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 Autonoma de Barcelona (SP)
Exergia SA (GR)
Regional Energy Agency of Crete (GR)

Date: July 2004

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THE MCDA TOOLKIT MANUAL (version 1.0)

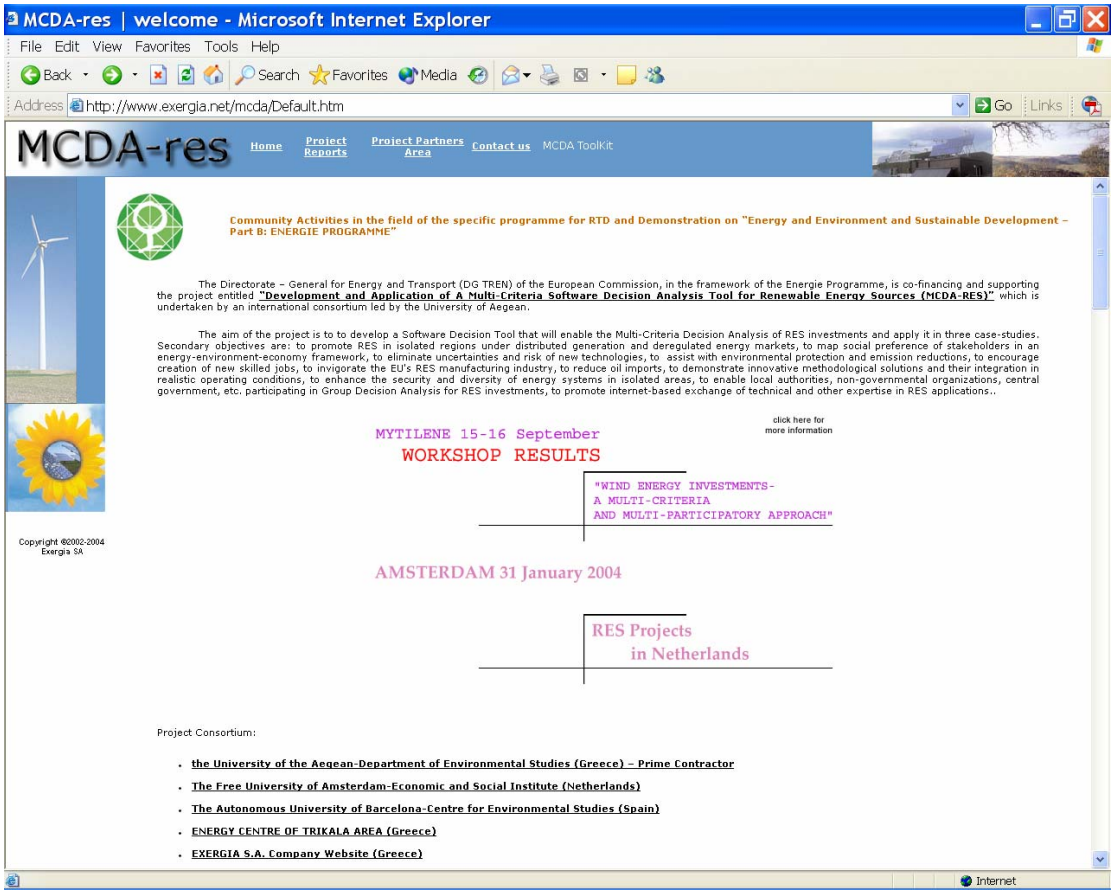
Contents

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]

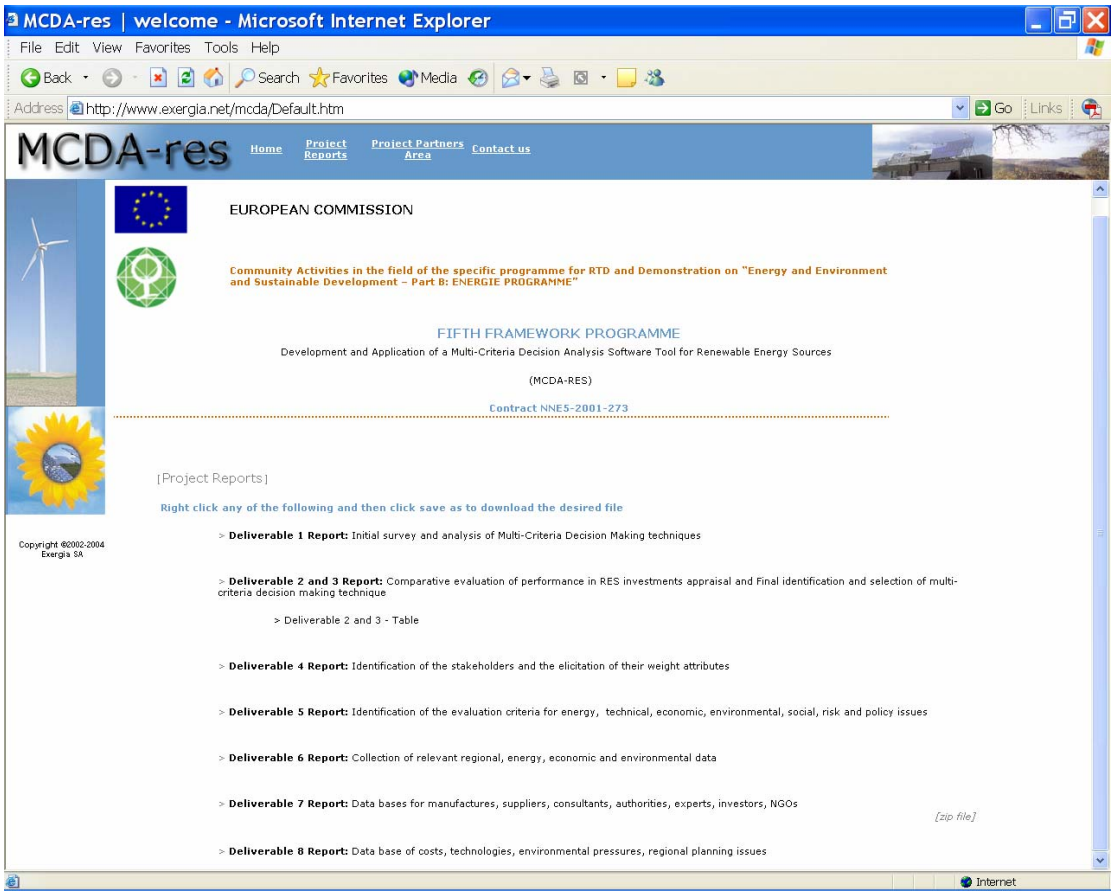
1. Main Screens



Screen 1.1: Initial screen – Home

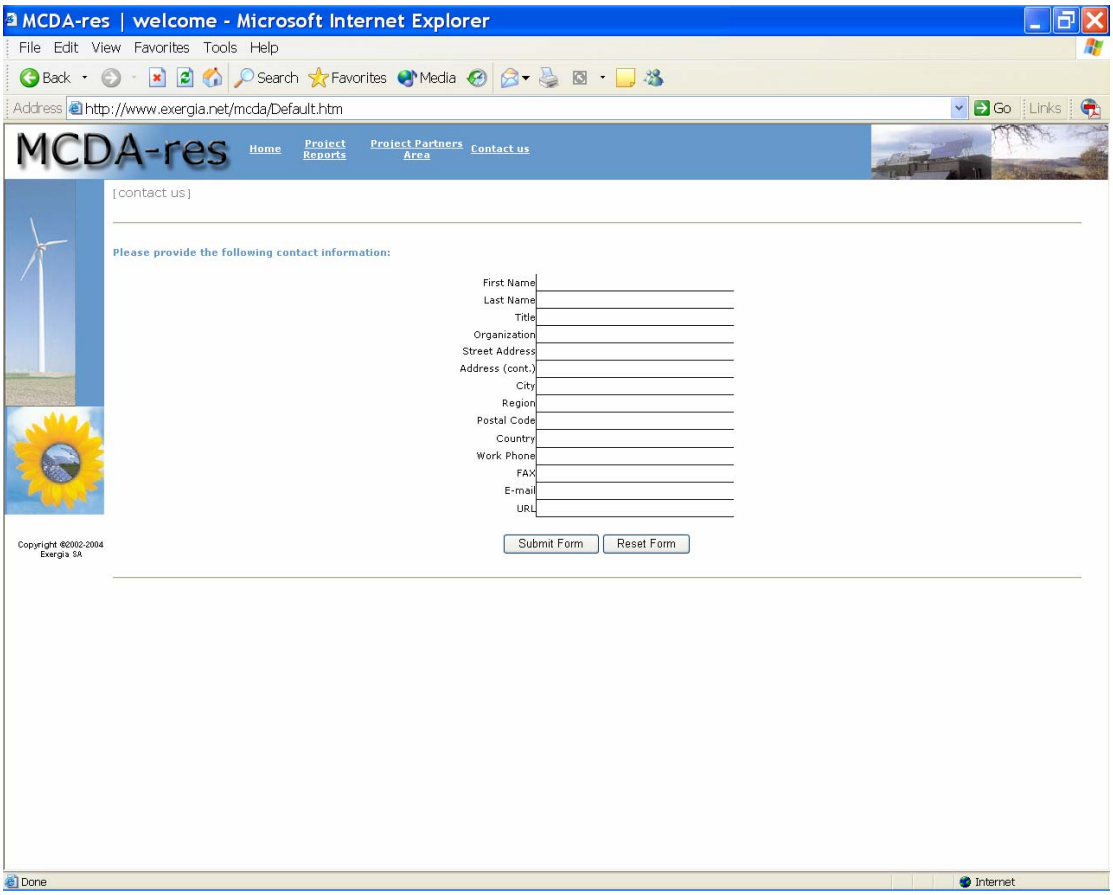
It provides an introduction to the MCDA-RES project; participants, duration, description of work, aim - objectives, work packages, etc.

