

EUROPEAN COMMISSION

FIFTH FRAMEWORK PROGRAMME



**Community Activities in the field of the specific programme for
RTD and Demonstration on "Energy and Environment and
Sustainable Development – Part B: ENERGIE PROGRAMME"**

***Development and Application of a Multi-Criteria
Decision Analysis Software Tool for Renewable Energy
Sources***

(MCDA-RES)

Contract NNE5-2001-273

Deliverable D12: Development of the CD and related manual

MCDA-RES – WP3: The development of the multimedia based software package

Development and Application of a Multi-Criteria Decision Analysis Tool For Renewable Energy Resources

Public

MCDA-RES
NNE5-2001-273

Project

Coordinator: **University of the Aegean (GR)**

Partners:

Economic and Social Institute, Free University Amsterdam (NL)
Universitat Autònoma de Barcelona (SP)
Exergia SA (GR)
Regional Energy Agency of Crete (GR)

Date: July 2004

PROJECT FUNDED BY THE EUROPEAN
COMMISSION UNDER THE EESD
5th FRAMEWORK PROGRAMME

THE MCDA TOOLKIT MANUAL (version 1.0)

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0. Introduction

The basic steps for the MCDA toolkit manual are presented in the following pages. It is advisable that the user follows the manual in relation with the internet-based toolkit as it can be found in the relevant site:

<http://www.exergia.net/mcda>

Note: Please forward all comments, errata, etc. to the following address:

Stavros Kourvas [S.Kourvas@exergia.gr]

1. Main Screens

MCDA-res | welcome - Microsoft Internet Explorer

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Community Activities in the field of the specific programme for RTD and Demonstration on "Energy and Environment and Sustainable Development - Part B: ENERGIE PROGRAMME"

The Directorate - General for Energy and Transport (DG TREN) of the European Commission, in the framework of the Energie Programme, is co-financing and supporting the project entitled "**Development and Application of A Multi-Criteria Software Decision Analysis Tool for Renewable Energy Sources (MCDA-RES)**" which is undertaken by an international consortium led by the University of Aegean.

The aim of the project is to to develop a Software Decision Tool that will enable the Multi-Criteria Decision Analysis of RES investments and apply it in three case-studies. Secondary objectives are: to promote RES in isolated regions under distributed generation and deregulated energy markets, to map social preference of stakeholders in an energy-environment-economy framework, to eliminate uncertainties and risk of new technologies, to assist with environmental protection and emission reductions, to encourage creation of new skilled jobs, to invigorate the EU's RES manufacturing industry, to reduce oil imports, to demonstrate innovative methodological solutions and their integration in realistic operating conditions, to enhance the security and diversity of energy systems in isolated areas, to enable local authorities, non-governmental organizations, central government, etc. participating in Group Decision Analysis for RES investments, to promote internet-based exchange of technical and other expertise in RES applications..

click here for more information

MYTILENE 15-16 September
WORKSHOP RESULTS

"WIND ENERGY INVESTMENTS - A MULTI-CRITERIA AND MULTI-PARTICIPATORY APPROACH"

AMSTERDAM 31 January 2004

RES Projects in Netherlands

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Project Consortium:

- **the University of the Aegean-Department of Environmental Studies (Greece) - Prime Contractor**
- **The Free University of Amsterdam-Economic and Social Institute (Netherlands)**
- **The Autonomous University of Barcelona-Centre for Environmental Studies (Spain)**
- **ENERGY CENTRE OF TRIKALA AREA (Greece)**
- **EXERGIA S.A. Company Website (Greece)**

Internet

Screen 1.1: Initial screen – Home

It provides an introduction to the MCDA-RES project; participants, duration, description of work, aim - objectives, work packages, etc.

An overview of the Mytilene and Amsterdam workshops is also presented (topics, description, participants, related presentations, virtual exercises, etc).

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FIFTH FRAMEWORK PROGRAMME

Development and Application of a Multi-Criteria Decision Analysis Software Tool for Renewable Energy Sources (MCDA-RES)

Contract NNE5-2001-273

[Project Reports]

Right click any of the following and then click save as to download the desired file

- > **Deliverable 1 Report:** Initial survey and analysis of Multi-Criteria Decision Making techniques
- > **Deliverable 2 and 3 Report:** Comparative evaluation of performance in RES investments appraisal and Final identification and selection of multi-criteria decision making technique
 - > Deliverable 2 and 3 - Table
- > **Deliverable 4 Report:** Identification of the stakeholders and the elicitation of their weight attributes
- > **Deliverable 5 Report:** Identification of the evaluation criteria for energy, technical, economic, environmental, social, risk and policy issues
- > **Deliverable 6 Report:** Collection of relevant regional, energy, economic and environmental data
- > **Deliverable 7 Report:** Data bases for manufactures, suppliers, consultants, authorities, experts, investors, NGOs
- > **Deliverable 8 Report:** Data base of costs, technologies, environmental pressures, regional planning issues

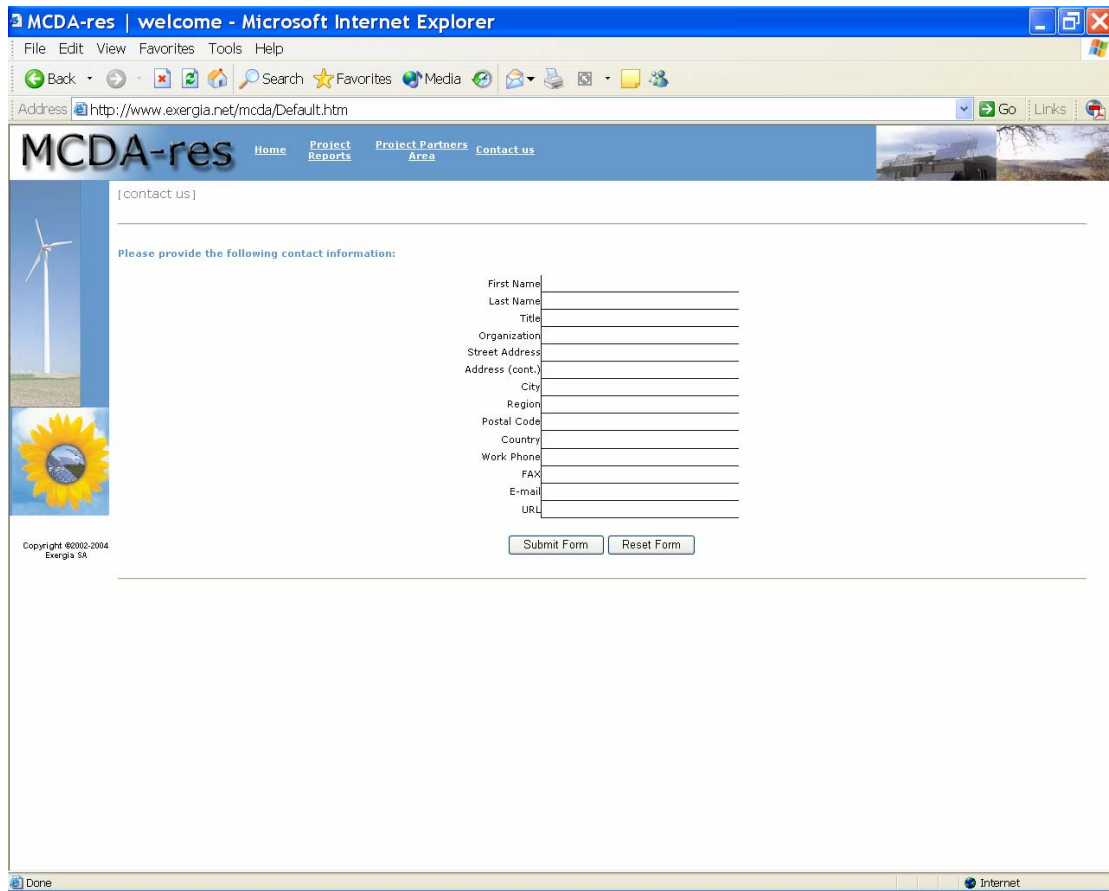
[zip file]

