Local Renewable Energy Planning: A Participatory Multi-Criteria Approach

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Renewable energy sources today can provide a promising alternative to conventional power generation, provided some economic, institutional, social and technical barriers could be overcome, and the appropriate planning instruments for their deployment are developed. In Greece, contemporary practice seems inadequate to address the multiple character of renewables and the need to ‘open up’ the decision-making process to actively include all stakeholders. A number of case studies has been examined in order to formulate a new regulatory framework. The results suggested that participatory multi-criteria decision aiding techniques can capture renewable energy and local stakeholders values as reflected in the weights and criteria. A new framework is established and proposed as a complement to current practice.

Keywords decision-making, Greece, multi-criteria, public participation, renewable energy planning

It is apparent that severe environmental, social, security, and safety problems emerge from the utilization of contemporary energy carriers. Local atmospheric pollution, regional and global environmental problems (acid rain and greenhouse gases), mainly from the use of fossil fuels, are well established. Renewable energy sources provide a promising alternative, and their deployment is thought of as an important energy policy priority for many countries. It has to, however, overcome technical, institutional, social and economic barriers as it exhibits localized environmental impacts—extensive land and water use requirements, landscape alteration, change of rural lifestyle, noise, etc. This multiple character of renewables renders the choice between different development proposals a laborious and complex task.

In this article, we present the experience from a number of consultations with stakeholders involved in renewable energy projects, the difficulties that have risen and we propose a new methodological framework of multi-participatory and multi-criteria decision-making.

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First, we present the theoretical background of multi-criteria decision analysis (MCDA) and the need for a regulatory framework to be applied in energy planning. Then we provide empirical evidence from Greece; a number of bilateral meetings with local stakeholders were organized in order to uncover the important factors among different projects. Next we argue that participatory multi-criteria methodologies could complement the current decision-making framework in Greece and we highlight the main structural characteristics of the new approach.

**MCDA: Theoretical Basis and Application to Energy Planning**

Multi-criteria decision analysis deals with the process of making decisions in the presence of multiple objectives. A decision-maker is to choose among several alternatives using two or more criteria. Since there is no alternative that performs better than all of the others according to all criteria, the solution depends on the preferences of the decision-maker and must be a compromise. When different groups of decision-makers with different criteria and points of view are involved in the process, a framework of understanding and mutual compromise must be established.

The use of multi-criteria decision techniques has a long history in energy planning and provides a sound methodological framework for (renewable) energy evaluation and appraisal (Siskos and Hubert, 1983). A number of conflicting factors (technological, economic, environmental, social, risk, etc.) must be taken into account since they may lead to local opposition that jeopardize future developments.

The early involvement of the public in the decision-making process is therefore necessary to: ensure that local values are reflected in decisions; obtain all essential information; inform the local community; and enhance the fairness and transparency of the procedure (Hobbs and Horn, 1997). Multi-criteria techniques allow for a variety of decision-makers to participate in the exercise with their appropriately determined weight factors. In most cases, participants must also formulate the problem (defining the objectives, propose alternatives to operationalize the objectives, establish criteria to evaluate alternatives). The analyst then identifies and proposes indices to measure the criteria. Local authorities, potential investors, central government, public pressure groups (NGOs and local media), academia, farmers associations, residents of the nearby area, etc. would probably have different perceptions on the problem, resulting in different priorities, thus valuing the choice criteria in a variety of ways. These people are invited to participate in an initiative workshop, and then, through interviews and possible similarities and differences, the decision-makers are identified and a dialogue is commenced.

Multi-criteria methods offer enhanced transparency for the whole process and provide deeper insights, resulting in familiarizing the actors involved with all important aspects. They decompose the problem and the ‘decision matrix,’ with all alternatives and their respective impacts. Thus, the decision-makers have the opportunity to address the problem in all of its technical dimensions (alternatives, criteria) and apply their weight attributes. However, political, economic and institutional changes will be essential if environmental and social considerations are to be applied to energy policies.