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



Screen 1.2: Project reports

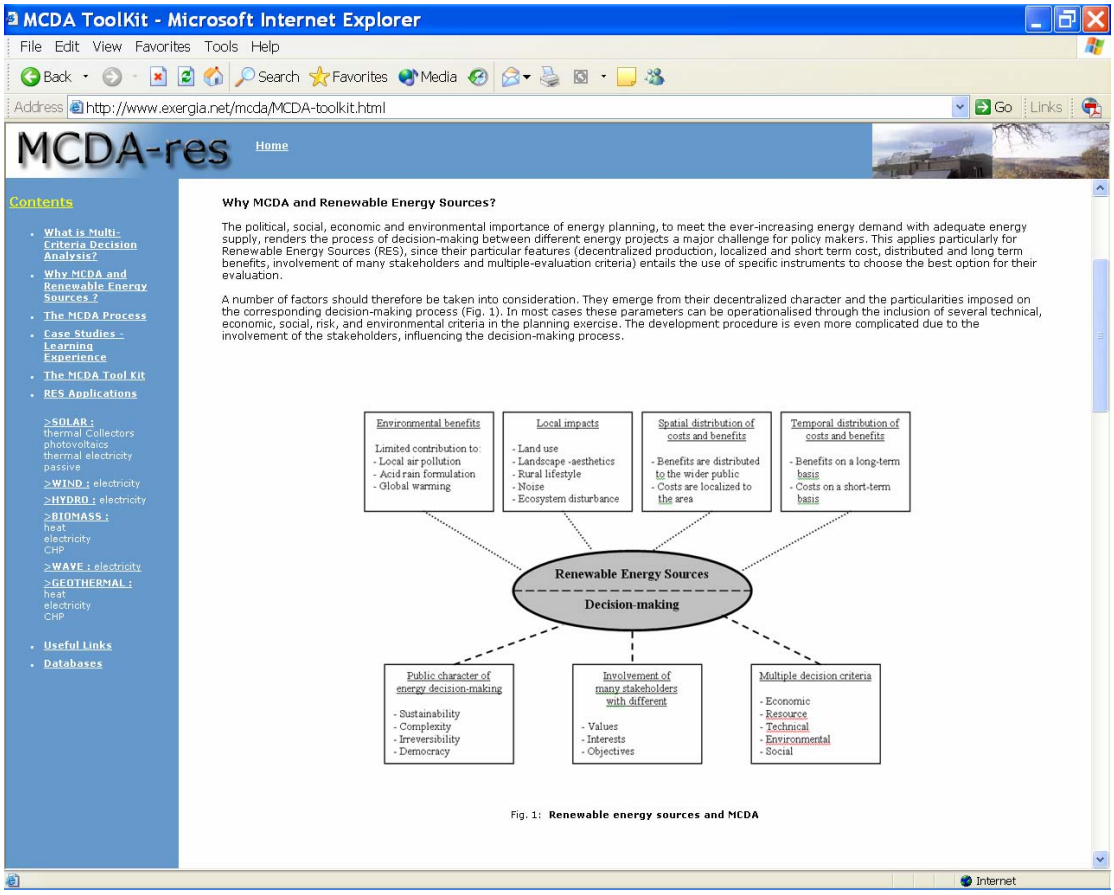
The project Deliverables accepted so far by the Commission Services can be found in the MCDA-RES web-site.



Screen 1.3: Contact details page

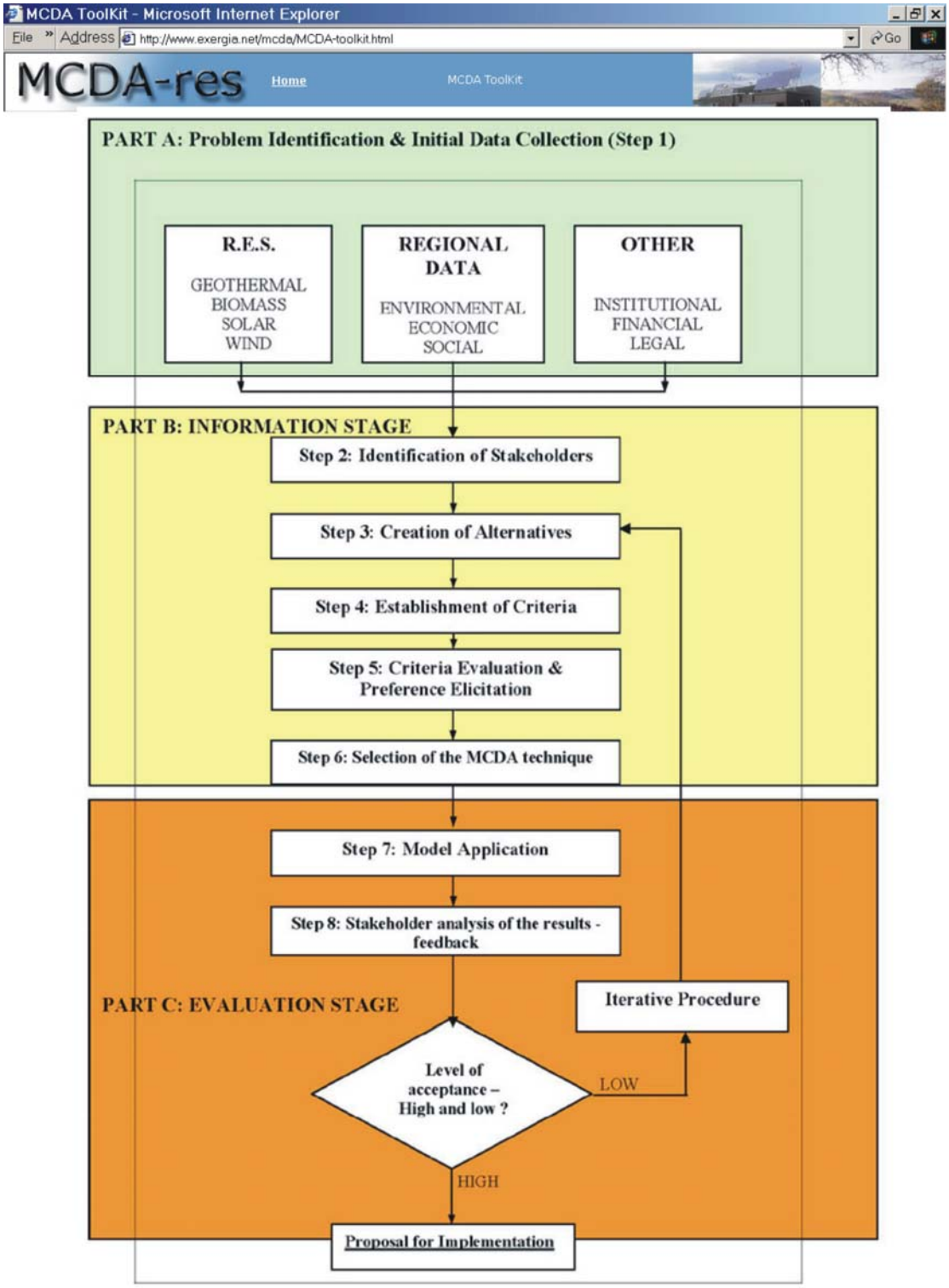
This page provides to the user with a communication gate with the consortium.

2. The MCDA Tool-kit



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

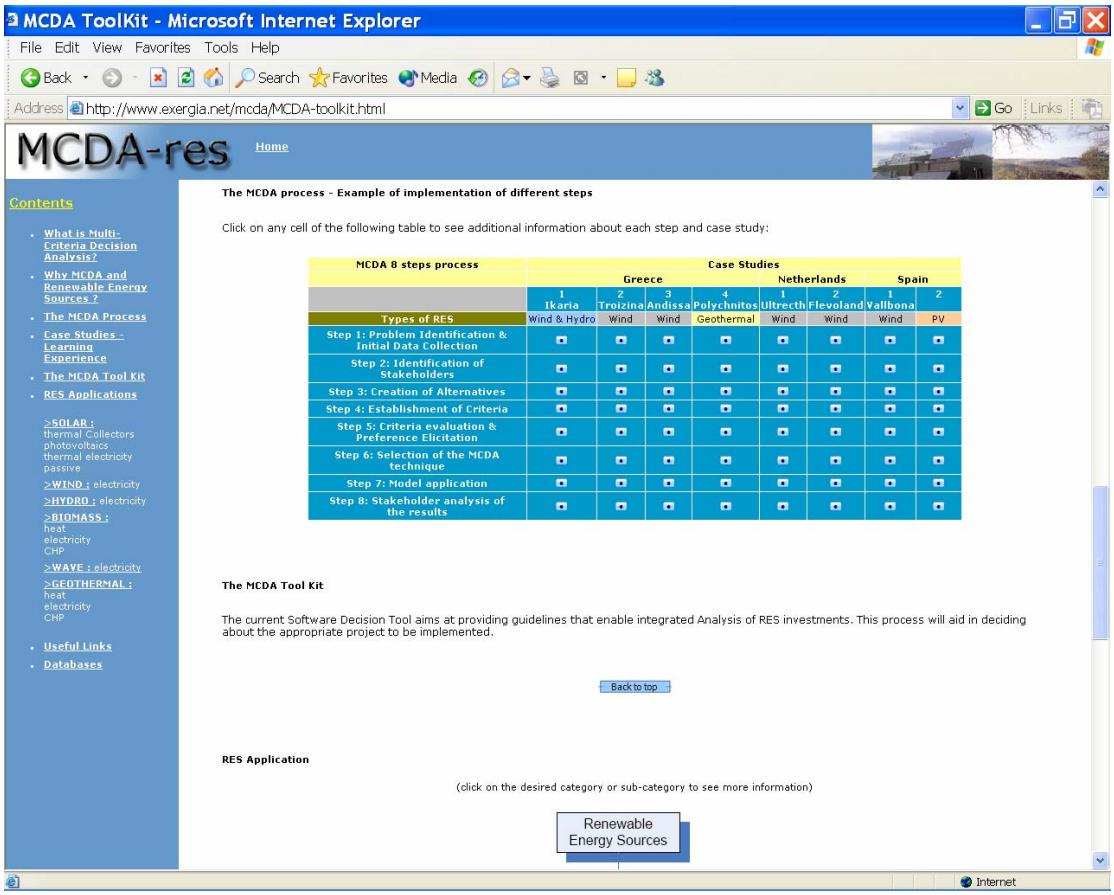
STEP 5: Criteria Evaluation and Preference Elicitation