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Internet

Screen 1.2: Project reports

The project Deliverables accepted so far by the Commission Services can be found in the MCDA-RES web-site.



Screen 1.3: Contact details page

This page provides to the user with a communication gate with the consortium.

2. The MCDA Tool-kit

Contents

- [What is Multi-Criteria Decision Analysis?](#)
- [Why MCDA and Renewable Energy Sources?](#)
- [The MCDA Process](#)
- [Case Studies - Learning Experience](#)
- [The MCDA Tool Kit](#)
- [RES Applications](#)

Why MCDA and Renewable Energy Sources?

The political, social, economic and environmental importance of energy planning, to meet the ever-increasing energy demand with adequate energy supply, renders the process of decision-making between different energy projects a major challenge for policy makers. This applies particularly for Renewable Energy Sources (RES), since their particular features (decentralized production, localized and short term cost, distributed and long term benefits, involvement of many stakeholders and multiple-evaluation criteria) entails the use of specific instruments to choose the best option for their evaluation.

A number of factors should therefore be taken into consideration. They emerge from their decentralized character and the particularities imposed on the corresponding decision-making process (Fig. 1). In most cases these parameters can be operationalised through the inclusion of several technical, economic, social, risk, and environmental criteria in the planning exercise. The development procedure is even more complicated due to the involvement of the stakeholders, influencing the decision-making process.

Environmental benefits

- Limited contribution to:
 - Local air pollution
 - Acid rain formulation
 - Global warming

Local impacts

- Land use
- Landscape -aesthetics
- Rural lifestyle
- Noise
- Ecosystem disturbance

Spatial distribution of costs and benefits

- Benefits are distributed to the wider public
- Costs are localized to the area

Temporal distribution of costs and benefits

- Benefits on a long-term basis
- Costs on a short-term basis

Public character of energy decision-making

- Sustainability
- Complexity
- Irreversibility
- Democracy

Involvement of many stakeholders with different

- Values
- Interests
- Objectives

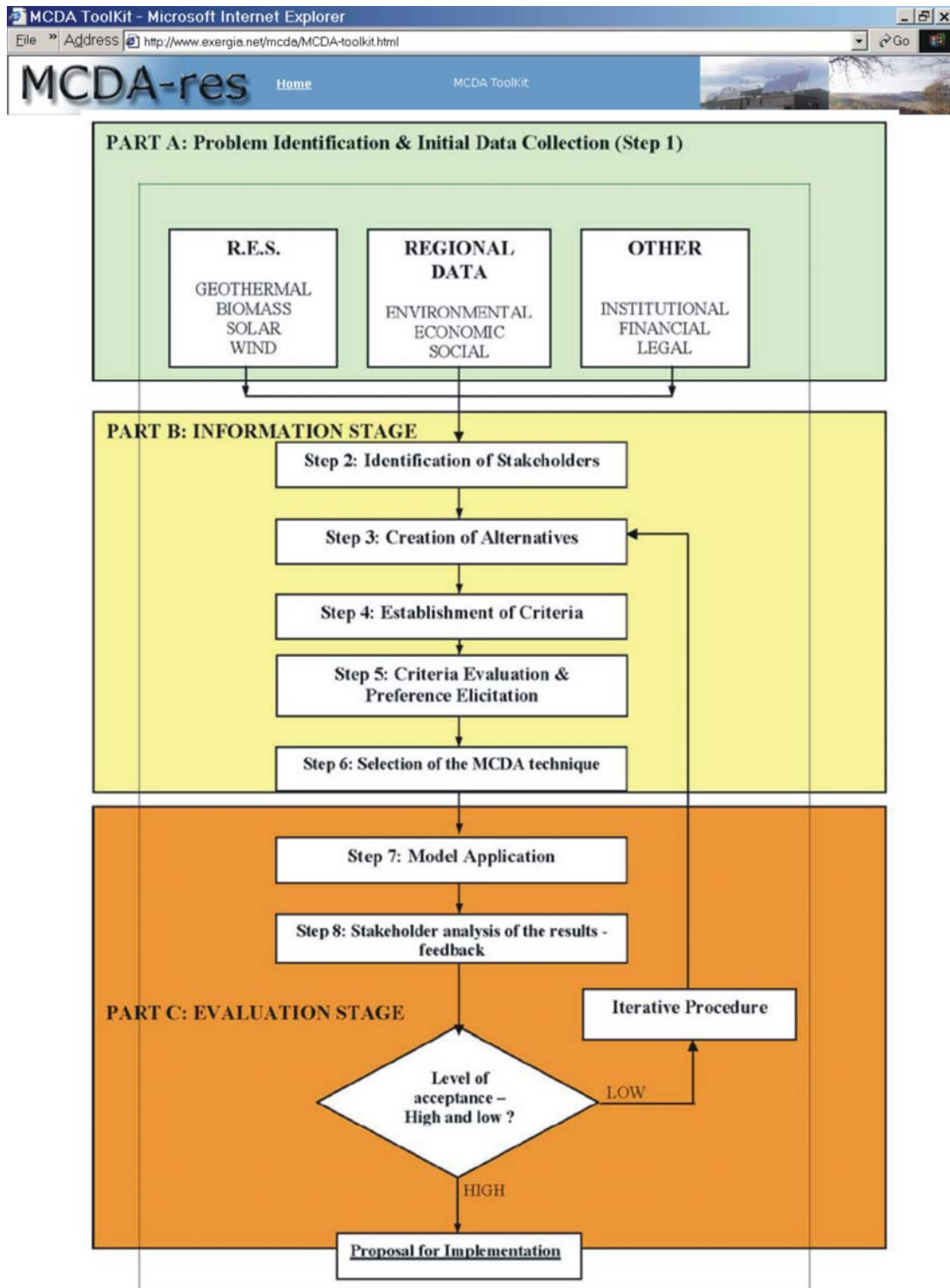
Multiple decision criteria

- Economic
- Resource
- Technical
- Environmental
- Social

Fig. 1: Renewable energy sources and MCDA

Screen 2.1: The MCDA Tool-kit, initial page

It introduces the concept of multi-criteria analysis to the user and explains its appropriateness in renewable energy planning and decision-making.



