001), especially during the season of summer tourism, impeding the life quality and the economic growth of local societies. This problem does not exist in mainland, since the large thermal power stations provide enough electricity to citizens.
- The introduction degree of wind power applications is quite different in these areas. In most islands there is a gradual penetration of wind turbines (Kaldellis, 2003; Kaldellis et al., 2003b), starting from the early small wind parks of PPC. Only recently a remarkable number of private wind parks has been erected. For

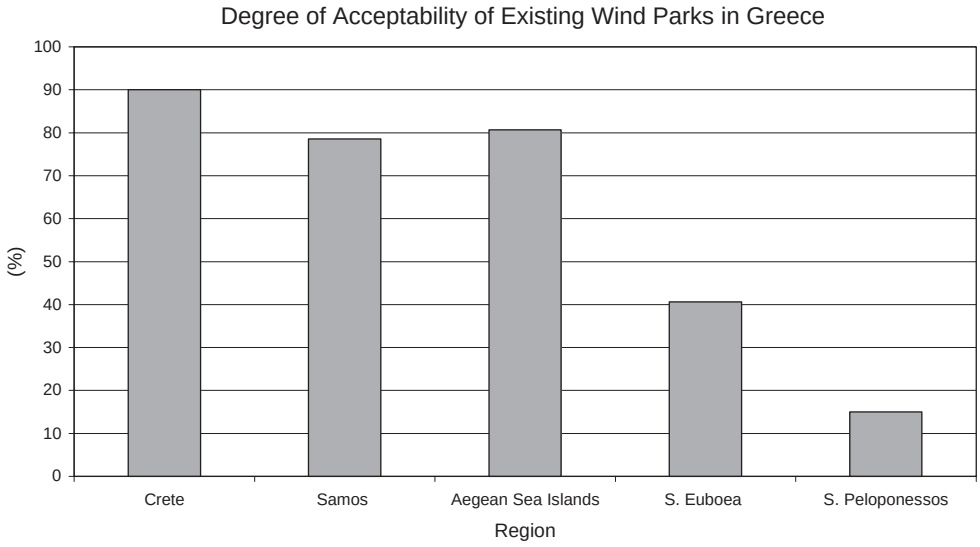

Fig. 7. Acceptability degree of existing wind parks throughout Greece.

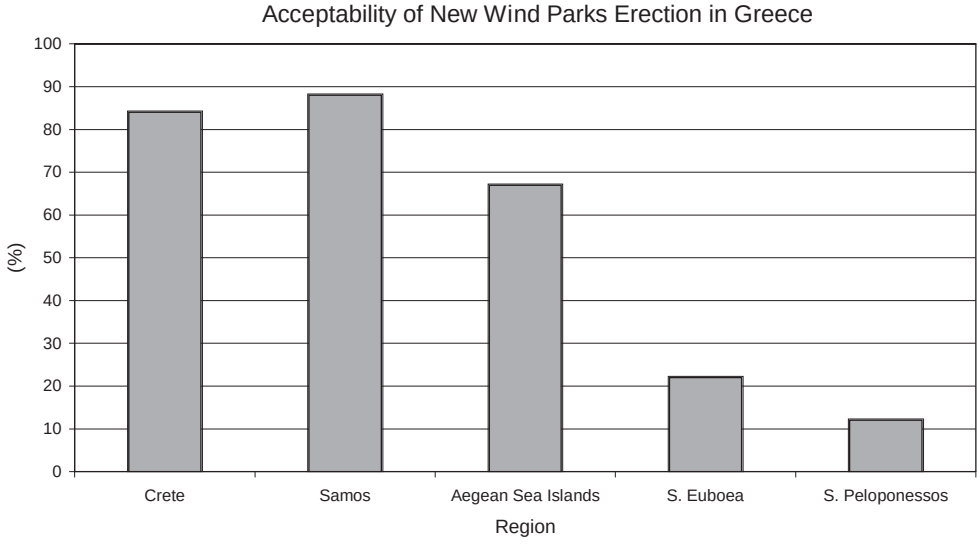

Fig. 8. Acceptability degree of new wind parks erection throughout Greece.

the mainland cases, a considerable number of huge machines have been rapidly installed in relatively closed areas, without appropriate respect for the local scenery aesthetics (Kaldellis and Vlachou, 2002b).

- Mainland people were much more conservative in their opinion, being mainly farmers and stock breeders. On the other hand, island people were much more open-minded, since many of them were seamen, traders or working in tourism, thus contacting foreign people and developing new ideas.

7. Conclusions

An extensive study was conducted concerning the public attitude towards wind energy applications, in several island and mainland Greek territories possessing high wind potential and investment interest. The results obtained generally declare significant acceptance of existing wind parks, being, however, fairly reduced for new installations. More specifically, in Greek islands the public attitude was clearly supportive for existing and new wind turbines, since only a small minority (less than 20%) was negatively expressed versus wind energy applications. On the other hand, in Greek mainland the public attitude is either divided or definitely against wind power applications.

The most troublesome outcome of this survey is the existence of a specific minority that is strongly against wind energy applications, disregarding any financial benefits of all these projects. Bear in mind that legal actions can be induced even by a single person.

Subsequently, among the primary conclusions drawn by the sample analyzed one may underline the necessity of additional public information regarding wind energy sector. This lack of proper information is also reflected in the unwillingness of local people to participate in new projects, basically due to their uncertainty regarding the financial results of similar ventures, especially in the local socio-economic environment.

In the authors' opinion, a remarkable negative public attitude towards wind energy applications in Greek mainland is encountered, which is not the case in Greek islands. Taking into consideration that most new wind power stations are scheduled for the mainland, if this undesirable situation is not properly analyzed and handled, the future of wind energy applications is questionable.

For all these reasons, the authors believe that the conclusions drawn are very characteristic of the public attitude towards wind power applications in Greece and may be found necessary for those related to the local energy planning procedures. Besides, the results obtained may clarify the existing situation and assist Greek society in taking vital decisions regarding the electricity production sector for the next decade, seriously considering the wind energy generation impact on everyday life.

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