STEP 6: Selection of the MCDA Technique

STEP 7: Model Application

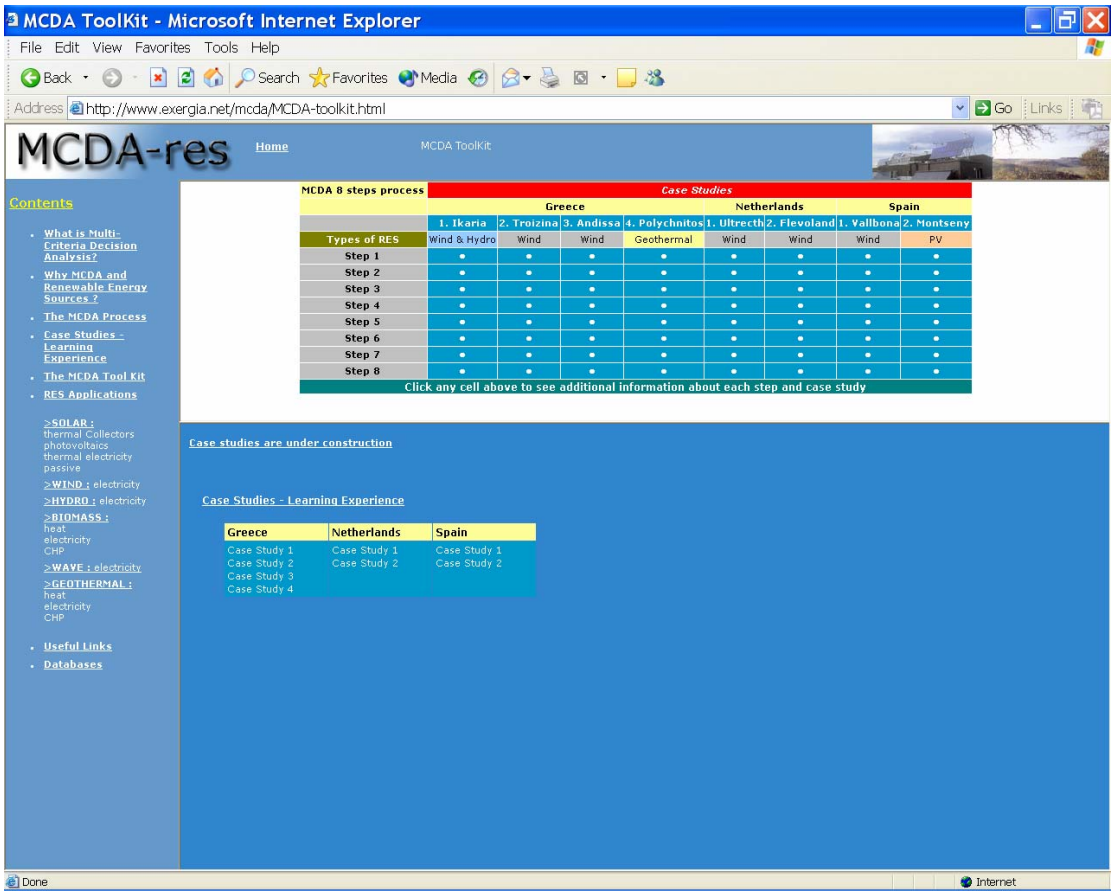
STEP 8: Stakeholders Analysis of Results and Feedback

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



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.

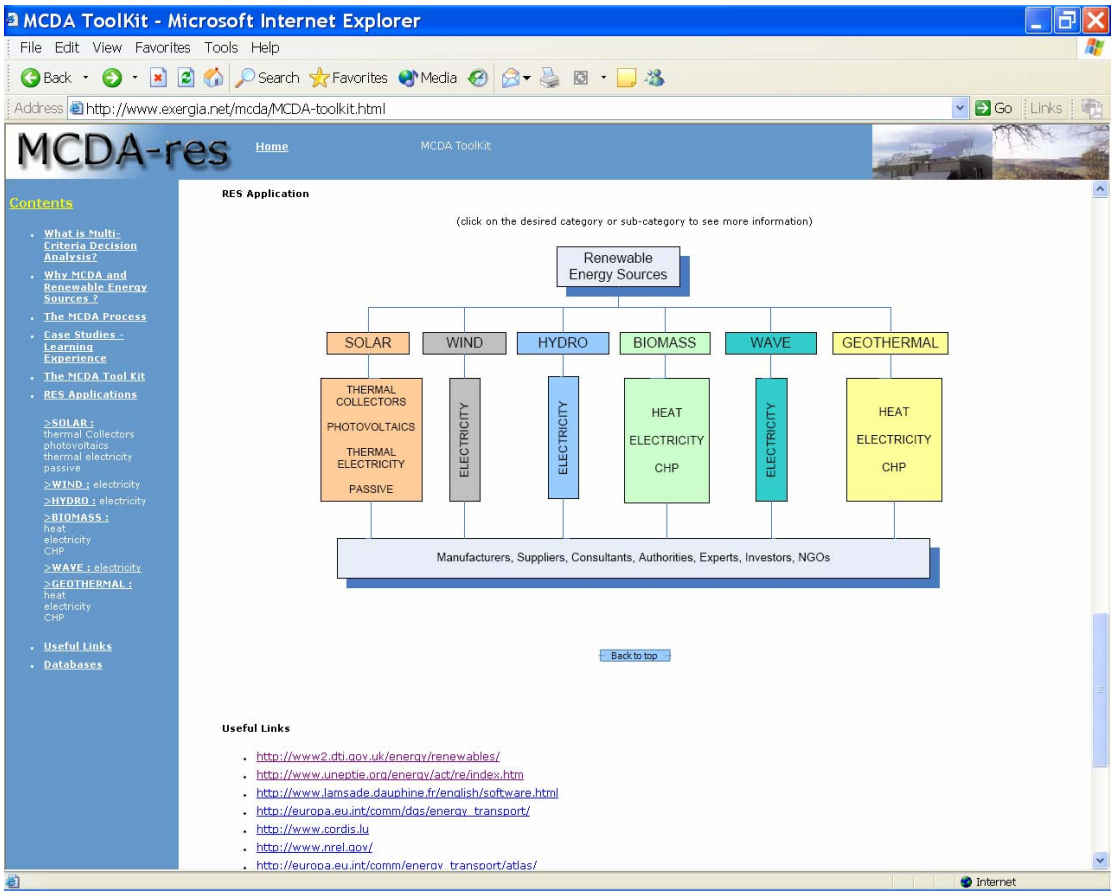


Screen 2.4: Case-studies, learning experiences

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:

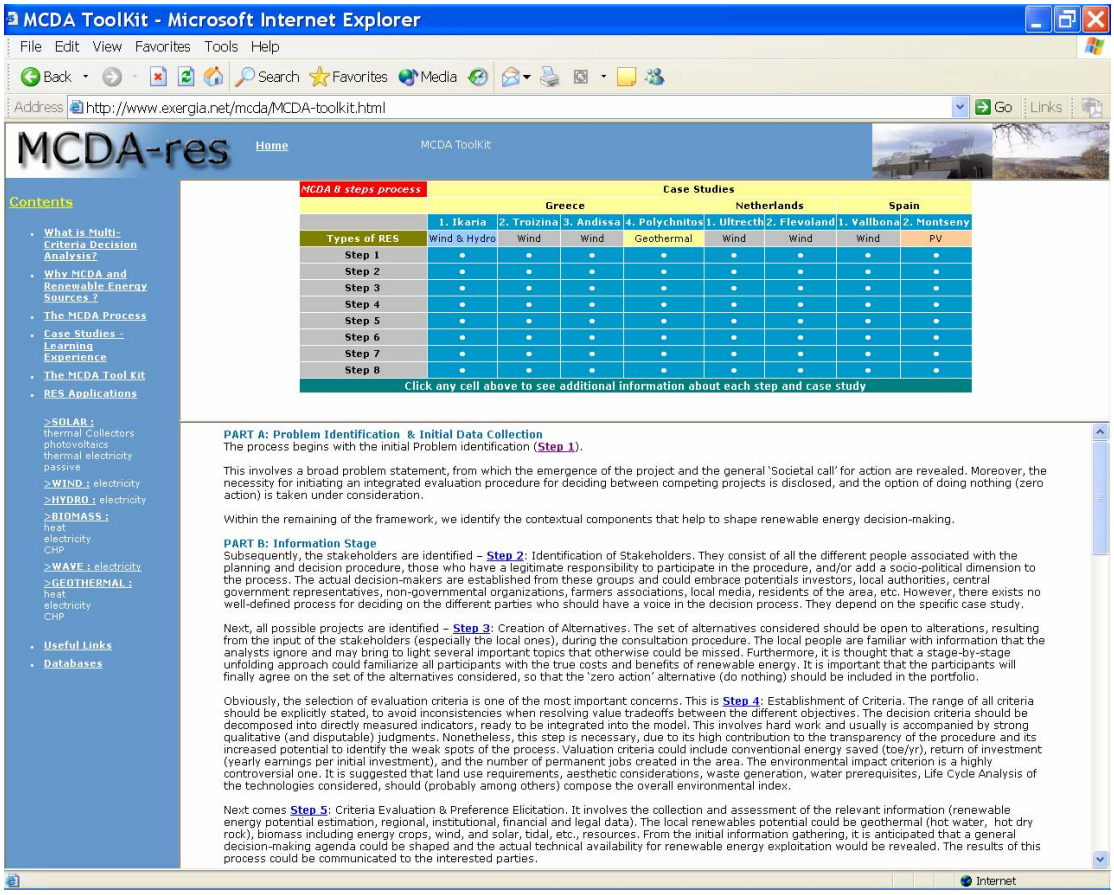
- Four (4) case-studies in Greece
  - No.1: Wind and hydro energy (islandic – non interconnected system)
  - No. 2: Wind energy (main land – interconnected system)
  - No.3: Wind energy (islandic – non interconnected system)
  - No.4: Geothermal energy (autonomous thermal applications)
- Two (2) case-studies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