Screen 2.2: The MCDA 8-Step process – Introductory page

In order to provide a user-friendly approach for the multi-criteria analysis of RES projects, the whole process is divided into 8 distinct steps, namely:

STEP 1: Problem Identification and Initial Data Collection

STEP 2: Identification of Stakeholders

STEP 3: Creation of Alternatives

STEP 4: Establishment of Criteria

STEP 5: Criteria Evaluation and Preference Elicitation

STEP 6: Selection of the MCDA Technique

STEP 7: Model Application

STEP 8: Stakeholders Analysis of Results and Feedback

The user can click on any STEP and gain access to complementary information.

MCDA ToolKit - Microsoft Internet Explorer

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Address http://www.exergla.net/mcda/MCDA-toolkit.html

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 - >WIND : electricity
 - >HYDRO : electricity
 - >BIOMASS : heat, electricity, CHP
 - >WAVE : electricity
 - >GEO THERMAL : heat, electricity, CHP
- Useful Links
- Databases

The MCDA process - Example of implementation of different steps

Click on any cell of the following table to see additional information about each step and case study:

MEDA 8 steps process	Case Studies							
	Greece				Netherlands		Spain	
Types of RES	1 Ikaria Wind & Hydro	2 Troizina Wind	3 Andissa Wind	4 Polychinitos Geothermal	1 Utrecht Wind	2 Flevoland Wind	1 Valldona Wind	2 PV
Step 1: Problem Identification & Initial Data Collection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Step 2: Identification of Stakeholders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Step 3: Creation of Alternatives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Step 4: Establishment of Criteria	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Step 5: Criteria evaluation & Preference Elicitation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Step 6: Selection of the MCDA technique	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Step 7: Model application	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Step 8: Stakeholder analysis of the results	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The MCDA Tool Kit

The current Software Decision Tool aims at providing guidelines that enable integrated Analysis of RES investments. This process will aid in deciding about the appropriate project to be implemented.

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RES Application

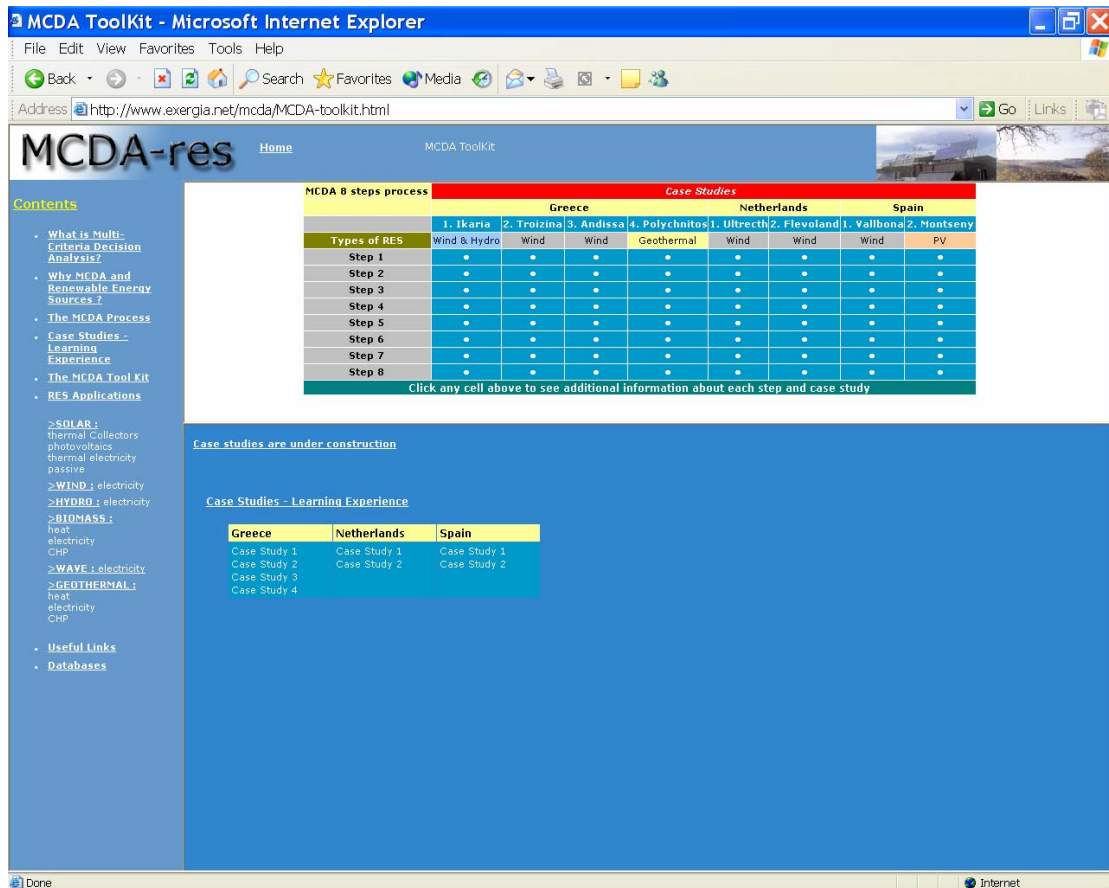
(click on the desired category or sub-category to see more information)

[Renewable Energy Sources](#)

Internet

Screen 2.3: The MCDA process – Examples of implementation of different steps

The Tool-kit can be accessed by either following the 8-STEPS approach, or through the case-studies in Greece, Netherlands and Spain. This Screen provides the main navigator gate.



Screen 2.4: Case-studies, learning experiences

The case-studies are considered as learning experiences. The user could gain insights of the way to implement the MCDA-RES Tool-kit.