While, at the state level, there exists a series of supporting instruments to enhance renewable energy-based electricity market penetration—guaranteed prices for producers, tax exemptions, direct support measures (grants, loans), indirect support (RTD, demonstration) and the renewables portfolio standard (RPS)—and several countries have already adopted such frameworks, it seems that not much has been done to incorporate local values and interests in the project evaluation. A challenge, therefore, emerges of how to
collect, store, analyze and communicate the relevant information under a consistent regulatory regime regarding local renewable energy exploitation and decision-making. One may view this regulatory approach as the means to connect these different (macro-micro) levels of reasoning. For example, after translating the current, overall EU objective of 12% renewables penetration into state, regional and local targets (according to the specific circumstances for each area—local environmental conditions, renewable potential availability, population, infrastructure, etc.), then one could use them to determine the appropriate preference to achieve these targets.

The call for a local integrated planning framework emerges from the prevailing conditions of the Western energy scene; these include the deregulation of energy systems, the integration of energy networks, the appreciation of environmental pressures, and the mobility of human resources. The policy issue addressed in the next section concerns the renewable energy scene in Greece.

The Greek Experience

Current Situation

Figure 1 presents the yearly electricity demand in Greece from 1991 to 2001 and the estimated demand for 2002–2004. Under the EU “burden-sharing” agreement for the 2012 Kyoto Protocol target, Greece’s greenhouse gas emissions are allowed to increase up to 25% above the 1990 level. The energy sector is considered to be of high importance since it is the main culprit for the bulk of total CO₂ emissions. Therefore, the increase of renewable energy penetration into the Greek national electricity system is sine qua non. According to the Greek Action Plan for Climate Change, an indicative target has been set to generate a substantial percentage of electricity by renewables (mainly wind energy) in 2010 (20.1%).

Figure 1. Electricity demand in the Greek interconnected mainland grid (Source: Hellenic Transmission System Operator—HTSO).
Even though renewable energy alleviates adverse environmental impacts from the global-regional scale (climate change, acid rain), it increases pressures to the local scale (landscape degradation, noise, conflicts with other land uses—recreational, touristic, etc.). Local communities challenged with these environmental and social impacts seem really skeptical. Past experience in Greece has shown that geothermal power faced insurmountable local opposition that, many times, leads to project abandonment (PPC, 1989).

Current planning practices in Greece do not seem to adequately address the multiple character of renewable energy, the local environmental impacts and the public opposition that arises. The contemporary regulatory framework enables the Regulatory Authority for Energy (RAE) to grant exploitation permits to specific investments that meet several techno-economic criteria that reflect mainly the central administration’s perception; the public consultation process is initiated only if objections are raised. A parallel to the planning of the project, interactive communication that may influence the outcome of the decision-making process itself, is never considered in these planning stages and this is thought to be a major obstacle.

The Cases Examined

In the framework of this research, a number of initial investigations (informal interviews, bilateral meetings, consultations, etc.) was conducted; during these we explored what aspects of the specific planning practice in Greece hamper renewables development and what actions can be undertaken to improve contemporary practice. Thus, we engaged in fourteen (14) consultations with investors and local stakeholders—mayors, presidents and members of local municipal councils, local media and NGO’s, local development companies, and regional authorities. The lengthy (several hours each) interviews covered a variety of cases with substantial differences regarding the overall potential of renewables in the area, the nature of the applications (wind, hydro, geothermal), the level of renewable penetration, and the existence of a connection to the main electricity grid.

Two of the cases examined refer to regions with high wind potential and proximity to the national grid that are destined to receive the bulk wind parks, i.e., S. Evoia and S. Lakonia (Figure 2). In addition, two islands (Lesvos, Chios) with wind and geothermal potential were examined.

From the initial investigation, five (5) case studies that were considered more mature for renewables implementation were examined in depth (Table 1). The following issues arose as needing pre-evaluation before the initiation of a project:

1) The experience of local people with the new energy technology proposed for their area. Locals, who in the beginning are negative/indifferent to new developments, change after a familiarization period, and become more favorable. Regions with prior development applications are thus more mature to welcome further projects and intense renewable exploitation, compared to regions with no such exposure.