Screen 2.5: RES applications and useful links

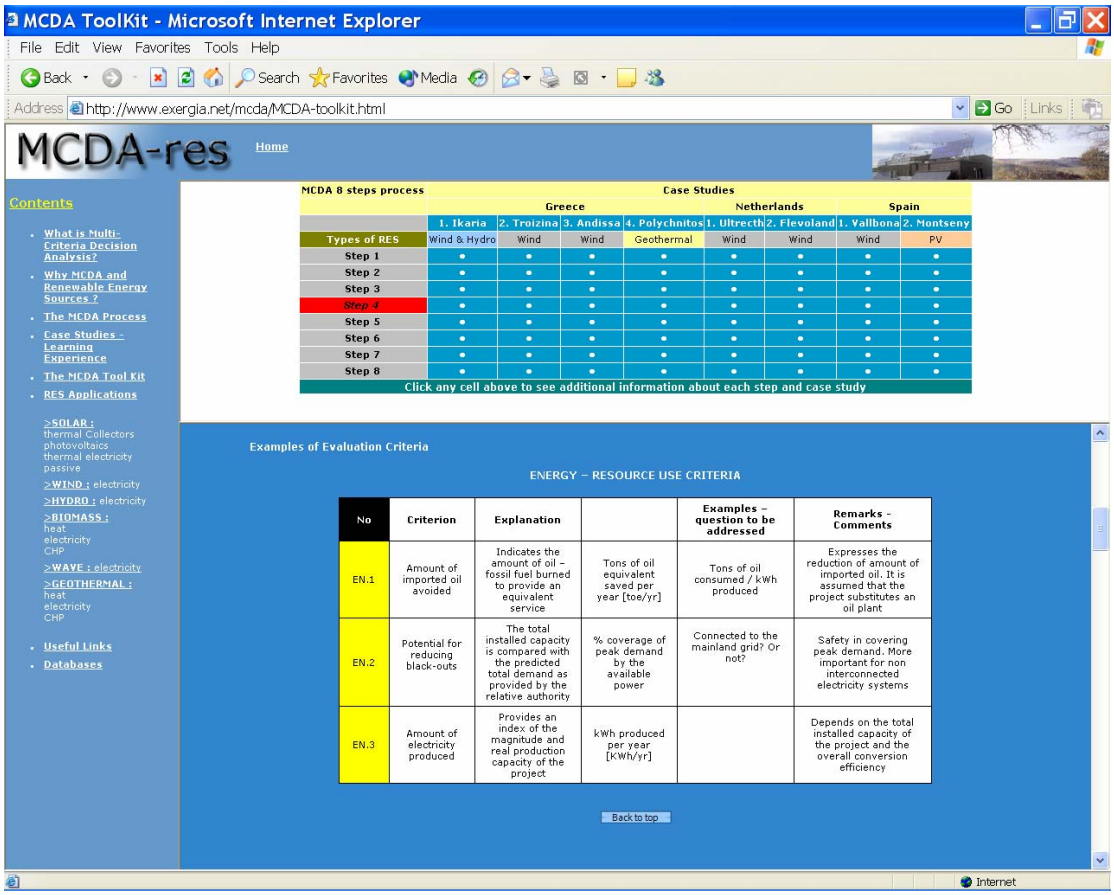
The user can access primary information regarding the different types of renewable energy and their pertinent applications. Photos and related presentations are also included. Links to the various Databases are also provided, according to the type of RES application selected.

3. MCDA 8 STEPS process



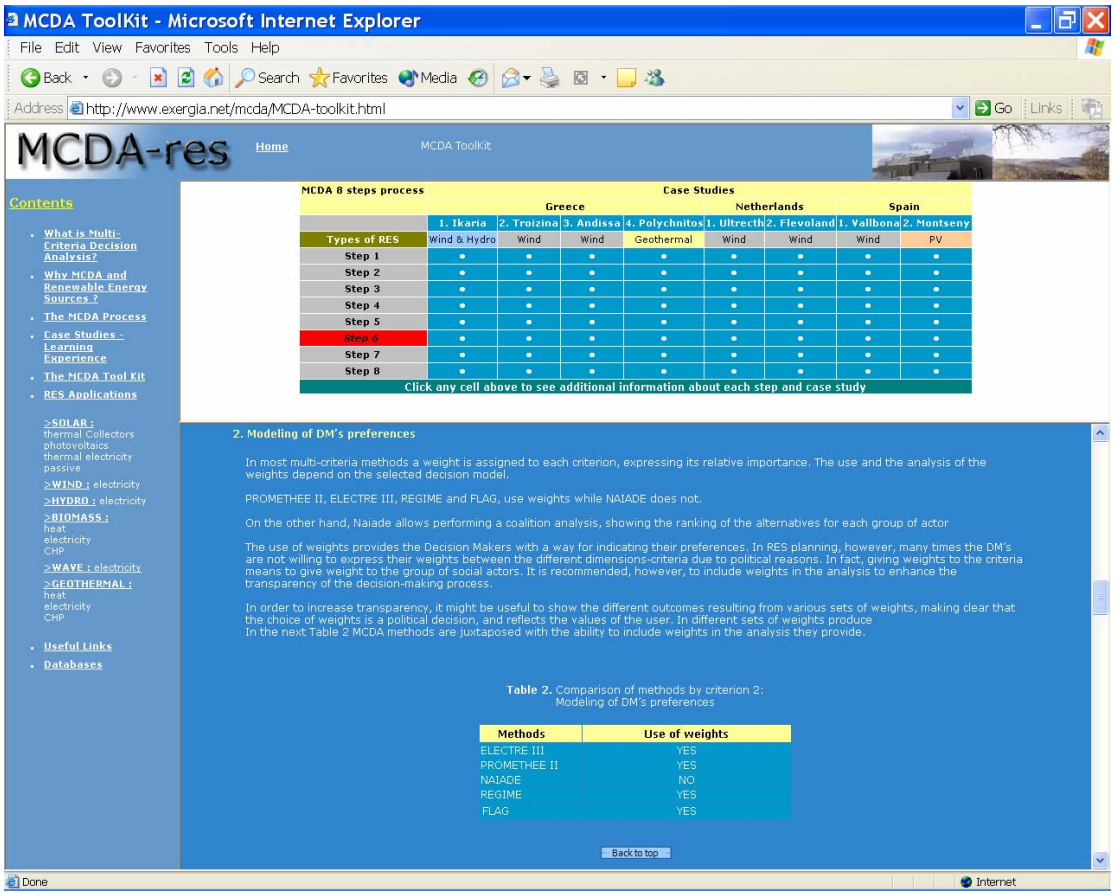
Screen 3.1: MCDA 8 Steps process

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.



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.