The case-studies comprise:

- ❖ Four (4) case-studies in Greece
 - No.1: Wind and hydro energy (islandic – non interconnected system)
 - No. 2: Wind energy (main land – interconnected system)
 - No.3: Wind energy (islandic – non interconnected system)
 - No.4: Geothermal energy (autonomous thermal applications)
- ❖ Two (2) case-studies in the Netherlands
 - No.1: Wind energy
 - No. 2: Wind energy
- ❖ Two (2) case-studies in Spain
 - No.1: Wind energy
 - No. 2: Solar energy

MCDA ToolKit - Microsoft Internet Explorer

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Address <http://www.exergla.net/mcda/MCDA-toolkit.html> Go Links

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RES Application

(click on the desired category or sub-category to see more information)

```

graph TD
    RES[Renewable Energy Sources] --> SOLAR[SOLAR]
    RES --> WIND[WIND]
    RES --> HYDRO[HYDRO]
    RES --> BIOMASS[BIOMASS]
    RES --> WAVE[WAVE]
    RES --> GEOTHERMAL[GEOTHERMAL]
    
    SOLAR --> SOLAR_T["THERMAL COLLECTORS<br/>PHOTOVOLTAICS<br/>THERMAL ELECTRICITY<br/>PASSIVE"]
    WIND --> WIND_E[ELECTRICITY]
    HYDRO --> HYDRO_E[ELECTRICITY]
    BIOMASS --> BIOMASS_E["HEAT<br/>ELECTRICITY<br/>CHP"]
    WAVE --> WAVE_E[ELECTRICITY]
    GEOTHERMAL --> GEOTHERMAL_E["HEAT<br/>ELECTRICITY<br/>CHP"]
    
    SOLAR_T --- MAN[Manufacturers, Suppliers, Consultants, Authorities, Experts, Investors, NGOs]
    WIND_E --- MAN
    HYDRO_E --- MAN
    BIOMASS_E --- MAN
    WAVE_E --- MAN
    GEOTHERMAL_E --- MAN
  
```

Manufacturers, Suppliers, Consultants, Authorities, Experts, Investors, NGOs

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Useful Links

- <http://www2.dti.gov.uk/energy/renewables/>
- <http://www.unep.ie.org/energy/act/re/index.htm>
- <http://www.lamsade.dauphine.fr/english/software.html>
- http://europa.eu.int/comm/das/energy_transport/
- <http://www.cordis.lu>
- <http://www.nrel.gov/>
- http://europa.eu.int/comm/energy_transport/atlas/

Internet

Screen 2.5: RES applications and useful links

The user can access primary information regarding the different types of renewable energy and their pertinent applications. Photos and related presentations are also included. Links to the various Databases are also provided, according to the type of RES application selected.

3. MCDA 8 STEPS process

The screenshot shows the MCDA ToolKit website. The browser title is "MCDA ToolKit - Microsoft Internet Explorer". The address bar shows "http://www.exergla.net/mcda/MCDA-toolkit.html". The page content includes a navigation menu on the left, a table of case studies, and detailed text for Step 1: Problem Identification & Initial Data Collection.

Types of RES	Greece				Netherlands		Spain	
	1. Ikaria Wind & Hydro	2. Troizina Wind	3. Andissa Wind	4. Polychnitos Geothermal	1. Utrecht Wind	2. Flevoland Wind	1. Vallbona Wind	2. Montseny PV
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

PART A: Problem Identification & Initial Data Collection
The process begins with the initial Problem identification (**Step 1**).

This involves a broad problem statement, from which the emergence of the project and the general 'Societal call' for action are revealed. Moreover, the necessity for initiating an integrated evaluation procedure for deciding between competing projects is disclosed, and the option of doing nothing (zero action) is taken under consideration.

Within the remaining of the framework, we identify the contextual components that help to shape renewable energy decision-making.

PART B: Information Stage
Subsequently, the stakeholders are identified – **Step 2**: Identification of Stakeholders. They consist of all the different people associated with the planning and decision procedure, those who have a legitimate responsibility to participate in the procedure, and/or add a socio-political dimension to the process. The actual decision-makers are established from these groups and could embrace potentials investors, local authorities, central government representatives, non-governmental organizations, farmers associations, local media, residents of the area, etc. However, there exists no well-defined process for deciding on the different parties who should have a voice in the decision process. They depend on the specific case study.

Next, all possible projects are identified – **Step 3**: Creation of Alternatives. The set of alternatives considered should be open to alterations, resulting from the input of the stakeholders (especially the local ones), during the consultation procedure. The local people are familiar with information that the analysts ignore and may bring to light 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, so that the 'zero action' alternative (do nothing) should be included in the portfolio.

Obviously, the selection of evaluation criteria is one of the most important concerns. This is **Step 4**: Establishment of Criteria. 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, ready to be integrated into the model. This involves hard work and usually is 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 (toe/yr), return of investment (yearly earnings per initial investment), and the number of permanent jobs created in the area. The environmental impact criterion is a highly controversial one. It is suggested that land use requirements, aesthetic considerations, waste generation, water prerequisites, Life Cycle Analysis of the technologies considered, should (probably among others) compose the overall environmental index.

Next comes **Step 5**: Criteria Evaluation & Preference Elicitation. It involves the collection and assessment of the relevant information (renewable energy potential estimation, regional, institutional, financial and legal data). The local renewables potential could be geothermal (hot water, hot dry rock), biomass including energy crops, wind, and solar, tidal, etc., resources. From the initial information gathering, it is anticipated that a general decision-making agenda could be shaped and the actual technical availability for renewable energy exploitation would be revealed. The results of this process could be communicated to the interested parties.

Screen 3.1: MCDA 8 Steps process

This is an initial introduction to the 8-STEP multi-criteria approach for integrated evaluation of RES projects. It presents the theoretical part of the Tool-kit and it also includes specific guidelines for decision-making.

MCDA ToolKit - Microsoft Internet Explorer

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Address http://www.exergia.net/mcda/MCDA-toolkit.html

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MCDA 8 steps process	Case Studies							
	Greece				Netherlands		Spain	
Types of RES	1. Ikaria Wind & Hydro	2. Troizina Wind	3. Andissa Wind	4. Polychnitos Geothermal	1. Utrecht Wind	2. Flevoland Wind	1. Vallbona Wind	2. Montseny PV
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Examples of Evaluation Criteria

ENERGY – RESOURCE USE CRITERIA

No	Criterion	Explanation		Examples – question to be addressed	Remarks – Comments
EN.1	Amount of imported oil avoided	Indicates the amount of oil – fossil fuel burned to provide an equivalent service	Tons of oil equivalent saved per year [ton/yr]	Tons of oil consumed / kWh produced	Expresses the reduction of amount of imported oil. It is assumed that the project substitutes an oil plant
EN.2	Potential for reducing black-outs	The total installed capacity is compared with the predicted total demand as provided by the relative authority	% coverage of peak demand by the available power	Connected to the mainland grid? Or not?	Safety in covering peak demand. More important for non interconnected electricity systems
EN.3	Amount of electricity produced	Provides an index of the magnitude and real production capacity of the project	kWh produced per year [kWh/yr]		Depends on the total installed capacity of the project and the overall conversion efficiency

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Screen 3.2: STEP 4 – Establishment of criteria

Five (5) main categories of evaluation criteria have been identified: energy, economic, environmental social and technological. A preliminary set (a total of 20 criteria), was drafted on this basis. Certain criteria are measured on a quantitative impact scale while for others a qualitative impact scale has been used. This Screen presents the proposed criteria related to the energy-resource base.