2) The size of the proposed project and the nature of the region under consideration. People were more reluctant to accept a huge wind farm with extended land use, new electricity lines across pristine areas and significant visual distraction. Inhabitants in recreational areas of aesthetic value would oppose renewable exploitation (NIMBY behavior), compared to people in agricultural regions with little touristic future.

3) The lack of a national spatial planning framework is an important obstacle blocking wind parks growth. The incidental development of windmills is perceived rather risky by local people, creates severe public opposition and generates
mistrust towards external investors and central government officials. Local people and elected representatives feel alienated from the whole procedure, which comes to their attention rather late in the whole planning phase.

**Local Stakeholders Perception**

In stakeholder interviews, the structuring of the problem, i.e., the identification of the objectives and the analysis of values is very important (Marttunen and Hamalainen, 1995). In the particular cases we examined, and since the process was at an initial stage, no explicit alternatives and no direct criteria indicators were identified since we thought that local officers should play an important role in formulating the problem and articulating their views. A ‘smooth’ approach, therefore, was selected in order first to set the decision context and obtain the necessary ground rules regarding renewables planning and implementation. This appears to improve the quality of the decision process (Hokkanen et al., 1999).

Two elements emerged from the initial stage of the discussions; the necessity to include local attitudes in decision-making and more than one criteria when evaluating proposals.

Local people thought it was unfair to proceed with the installation of energy plants without prior communication with them. The main reason for public opposition seems to be the inability of the central government practices to promote an integrated assessment of the new projects and their seemingly arrogance to proceed to decisions without asking...
<table>
<thead>
<tr>
<th>Municipality</th>
<th>Existing Capacity (MW)</th>
<th>Project ownership</th>
<th>Planned Capacity (MW)</th>
<th>Project ownership</th>
<th>Maximum potential Capacity (MW)</th>
<th>Local attitude</th>
<th>Renewable potential</th>
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*Note*: M: Municipal; F: Foreign investor.
local people. Small municipalities, especially, do not have the technical, administrative and economic resources to implement such procedures on their own. Perhaps regional and local energy agencies could act as intermediaries between foreign and/or Greek big corporations and local municipal development companies.

Taken as a whole, it is considered that local municipal development companies could play a significant role in the development of renewables in Greece, and any future planning procedures should take this seriously into account. In addition, it is of paramount importance the fact that public local opposition is smaller when the sponsor is the local council. Our findings strongly support this advocacy, as indicated in Table 1.

A wide range of issues, e.g., employment, environmental quality, energy consumption, financial, etc., are at stake and should, therefore, be addressed as part of a wider regional policy problem. During the interviews it was emphasized that contemporary planning practices, as employed by RAE, do not adequately cover this multiple character of renewable energy.

The four criteria of sustainability, namely energy-resource, economy, environment and society were easily identified by the majority of the people that participated in our consultations; they were also willing to submit weight factors that are presented in Table 2. Under the criterion “economy” the net financial benefit to the area was considered. It should therefore be differentiated from the net present value criterion, as this applies to the investor.

It must be noted that in most of cases the investor was an outside company and not the municipal or regional authority itself. In such a case, he is obliged by law to return 2% of profits to the local community; this is supposed to be a trade-off for the exploitation of the local energy resource. This should also compensate for the environmental deterioration and the economic losses arising from the loss of revenue from other activities in the area, such as agriculture, tourism, recreational, mountaineering, etc. One may say that this monetary valuation could be seen as the willingness-to-accept the environmental degradation imposed and moreover compensate for the loss of other development opportunities. It was perceived by the local people that such a monetary reimbursement should be analytically estimated and not considered as a fixed percentage of the electricity revenues of the investor company. Nevertheless, further research seems necessary under a contingent valuation approach to reveal the optimum level of payment, although the important limitations of the specific approach are well known (Sagoff, 1998).

Even though in some cases the level of this compensation seemed to be of outmost importance, in other instances it was thought that no monetary payment could

<table>
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<th>Municipality</th>
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<th>Environment</th>
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levy the environmental degradation and the loss of the revenue from other activities, mainly touristic. In particular, some participants proposed benign tourism development as the correct way to improve local economy and pointed out that such development pattern is in conflict with the installation of wind parks in the region. In other regions, a third approach argued that wind parks and tourism activities can coexist peacefully in parallel.