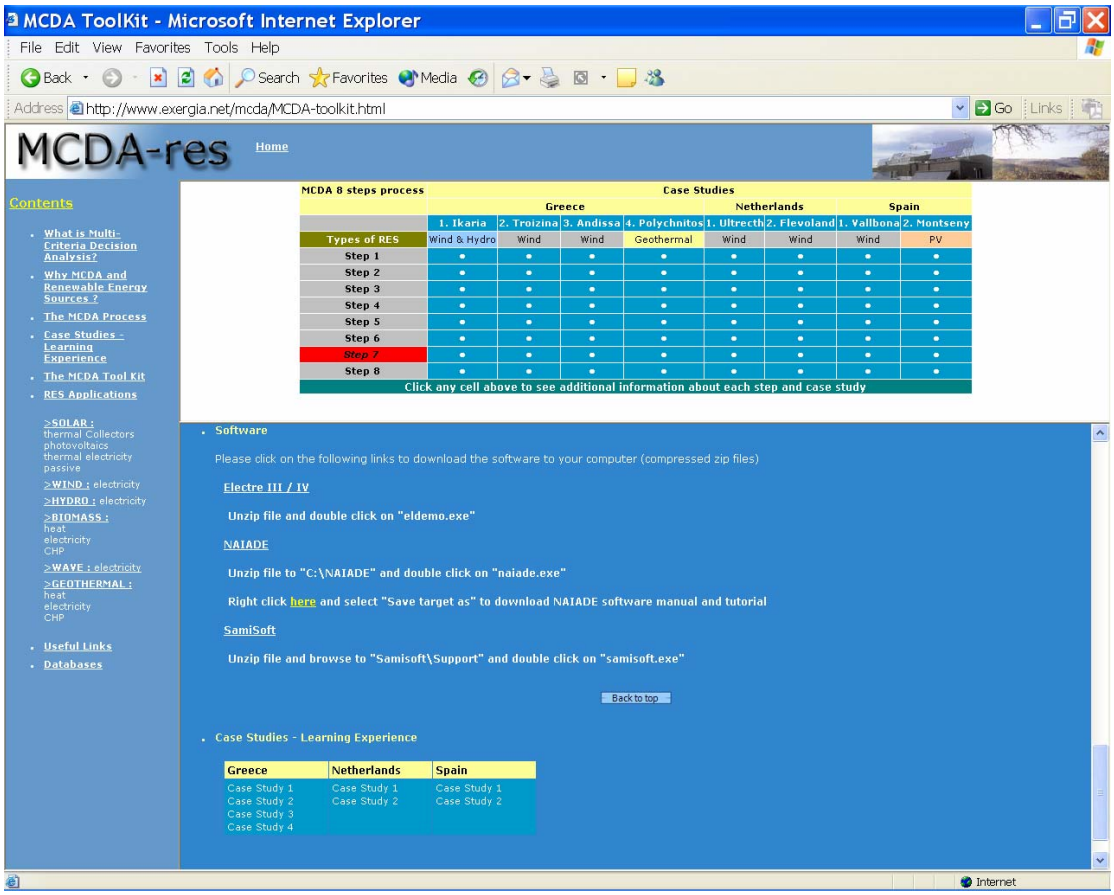


Screen 3.3: STEP 6 – Selection of the MCDA technique

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
- NAIADE

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

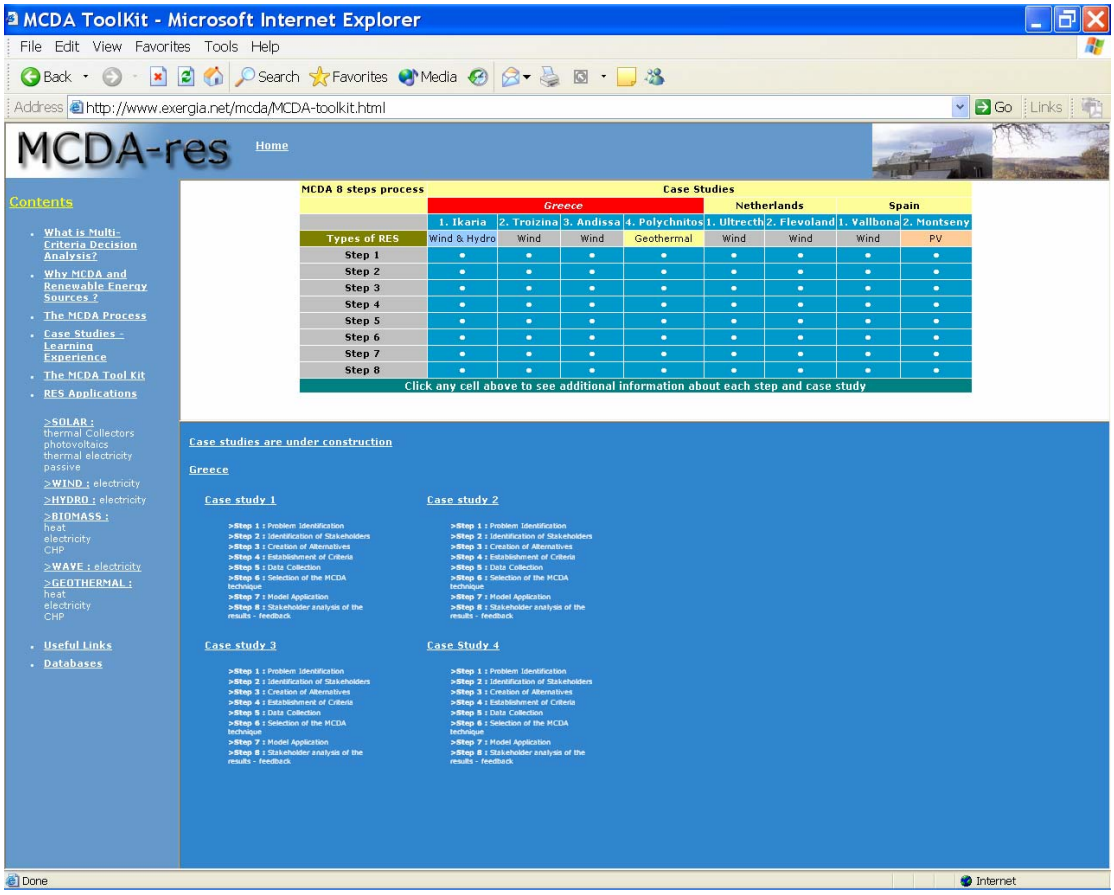


Screen 3.4: STEP 7 - Model application

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.

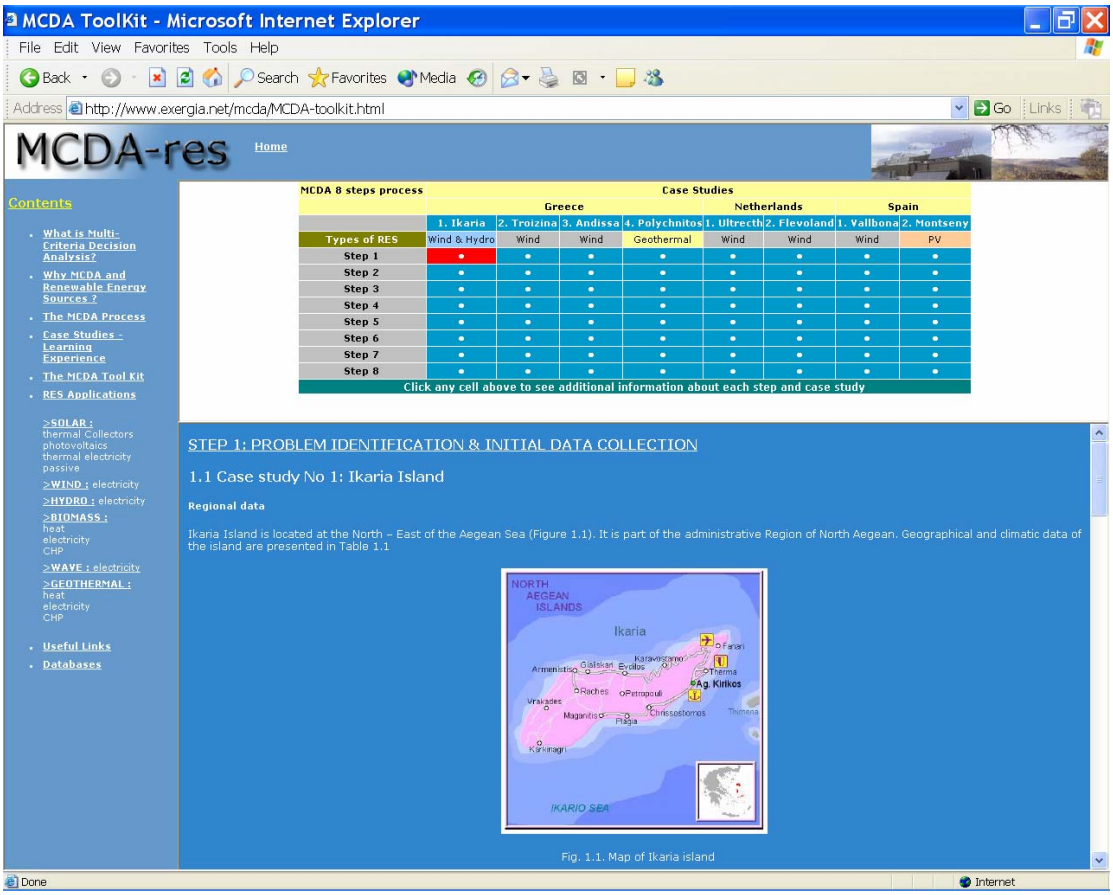
4. Case-studies

4.1 Greece



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

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

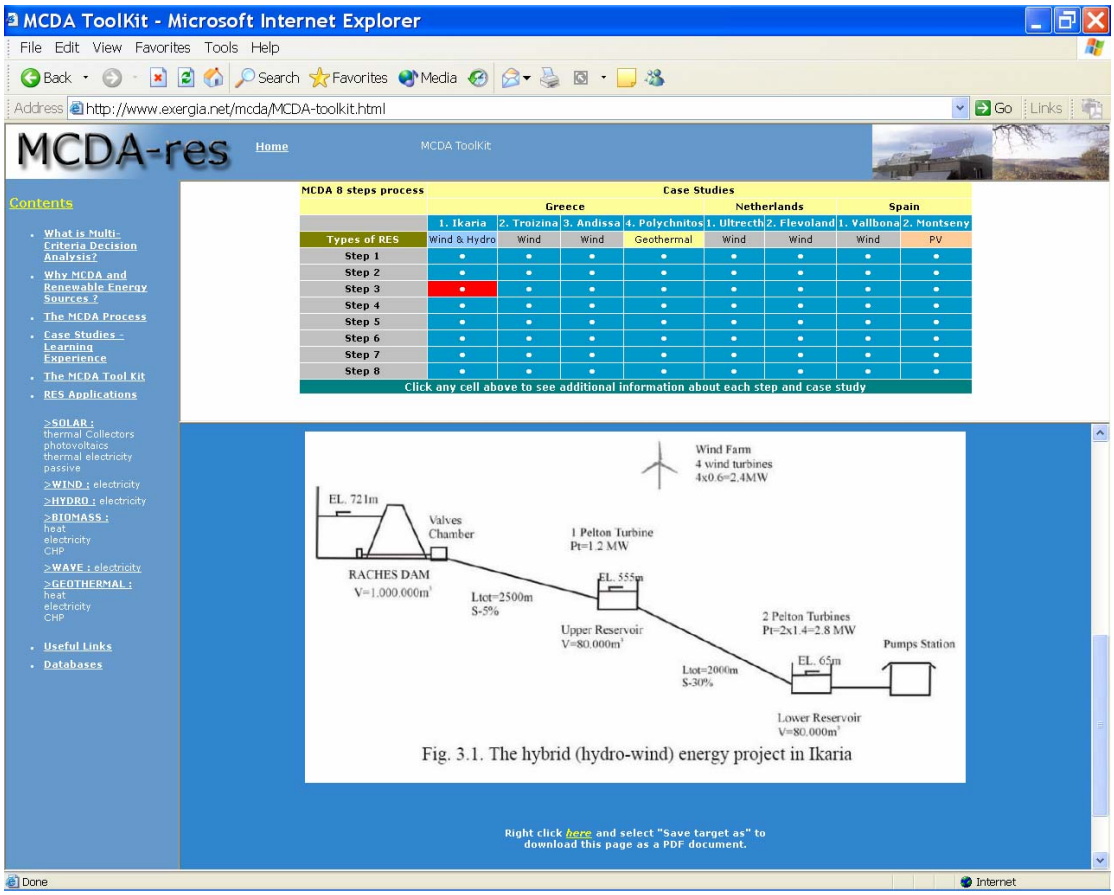


Screen 4.1.2: Greek case-study No.1 – STEP 1

This Screen corresponds to STEP 1 of the 1st Greek case-study.