MCDA 8 steps process

Types of RES	Case Studies							
	Greece				Netherlands		Spain	
	1. Icaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

2. Modeling of DM's preferences

In most multi-criteria methods a weight is assigned to each criterion, expressing its relative importance. The use and the analysis of the weights depend on the selected decision model.

PROMETHEE II, ELECTRE III, REGIME and FLAG, use weights while NAIADA does not.

On the other hand, NAIADA allows performing a coalition analysis, showing the ranking of the alternatives for each group of actor.

The use of weights provides the Decision Makers with a way for indicating their preferences. In RES planning, however, many times the DM's are not willing to express their weights between the different dimensions-criteria due to political reasons. In fact, giving weights to the criteria means to give weight to the group of social actors. It is recommended, however, to include weights in the analysis to enhance the transparency of the decision-making process.

In order to increase transparency, it might be useful to show the different outcomes resulting from various sets of weights, making clear that the choice of weights is a political decision, and reflects the values of the user. In different sets of weights produce In the next Table 2 MCDA methods are juxtaposed with the ability to include weights in the analysis they provide.

Table 2. Comparison of methods by criterion 2: Modeling of DM's preferences

Methods	Use of weights
ELECTRE III	YES
PROMETHEE II	YES
NAIADA	NO
REGIME	YES
FLAG	YES

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Screen 3.3: STEP 6 – Selection of the MCDA technique

A number of multi-criteria decision analysis techniques can be found. The MCDA-RES Tool-kit incorporates 4 methods-techniques, namely:

- REGIME - FLAG models
- ELECTRE III
- PROMETHEE II
- NAIADA

The user could follow specific guidelines to choose the appropriate MCDA technique for her particular case.

MCDA ToolKit - Microsoft Internet Explorer

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Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Software

Please click on the following links to download the software to your computer (compressed zip files)

[Electre III / IV](#)

Unzip file and double click on "eldemo.exe"

NAIADE

Unzip file to "C:\NAIADE" and double click on "naiade.exe"

Right click [here](#) and select "Save target as" to download NAIADE software manual and tutorial

SamiSoft

Unzip file and browse to "SamiSoft\Support" and double click on "samisoft.exe"

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Case Studies - Learning Experience

Greece	Netherlands	Spain
Case Study 1	Case Study 1	Case Study 1
Case Study 2	Case Study 2	Case Study 2
Case Study 3		
Case Study 4		

Screen 3.4: STEP 7 - Model application

In order to actually apply the MCDA-RES Tool-kit, the user should download a particular method – software. Manual for each software is also included.

4. Case-studies

4.1 Greece

The screenshot shows the MCDA ToolKit website in Microsoft Internet Explorer. The page title is "MCDA ToolKit - Microsoft Internet Explorer" and the address bar shows "http://www.exergla.net/mcda/MCDA-toolkit.html". The website header includes "MCDA-res" and "Home".

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Case Studies

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Types of RES	1. Ikaria Wind & Hydro	2. Troizina Wind	3. Andissa Wind	4. Polychnitos Geothermal	1. Utrecht Wind	2. Flevoland Wind	1. Vallbona Wind	2. Montseny PV
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Case studies are under construction

Greece

Case study 1

- >Step 1 : Problem Identification
- >Step 2 : Identification of Stakeholders
- >Step 3 : Creation of Alternatives
- >Step 4 : Establishment of Criteria
- >Step 5 : Data Collection
- >Step 6 : Selection of the MCDA technique
- >Step 7 : Model Application
- >Step 8 : Stakeholder analysis of the results - feedback

Case study 2

- >Step 1 : Problem Identification
- >Step 2 : Identification of Stakeholders
- >Step 3 : Creation of Alternatives
- >Step 4 : Establishment of Criteria
- >Step 5 : Data Collection
- >Step 6 : Selection of the MCDA technique
- >Step 7 : Model Application
- >Step 8 : Stakeholder analysis of the results - feedback

Case study 3

- >Step 1 : Problem Identification
- >Step 2 : Identification of Stakeholders
- >Step 3 : Creation of Alternatives
- >Step 4 : Establishment of Criteria
- >Step 5 : Data Collection
- >Step 6 : Selection of the MCDA technique
- >Step 7 : Model Application
- >Step 8 : Stakeholder analysis of the results - feedback

Case Study 4

- >Step 1 : Problem Identification
- >Step 2 : Identification of Stakeholders
- >Step 3 : Creation of Alternatives
- >Step 4 : Establishment of Criteria
- >Step 5 : Data Collection
- >Step 6 : Selection of the MCDA technique
- >Step 7 : Model Application
- >Step 8 : Stakeholder analysis of the results - feedback

Screen 4.1.1: The case-studies in Greece – Introductory page

This Screen provides an overview of the four (4) case-studies in Greece.

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MCDA 8 steps process	Case Studies							
	1. Ikaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Types of RES	Wind & Hydro	Wind	Wind	Geothermal	Wind	Wind	Wind	PV
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Fig. 3.1. The hybrid (hydro-wind) energy project in Ikaria

Right click [here](#) and select "Save target as" to download this page as a PDF document.

Screen 4.1.3: Greek case-study No.1 – STEP 3

Presentation of Alternative Scenario No.2: The hybrid (wind-hydro) plant in Ikaria Island.

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MCDA 8 steps process	Case Studies							
	Greece				Netherlands		Spain	
Types of RES	1. Icaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Table 4.5. Technological criteria

No	Criterion	Explanation	Indicator - unit of measurement	Examples - question to be addressed	Remarks - Comments
T.1	Reliability and safety	Refers to the maturity of the technology used, to the risk of a serious accident, to the capacity to provide electricity when needed, and to the stability of the network.	Qualitative scale		

EN ENERGY CRITERIA EC ECONOMIC CRITERIA
 ENV ENVIRONMENTAL CRITERIA S SOCIAL CRITERIA
 T TECHNOLOGICAL CRITERIA

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Screen 4.1.4: Greek case-study No.1 – STEP 4

Presentation of the Technological Criteria selected for the 1st Greek case-study.