The next important attribute concerns the sitting of wind farms. The existence of appropriate spatial planning is perceived as the most important factor reflecting on the environmental criterion. However, the introduction of wind farms in an area is not without political repercussions. In the absence of a clear, spatial planning scheme, and of commonly agreed rules, people perceive any attempt from the central government to promote or not such a project as an exercise of political manipulation, and their political reactions reflect such perceptions. Voting characteristics have a strong party support prehistory and people express their resentment to central government opposing or welcoming wind park schemes based on their party inclination attitudes. In a particular region in Lakonia, the former mayor lost the elections when he was seen as backing the wind energy development and his percentage of votes was shattered to a mere 9% from the 38% that he had obtained in the previous elections. It should also be stressed here that the political backstage is highly influential and cannot be easily captured. Hidden background information and local social dynamics are always present in such cases.

Regarding the social-employment issue, there was a consensus that the employment contribution of wind energy projects is marginal; experienced engineers servicing the wind generators come all the way from the capital city of Athens, with local service staff employed only for secondary jobs.

As a final point it was recognized that a general unfolding stage-by-stage approach is appropriate, at least as a basis, for scenario formulation and subsequent evaluation towards group consensus.

The main obstacles hindering wind energy development in Greece, as emerging from the consultation meetings with local stakeholders, are summarized as follows:

- The lack of a robust financial plan to assist local development companies in order to exploit their renewable energy resource and install and operated their own energy stations.
- The lack of a national and regional spatial planning scheme.
- The lack of the appropriate technical and administrative personnel in prefectures and municipal offices.
- The limited capacity of the established electric transportation and distribution network and the severe aesthetic and other environmental consequences of its expansion.
- The cumbersome administrative procedures for the establishment of the appropriate certificates.
- The missing trust between the local people/local authorities and the central administration. The experience with past development of wind projects has added to this mistrust.
- The need to include local people in the evaluation procedure to influence the decision-making process regarding the future of their area.

The next section highlights the main features of the new agenda as it was formulated.
An Outline of the New Framework

In Figure 3, we present the new planning approach. The basic outline begins with the initial collection and assessment of the relevant information (renewable energy potential estimation, regional, institutional, financial and legal data). A general decision-making agenda is shaped and the thus the actual technical availability for renewable energy is revealed.

The stakeholders are associated with the planning and decision process, those who have a legitimate responsibility to participate in the procedure, and/or add a socio-political dimension to it (Lahdelma et al., 2000). Alternative projects should be open to alterations, resulting from the input of the stakeholders during the consultation. The local people are
familiar with information that the analysts ignore and may bring to focus several important topics that otherwise could be missed. Furthermore, it is thought that a stage-by-stage unfolding approach could familiarize all participants with the true costs and benefits of renewable energy. It is important that the participants will finally agree on the set of the alternatives considered, and that the ‘zero action’ alternative should be included in the portfolio.

This framework offers a different perspective to the one existing when RAE and the particular investor “drive” the process and when the procedure reaches this stage the project portfolio is already formed. Our approach, however, assumes an active involvement of the various stakeholders and the analysts (as facilitators) in the scenario formulation. It gives the decision-making process a substantial bottom-up dimension from an early phase. This is more the case in similar occasions in the Scandinavian countries (Hokkanen and Salminen, 1997). A big difference exists, therefore, between the frameworks of decision-making in northern European countries, where established participatory multi-criteria procedures have a long tradition in action, and countries like Greece that lack similar experience. However, promoting local engagement from the very early stages of the process is usually costly and time consuming. This is added to the long periods needed for the procurement of new energy plants, and it comes to disagreement with the imminent actions needed to counteract the greenhouse effect and other environmental pressures.