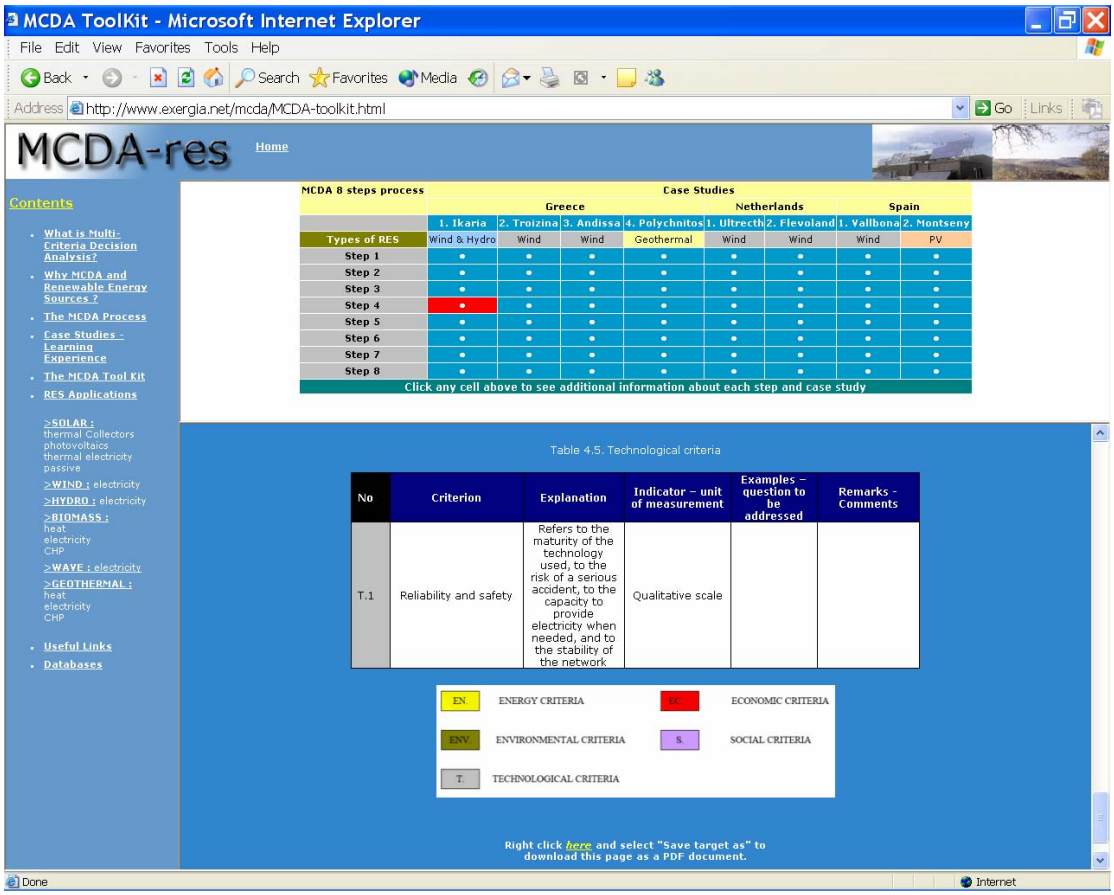
Type of RES: Wind and Hydro Energy

Selected MCDA technique: PROMETHEE II



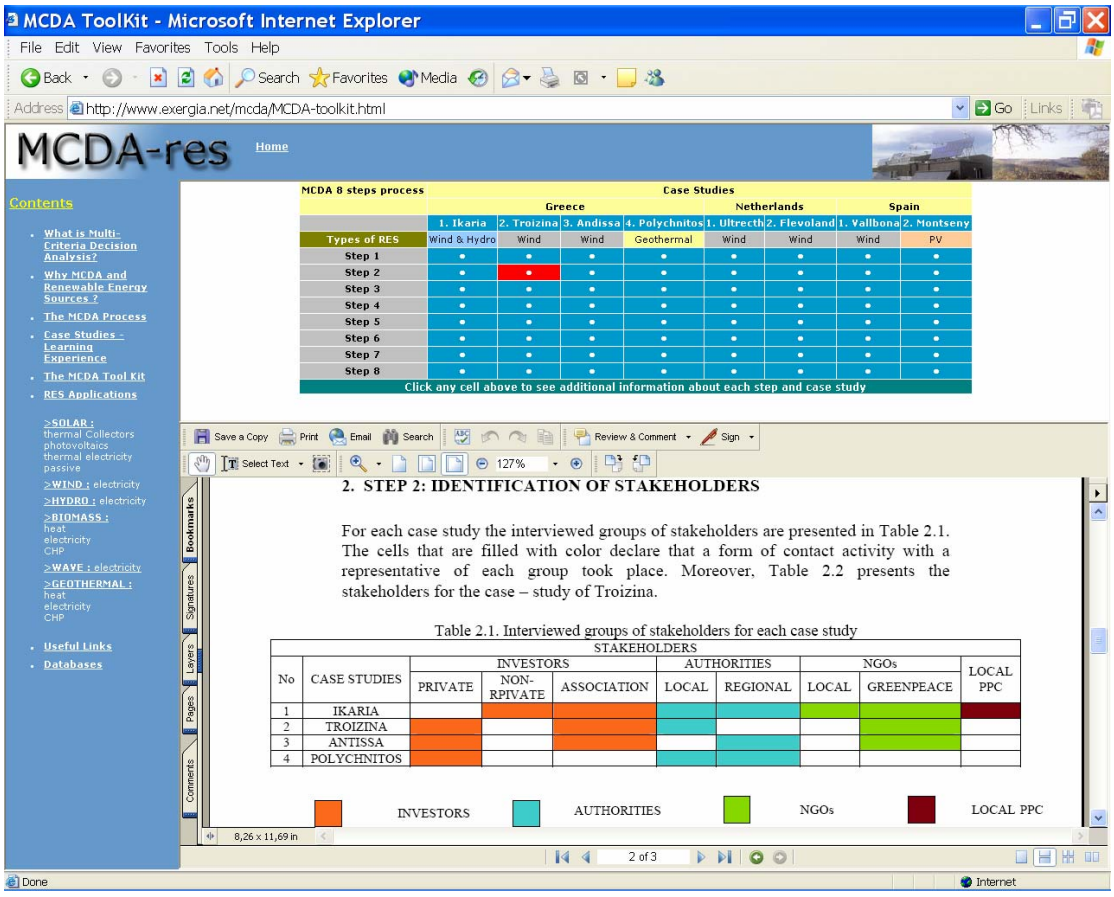
Screen 4.1.3: Greek case-study No.1 – STEP 3

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



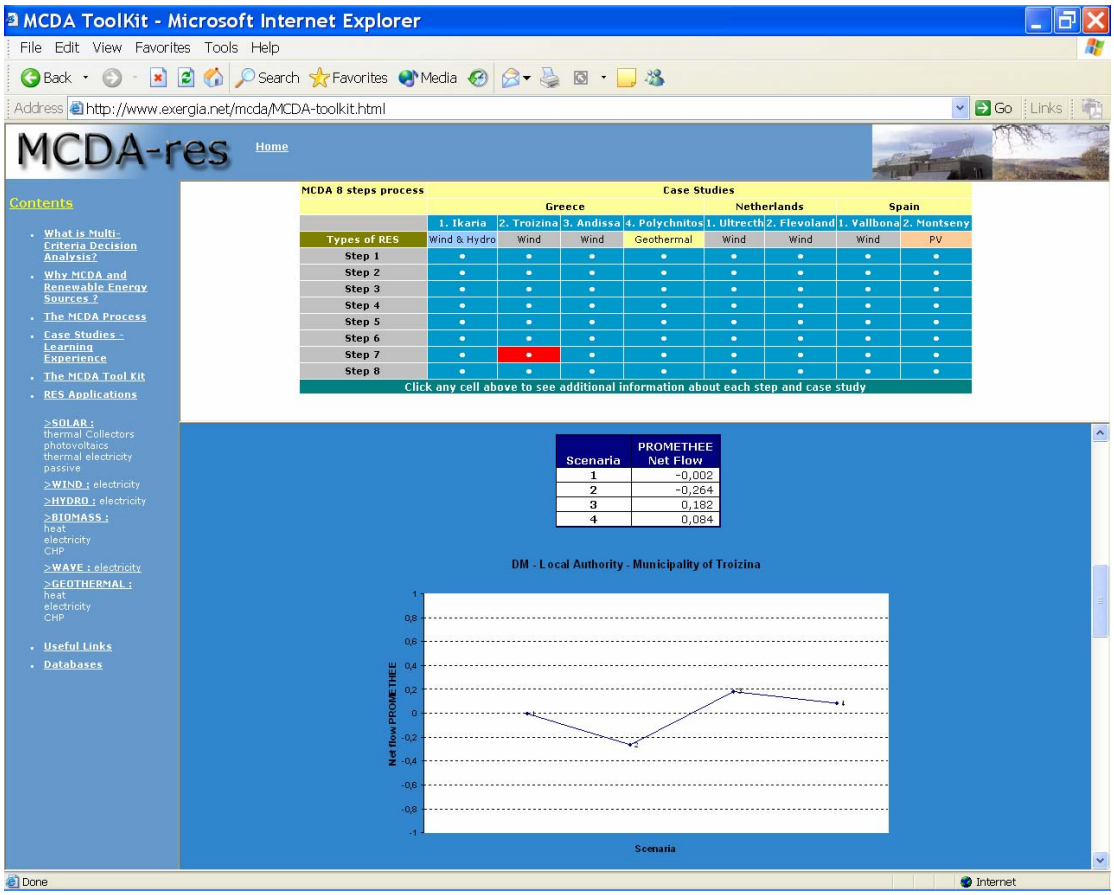
Screen 4.1.4: Greek case-study No.1 – STEP 4