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MCDA 8 steps process	Case Studies							
	Greece				Netherlands		Spain	
Types of RES	1. Icaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

2. STEP 2: IDENTIFICATION OF STAKEHOLDERS

For each case study the interviewed groups of stakeholders are presented in Table 2.1. The cells that are filled with color declare that a form of contact activity with a representative of each group took place. Moreover, Table 2.2 presents the stakeholders for the case - study of Troizina.

Table 2.1. Interviewed groups of stakeholders for each case study

No	CASE STUDIES	STAKEHOLDERS							
		INVESTORS			AUTHORITIES		NGOs		LOCAL PPC
		PRIVATE	NON-RPRIVATE	ASSOCIATION	LOCAL	REGIONAL	LOCAL	GREENPEACE	
1	IKARIA								
2	TROIZINA								
3	ANTISSA								
4	POLYCHNITOS								

Legend: INVESTORS (orange), AUTHORITIES (cyan), NGOs (green), LOCAL PPC (red)

Screen 4.1.5: Greek case-study No.2 – STEP 2 (PDF version)

Material for each STEP and case-study can also be accessible in PDF format to enable easy overview and printed layout. This Screen presents the type of stakeholders that have been identified for the Greek case-studies and particularly for case-study No 2 (wind energy).

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MCDA 8 steps process

Types of RES	Case Studies							
	Greece				Netherlands		Spain	
	1. Ikaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Wind & Hydro	•	•	•	•	•	•	•	•
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Scenario	PROMETHEE Net Flow
1	-0,002
2	-0,264
3	0,182
4	0,084

DM - Local Authority - Municipality of Troizina

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Screen 4.1.6: Greek case-study No.2 – STEP 7

The results of the model application are presented in a Table and Graphic format.

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MCDA 8 steps process	Case Studies							
	Greece				Netherlands		Spain	
Types of RES	1. Ikaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

3. STEP 3: CREATION OF ALTERNATIVES

Case study No 3: Lesvos Island –Andissa

1st scenario: "Do-nothing"
No additional W/Ts will be installed in the area. Current wind capacity installed in the area is 7.2 MW (12 W/T *0.6 MW each).

2nd scenario: "Extension of the existing wind park"
In the second scenario the plans of the investors (Elliniki Technodomiki Energiaki S.A.), are exactly followed. Another 3 W/Ts of 0.6 MW each are to be installed at the area of the existing wind park.

Screen 4.1.7: Greek case-study No.3 – STEP 3 (PDF version)

The Alternative Scenarios formulated for the 3rd case-study in Greece.

Type of RES: Wind Energy

No of alternatives: 2

Selected MCDA technique: PROMETHE II

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MCDA 8 steps process	Case Studies							
	Greece				Netherlands		Spain	
Types of RES	1. Icaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Fig. 5.3. Criteria weights of the Greenpeace for the Andissa case study

For the Lesvos Island - Andissa case-study, three (3) types of stakeholders/Decision-Makers have been identified, namely Investors, Authorities, and Non-governmental organizations.

Screen 4.1.8: Greek case-study No.3 – STEP 5

This Screen presents the results of the weight elicitation module.

Decision-Maker: Non-governmental Organization – GREENPEACE

No of criteria: 18

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MCDA 8 steps process	Case Studies							
	Greece				Netherlands		Spain	
Types of RES	1. Icaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

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0. INTRODUCTION

1. STEP 1: PROBLEM IDENTIFICATION & INITIAL DATA COLLECTION

1.1 Case study No 1: Icaria Island

1.2 Case study No 2: Troizina

1.3 Lesvos Island

1.3.1 Case study No 3: Lesvos - Andissa

1.3.2 Case study No 4: Lesvos - Polychnitos

2. STEP 2: IDENTIFICATION OF STAKEHOLDERS

3. STEP 3: CREATION OF ALTERNATIVES

4. STEP 4: ESTABLISHMENT OF CRITERIA

5. STEP 5: CRITERIA EVALUATION & PREFERENCE ELICITATION

6. STEP 6: SELECTION OF THE MCDA TECHNIQUE

7. STEP 7: MODEL APPLICATION

8. STEP 8: STAKEHOLDER ANALYSIS OF THE RESULTS - FEEDBACK

8,26 x 11,69 in 1 of 5

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Screen 4.1.9: Greek case-study No.3 – STEP 8 (PDF version)

Every PDF file starts with a Table of Contents indicating the particular case-study and STEP.

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MCDA 8 steps process	Case Studies							
	Greece				Netherlands		Spain	
Types of RES	1. Icaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Table 5.3. Criteria weights (%) of the DMs for the Polychnitos case study

CRITERIA	INVESTOR	AUTHORITIES	
		LOCAL	REGIONAL
EN. 1	18,8	18,4	19,0
EC. 1	12,5	14,3	9,5
EC. 2	18,8	16,3	11,9
ENV. 1	14,3	12,2	14,3
ENV. 2	9,8	9,2	7,1
ENV. 3	9,8	9,2	16,7
S. 1	16,1	20,4	21,4

Screen 4.1.10: Greek case-study No.4 – STEP 5

The evaluation criteria and the elicitation of preference for the 4th case-study in Greece

Type of RES: Geothermal Energy

Decision-Maker: Investor

No of Criteria: 7

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MCDA 8 steps process	Case Studies							
	Greece				Netherlands		Spain	
Types of RES	1. Icaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

STEP 6: SELECTION OF THE MCDA TECHNIQUE

Regarding the case - study of Lesvos - Polychnitos, two Multi-Criteria Decision Analysis methods were selected:

- PROMETHEE II
- ELECTRE III

The selection of the above methods was based on the following characteristics:

- Both methods take into account the participants subjective preferences
- They have the ability to support a large number of decision makers
- They can both handle many criteria and alternatives
- The treatment of inaccurate and uncertain data is possible as well as the use of mixed kind of information
- From the implementation of both methods the explicit ranking of the alternatives is provided. Moreover, the interpretation of all software parameters is possible which enhances the transparency of the procedure.

Furthermore, ELECTRE III does not allow compensation between the criteria and it is literally proposed in cases where it is not possible to apply more than one method.

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Screen 4.1.11: Greek case-study No.4 – STEP 6

The selection of the appropriate MCDA technique

For the 4th Greek case-study, both the ELECTRE III and the PROMETHEE II MCDA techniques have been selected and applied.