One of the important points is also the selection of the criteria for evaluating the project. The range of all criteria should be explicitly stated, to avoid inconsistencies when resolving value tradeoffs between the different objectives. The decision criteria should be decomposed into directly measured indicators, and ready to be integrated into the model. This involves hard work and is usually accompanied by strong qualitative (and disputable) judgments. Nonetheless, this step is necessary, due to its high contribution to the transparency of the procedure and its increased potential to identify the weak spots of the process. Valuation criteria could include conventional energy saved, local energy availability, return of investment, contribution to regional economy, number of permanent and/or temporary jobs created in the area, and potential controversies with other uses. The environmental impact criterion is highly disputable. It is suggested that land use requirements, aesthetic considerations, waste generation, water prerequisites, and life cycle analysis of the technologies considered, should (probably among others) compose the overall environmental index. The decomposition of the environmental criterion is still an area of an ongoing research.

The next step is the selection of the multi-criteria decision aid methodology. There exists a variety of available methods and different authors propose different ways of categorizing them (Zeleny, 1982; Vincke, 1992). There are no better or worse techniques; rather, some techniques better fit some kinds of situations. A major problem arises from the fact that different methods applied to the same case, using the same data, produce different results. Even so, each methodology provides a different compromise between appropriateness, ease of use, and credibility of results. However, the particular methodology chosen determines the way in which the preference of the decision-makers is elicited since different methods require different kind of weights. Nevertheless, there always exist an inherent difficulty in transforming a qualitative preference to a numerical ranking.

The model’s application ends with the ranking of the renewable energy supply options, or the selection of the ‘best’ alternative according to input. It is usually the case that no group consensus is established at this stage. Nevertheless, an iterative procedure can be initiated, starting from an enhanced sensitivity analysis of the criteria weights (Haralambopoulos and Polatidis, 2003). It can be said, however, that group consensus
still remains a more intuitive, than mathematically, manipulative procedure. The model outcome is always only a proposal. The decision support systems are designed to help decision-makers decide, and not to replace them.

Discussion and Conclusions

The intrinsic character of renewables—decentralized implementation, multiple-criteria nature, local impacts—entails the use of multi-criteria participatory approaches for their valuation. This could be considered as the normative view of renewable energy planning (multi-participatory as regards the decision-making process and multi-criteria as regards the evaluation procedure). Within such a framework, the actual renewable energy potential to be exploited might be reflected in the criteria and weights chosen.

Under present conditions in Greece, the proposed framework could identify activities that should construct a decentralized decision-making process for renewable energy development and provide a complementary approach to the one currently performed by RAE. The original (RAE-investor oriented) approach takes the objectives of the local community under consideration only in a passive way. This practice appears to kindle local opposition, which in turn decreases the viability of the projects. Consequently, a complementary (RAE-investor and locals oriented) approach has been proposed. The new frame integrates local concerns and objectives and decomposes social trade-off decisions under an agenda of mutual understanding. Further endeavors are needed, however, to connect its potential for renewables deployment with overall environmental, social and resource objectives. Having achieved that, the possibility emerges to quantify the distance between contemporary practices and future developments situation according to targets. Following that, the necessary institutional changes to meet these targets must be discovered.

In this research a number of stakeholders have been invited to participate in bilateral meetings in an attempt to elicit their values regarding contemporary planning practice in Greece and the future of renewable energy in their areas. The cases considered comprised a diversity of attributes in order to incorporate different resources, regions, particular local situations, stakeholders and views. The evidence initially disclosed the limitations of renewable energy planning in Greece. Further, they provided insights concerning local stakeholder’s perception for renewable energy.

A new complementary outline based to an extension of the already established decision-making frame employed by RAE was constructed. A diversity of value functions resulting from the different interests of the people involved is now explicitly included in the administrative process. In the long run, the new frame could educate the people involved about the true costs and benefits of renewables, and familiarize them with participatory democratic processes for local decision-making. A pathway towards reaching group consensus could be revealed and a gradual shift from current institutional practices could be initiated, through small transitional goals, towards ongoing democratic political process.

Appropriate forms of criteria for the Greek case have been identified from the insights gained by consulting with the local administration. Moreover, real weights factors have been elicited reflecting the interest of the stakeholders participating in the exercise. Nevertheless, since social consensus is hardly ever the direct outcome of such procedures, an iterative process could be launched to provide a pathway towards the identification of a compromise solution. It is concluded that, for the Greek case, such a framework could complement contemporary planning initiatives.
References