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



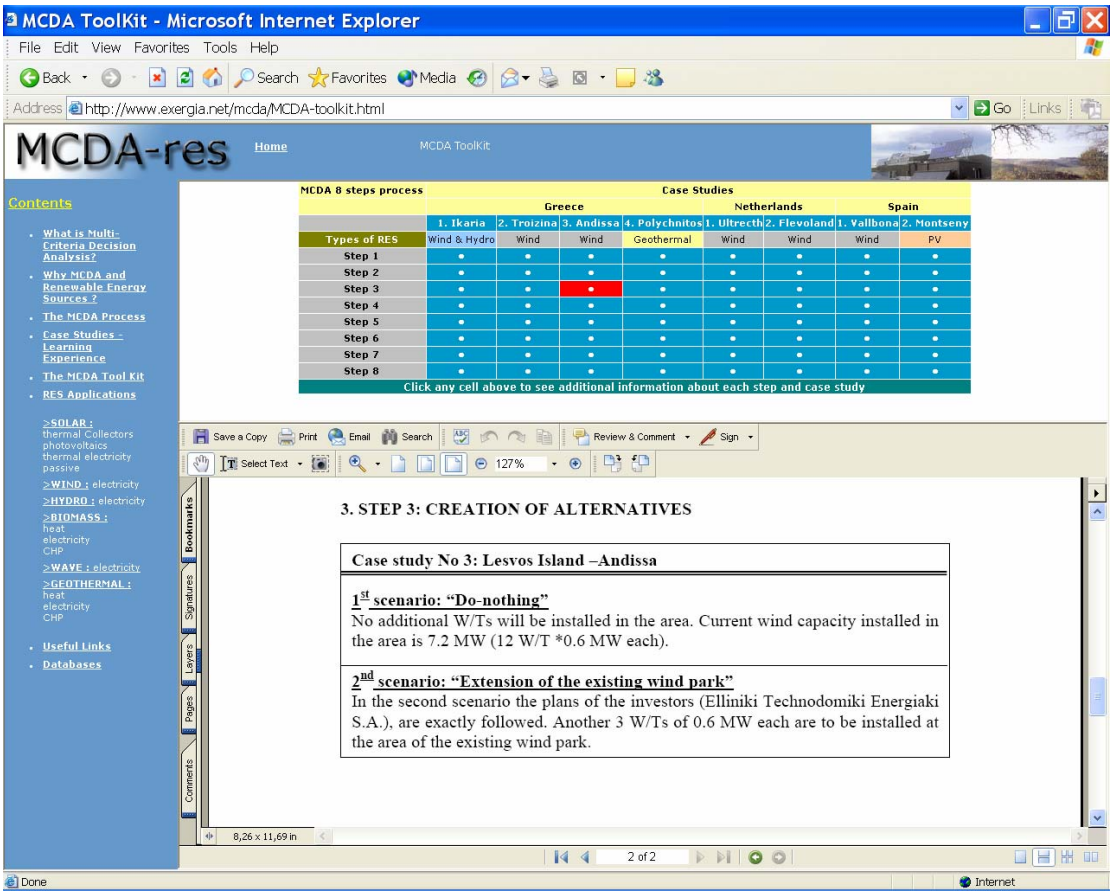
Screen 4.1.5: Greek case-study No.2 – STEP 2 (PDF version)

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).



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.



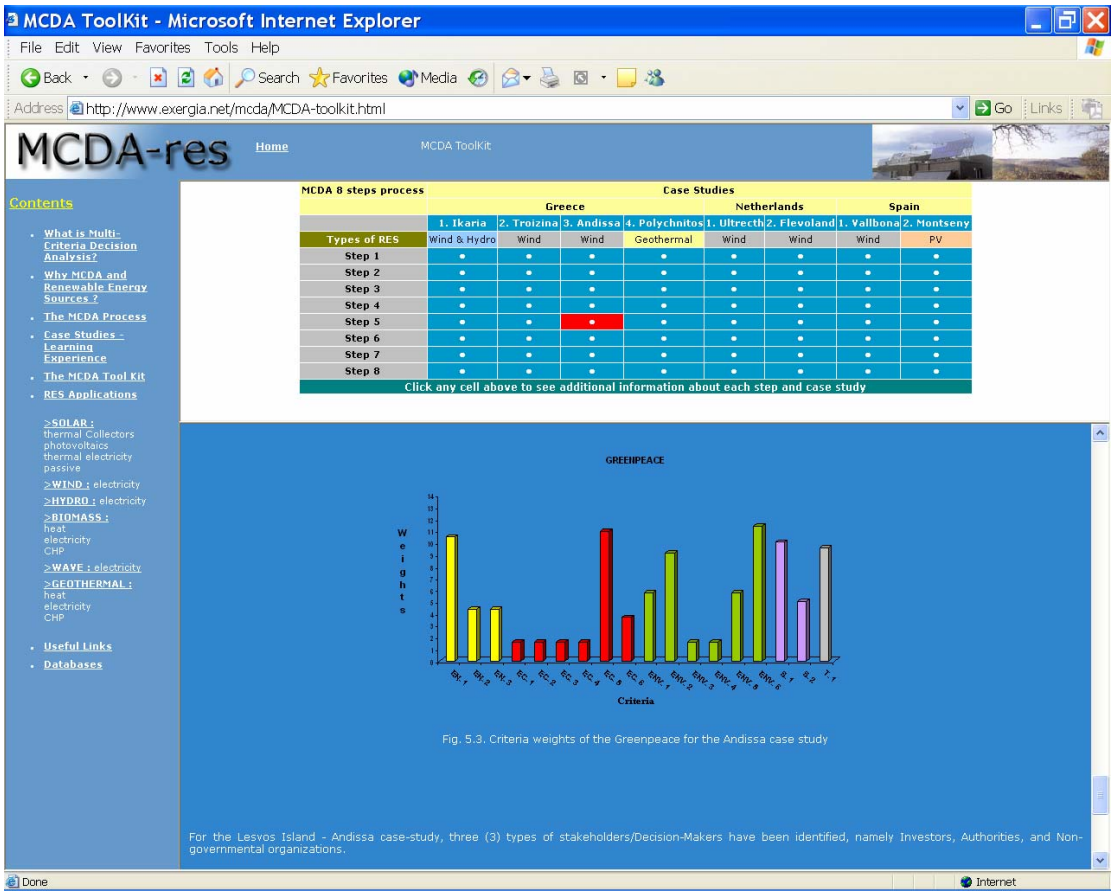
Screen 4.1.7: Greek case-study No.3 – STEP 3 (PDF version)

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

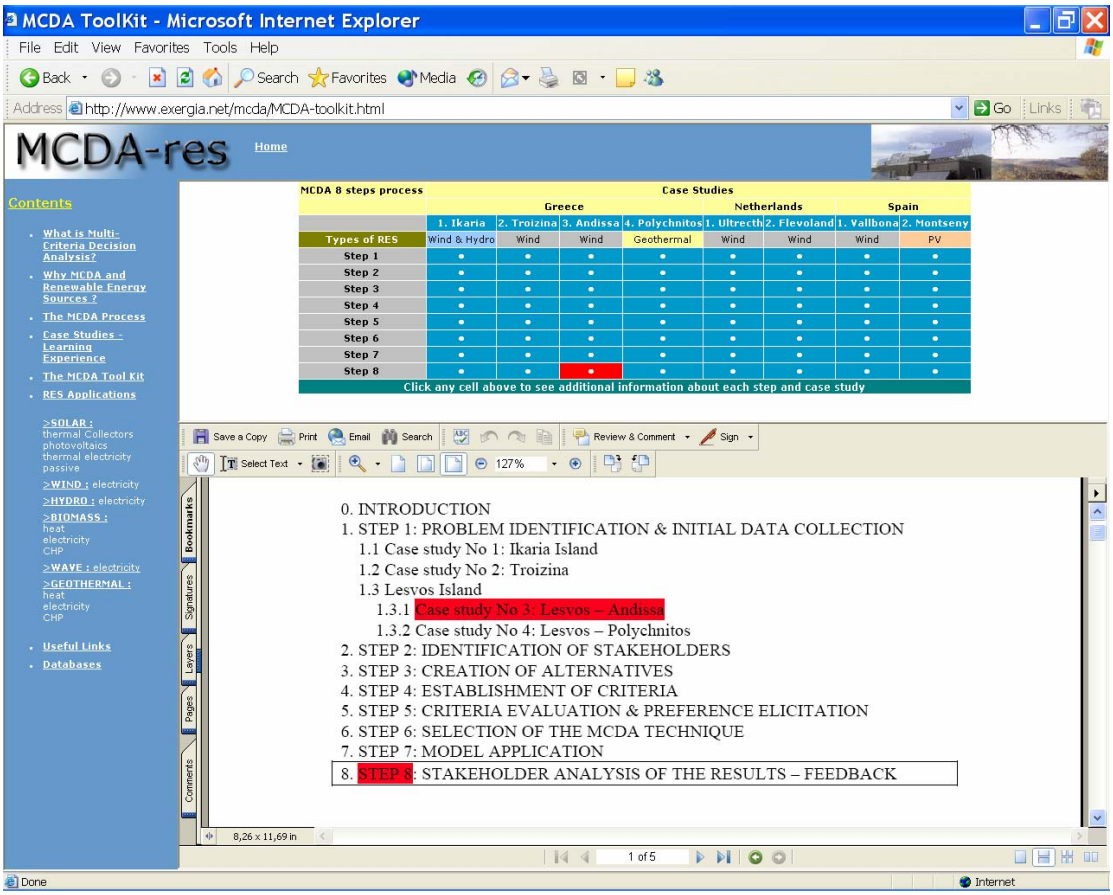


Screen 4.1.8: Greek case-study No.3 – STEP 5

This Screen presents the results of the weight elicitation module.