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Types of RES	Case Studies							
	Greece				Netherlands		Spain	
	1. Icaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Wind & Hydro	•	•	•	•	•	•	•	•
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Table 7.1. Presentation of the PROMETHEE II results

Scenarios	INVESTOR	LOCAL AUTHORITIES	REGIONAL AUTHORITIES
Net flows for each alternative scenario			
1st	0,23	0,11	-0,03
2nd	-0,32	-0,30	-0,43
3rd	0,03	-0,03	0,27
4th	-0,14	0,06	0,07

INVESTOR RANKING

Figure 7.1. Graphical presentation of the investor's results

Screen 4.1.12: Greek case-study No.4 – STEP 7

Results of the PROMETHEE II method and ranking of alternative scenarios for the Decision-Maker: Investor (graphical presentation)

4.2 Netherlands

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>WIND : electricity

>HYDRO : electricity

>BIOMASS : heat, electricity, CHP

>WAVE : electricity

>GEOTHERMAL : heat, electricity, CHP

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MCDCA 8 steps process

Types of RES	Case Studies							
	Greece				Netherlands		Spain	
	1. Ikaria	2. Troizina	3. Andissa	4. Polychnitos	1. Utrecht	2. Flevoland	1. Vallbona	2. Montseny
Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Policy field	Treaty	Year	Subject
Climate change	UN framework convention on climate change	1992	Stabilising the concentration of greenhouse gasses in the atmosphere
	Kyoto protocol	1997	Emission reduction of greenhouse gasses
Bird and nature protection	Convention on wetlands	1971	Conservation of wetlands
	Convention of Bern	1979	Conservation of European wildlife and natural habitats
	Convention of Bonn	1979	Conservation of migratory species of wild animals
	AEWA	1995	Conservation of African Eurasian migratory waterbirds
	Bird and habitat guidelines	1979	Protection and conservation of nature area's where wild birds and animals live in Europe
	/		
	Convention of Rio de Janeiro	1992	Conservation and protection of the biological diversity

Table 3: The national, regional and local guidelines of the Netherlands

National	Regional	Local
Emission reduction	Spatial policy	Spatial policy
Energy policy	Wind energy	Sustainable development
Nature conservation	Energy	Wind energy
Safety	Environment	
Spatial policy	Nature and landscape	
Economic policy	Cultural history	
	Economic policy	

Screen 4.2.1: Dutch case-study No.1 – STEP 1

Problem Identification and Initial Data Collection; Policy Data

Type of RES: Wind Energy

MCDCA technique: REGIME Analysis

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>SOLAR: thermal Collectors, photovoltaics, thermal electricity, passive

>WIND: electricity

>HYDRO: electricity

>BIOMASS: heat, electricity, CHP

>WAVE: electricity

>GEOTHERMAL: heat, electricity, CHP

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Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Case study: Province Utrecht

Stakeholder analysis of results

The final result of the Regime analysis based on relative scores is presented in Table 17. The most preferred variant for each location is given including the ranking and the production capacity.

Table 17: Preferred locations according to the Regime analysis

Loc.	Description of location	Rank	Capacity
2	Amsterdam Rhine canal, base alternative, variant 2	1	72MW
1	A2 highway near Vinkeveen, base alternative, variant 2	4	36MW
4	A1 highway near Baarn, alternative 1, variant 2	11	40.5MW
3	A12 highway near Woerden, base alternative, variant 1	12	40MW
5	A2 highway near Breukelen, base alternative, variant 1	31	20MW

As stated before the realisation of just the first park will comply with the target of the

Screen 4.2.2: Dutch case-study No.1 – STEP 8 (PDF version)

Stakeholders' analysis of results and feedback

Preferred wind mills locations according to REGIME Analysis

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photovoltaics
thermal electricity
passive

➤ **WIND**:
electricity

➤ **HYDRO**:
electricity

➤ **BIOMASS**:
heat
electricity
CHP

➤ **WAVE**:
electricity

➤ **GEOTHERMAL**:
heat
electricity
CHP

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Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

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In this figure the relationship between CTVs, flags and indicator values are illustrated. If the outcome value of this cost-indicator is lower than 85 units, e.g. 70 units, it receives a green flag, which means that there is no reason for concern. If the indicator has an outcome value of 110 units, it receives a red flag, which means that trend should be reversed.

Green: No reason for concern
Red: Reverse trend
Yellow: Be alert
Black: Acceptable development

Figure 2: The relation between Critical Threshold Values and the colour of the flags

The Flag Model provides instruments to analyse alternatives in two ways. Firstly, it can be used to focus on a single alternative, to find out whether an alternative is acceptable or not. Secondly the model can compare several choice options and classify which alternative scores best.

The standard model consists of four steps:

1. Identifying a set of measurable indicators;
2. Assessing the impact of the alternatives on these indicators;
3. Establishing a set of normative reference values (CTV's);
4. Evaluating the relevant alternatives.

In Step 1 of the Flag procedure, the set of measurable indicators has to be identified. Criteria can be measured with the help of indicators. Indicators are pieces of information designed to communicate complex messages in a simplified, (quasi-) quantitative manner so that empirical progress in achievements of policy goals can be measured (Rotmans, 1997). The number of relevant indicators is not restricted a priori; the Flag Model can include any number. Of course, the choice of the indicators is subordinate to the relevant choice problem at hand. In the second step, the impact matrix has to be filled with empirical information. This structured information table contains the values that the indicators assume for each alternative considered. The Flag Model contains various classes of policy-relevant

Screen 4.2.3: Dutch case-study No.2 – STEP 6

Selected MCDA technique: FLAG model

4.3 Spain

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Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Evaluation of the potential of renewable energy sources

This evaluation was made based in a model called REGIS (based on GIS). This model associates specific data related to renewable energies (hydroelectric centrals, solar installations census, solar radiation, wind atlas, etc.) and the territory (edification, water courses, natural interest spaces, forest, communication ways, etc.), allowing to do an integrated analysis of four types of renewable energies: solar, hydraulic, wind and biomass energies. The REGIS model is able to simulate scenarios in concrete zones, and it gives information of energy production, primary energy saving and emissions of CO₂ and SO₂ that can be avoided.

Figure 1. Distribution of renewable energy uses in the year 2000.
(Source: Catalonia Renewable Energy Plan)

Screen 4.3.1: Spanish case-study No.1 – STEP 1

Problem Identification and Initial Data Collection; Evaluation of potential of renewable energy source

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Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Activity	Place and Date	Participants
Preliminary meeting	Municipality of Vallbona de les Monges 19/12/2003	2 Mayors
Open presentation of the project	Municipality of Vallbona de les Monges 09/01/2004	~30
Open presentation of the project	Municipality of Rocallaura 10/01/2004	~40
Focus group	Municipality of Vallbona de les Monges 16/01/2004	5
Preliminary meeting	Municipality of Els Omells de Na Gaia 16/01/2004	Mayor and 2 councillors
Open presentation of the project	Bar of the town of Els Omells de Na Gaia 17/01/2004	~30
Focus group	Municipality of Els Omells de Na Gaia 24/01/2004	5
Open presentation of the project	Municipality of Senan 14/02/2004	~25
Open presentation of the project	Central office of Montblanquet 27/03/2004	~15
Presentation of the preliminary results	Municipality of Vallbona de les Monges (and Rocallaura) 12/06/2004	2 Mayors and 4 councillors
Presentation of the preliminary results	Municipality of Els Omells de Na Gaia 25/06/2004	1 Mayors and 2 councillors
Open presentation of results	Bar of the town of Els Omells de Na Gaia 10/07/2004	~20

Social actor	Scale of action	Position regarding the windparks

Screen 4.3.2: Spanish case-study No.1 – STEP 2

Identification of Stakeholders

Participatory tool applied for approaching the social actors involved

Institutional Analysis

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Click any cell above to see additional information about each step and case study

Alternative ST (Serra del Tallat project)

This project has been submitted by Energia Hidroeléctrica de Navarra (EHN). Its characteristics are shown in Table 10, and in Figure 12 it can be seen its configuration.

Name	ST
Number of windmills	33
Power capacity	49.5 MW
Windmills' power	1.5 MW
Rotor height	80 m
Rotor diameter	71 m

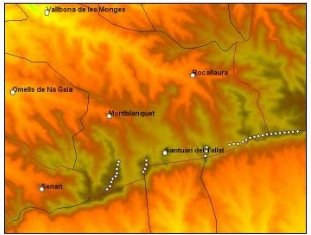


Figure 12. Location of the alternative Serra del Tallat

Alternative EB+ST (Proyectos Coma Bertran y Serra del Tallat)

This alternative is the combination between the final projects presented by Gerssa and EHN. Table 11 presents the characteristics of the windfarm, and Figure 13 shows its location.

Screen 4.3.3: Spanish case-study No.1 – STEP 3

Visual presentation of the Alternative Scenarios formulated for the 1st case-study in Spain

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Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

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Figure 22. Criteria for evaluating local visual impact

Amount of windmills

Distance

8,26 x 11,69 in 7 of 11

Done Internet

Screen 4.3.4: Spanish case-study No.1 – STEP 5 (PDF version)

Criteria for evaluating local visual impact – relevant parameters

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MCDA 8 steps process		Case Studies							
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Step 1	•	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•	•

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Figure 23. Regional ranking

Print	Intersection	Alternatives
0.85	F	A CB Pre
0.83	D	B CB
0.78	C	C ST
0.74	E	D CB+ST
0.72	G	E ST+
0.68	J	F CB+ST Pre
0.64	I	G L1
0.62	H	H L2
0.57	K	I R1
0.55	L	J R2
0.55	A	K A
0.50	B	L NP

Screen 4.3.5: Spanish case-study No.1 – STEP 7

Model Application: NAIADE method

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Step 1	•	•	•	•	•	•	•	•
Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Screen 4.3.6: Spanish case-study No.2 – STEP 1

Ideal problem structuring in Social Multi-Criteria Evaluation

Type of RES: Solar Energy

Application: PV systems

Selected MCDA Technique: NAIADE

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MCDA 8 steps process

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Step 2	•	•	•	•	•	•	•	•
Step 3	•	•	•	•	•	•	•	•
Step 4	•	•	•	•	•	•	•	•
Step 5	•	•	•	•	•	•	•	•
Step 6	•	•	•	•	•	•	•	•
Step 7	•	•	•	•	•	•	•	•
Step 8	•	•	•	•	•	•	•	•

Click any cell above to see additional information about each step and case study

Table 11. Sensitivity analysis of the Social Multicriteria Evaluation for owners, 1998 and 2004

Crossover value	1998						2004					
	a=0,4		a=0,6		a=0,8		a=0,4		a=0,6		a=0,8	
	Low	high	Low	high	low	high	low	high	low	High	Low	high
Minimum Operator	F S	S F.PV	E S.PV	S F.PV	F PV S	S F.PV	G PV	G PV	G PV	G PV	PV G	PV G
Zimmermann- Zysno Operator $\gamma=0$	F S.PV	S F.PV	E S.PV	F .S S	F PV S	S F.PV	G PV	G PV	G PV	G PV	PV G	PV G
Simple product	F S.PV	S F.PV	E S.PV	S F.PV	F PV S	S F.PV	G PV	G PV	G PV	G PV	PV G	PV G

The sensitivity analysis for inhabitants also shows that the results for 1998 are robust for lower crossover values, whereas they change with higher crossover values. In 2004 they are stable.

Screen 4.3.7: Spanish case-study No.2 – STEP 7

Model Application: NAIADE method; Presentation of the results

5. Conclusions

The main objective of the FP5 – EESD MCDA-RES project is the development of a Software Decision Tool that will enable the Multi-Criteria Decision Analysis (MCDA) of energy projects utilizing Renewable Energy Sources (RES) and the comparative assessment of its application in three case-studies in different member states of the EU. This manual provides an overview of the MCDA-RES software Tool-kit. The Tool-kit is currently available on-line at the web-site:

www.exergia.net/mcda

A CD off-line version of the Tool-kit is also provided.

The Tool-kit initially provides information regarding the methodological approach of multi-criteria analysis and its suitability in renewable energy planning and evaluation of RES projects. Subsequently, it gives an overview of the different types of RES applications, including examples, photos, virtual presentations and exercises. The results of two (2) relevant Workshops organized in Greece (Lesvos-Mytilene) and Netherlands (Amsterdam) are also included.

The decision-making process is structured around 8 distinct steps, as presented earlier. These steps provide a general outline for understanding and applying the Tool-kit. They can be followed either by a theoretical means or through the practical application of the Tool-kit in 8 different case-studies in Greece, Netherlands and Spain. A main navigator Screen guides the user in her choice of the theoretical (experienced users) or the practical (non-experts) way of the CD implementation.

The case-studies include wind, hydro, solar and geothermal ventures, interconnected or non-interconnected systems, electrical and thermal uses, islandic or main land areas, and different multi-criteria analytical techniques. Each case-study is structured around the eight (8) proposed steps and the user can easily navigate between different steps, case-studies and types of RES. The case-studies' material is also available in PDF form in order to enable the user for easy overview and printed layout.

The MCDA-RES Tool-kit will be concluded after the Training Course, where it will be thoroughly presented to pertinent stakeholders from Greece, Netherlands and Spain. It is anticipated that valuable feedback will be gained and the Tool-kit will be accordingly complemented and improved.