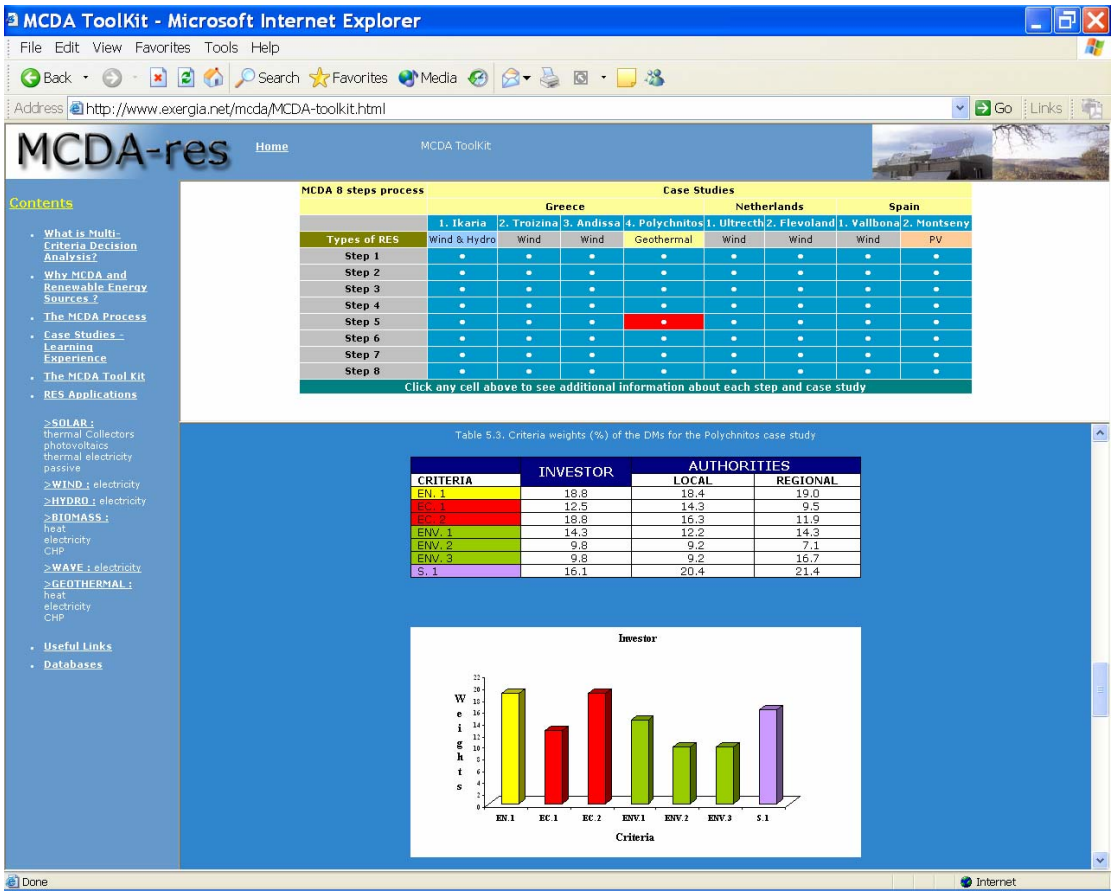
Decision-Maker: Non-governmental Organization – GREENPEACE

No of criteria: 18



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.



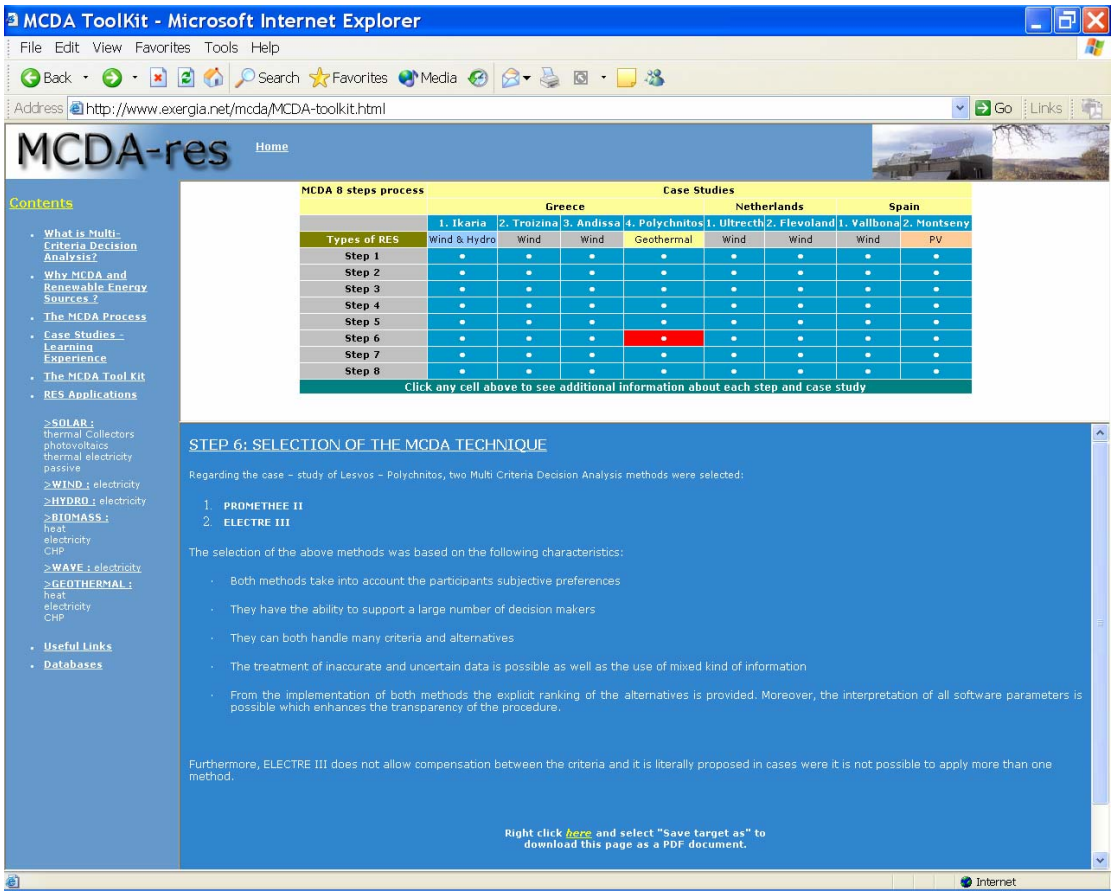
Screen 4.1.10: Greek case-study No.4 – STEP 5

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

Type of RES: Geothermal Energy

Decision-Maker: Investor

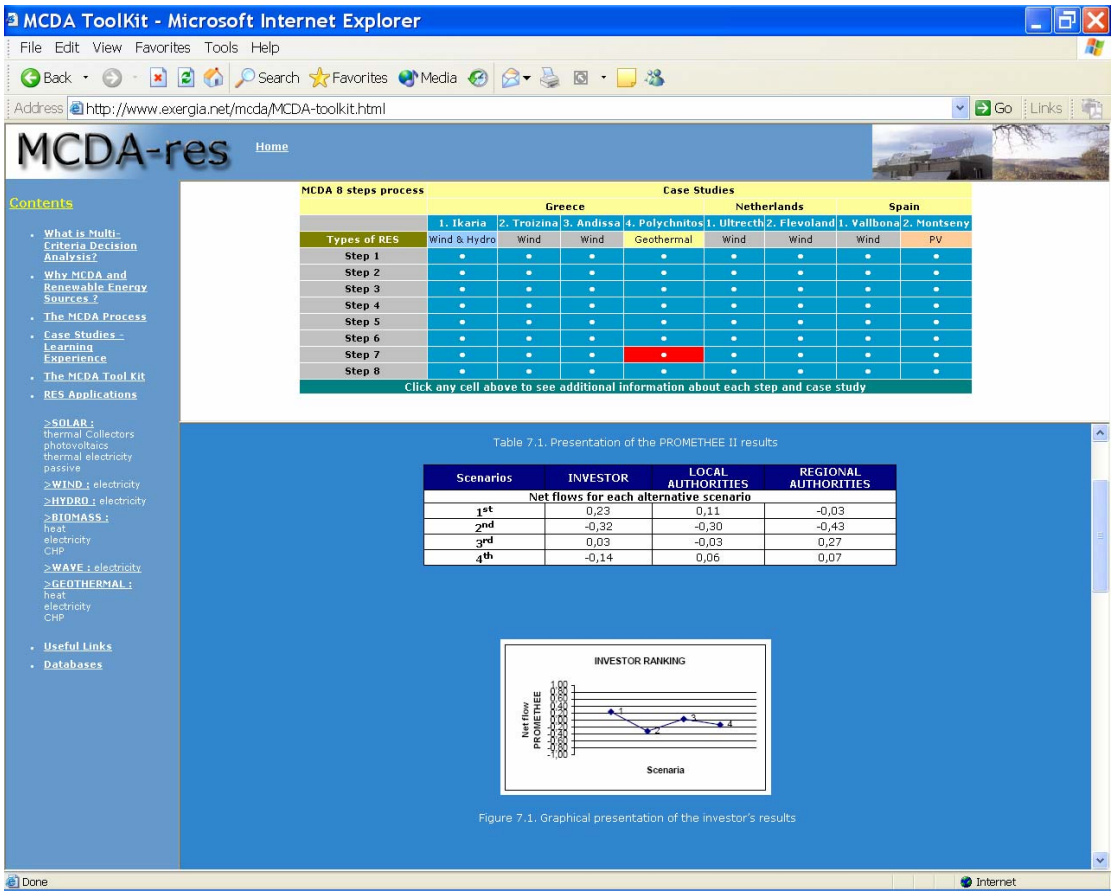
No of Criteria: 7



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

The selection of the appropriate MCDA technique

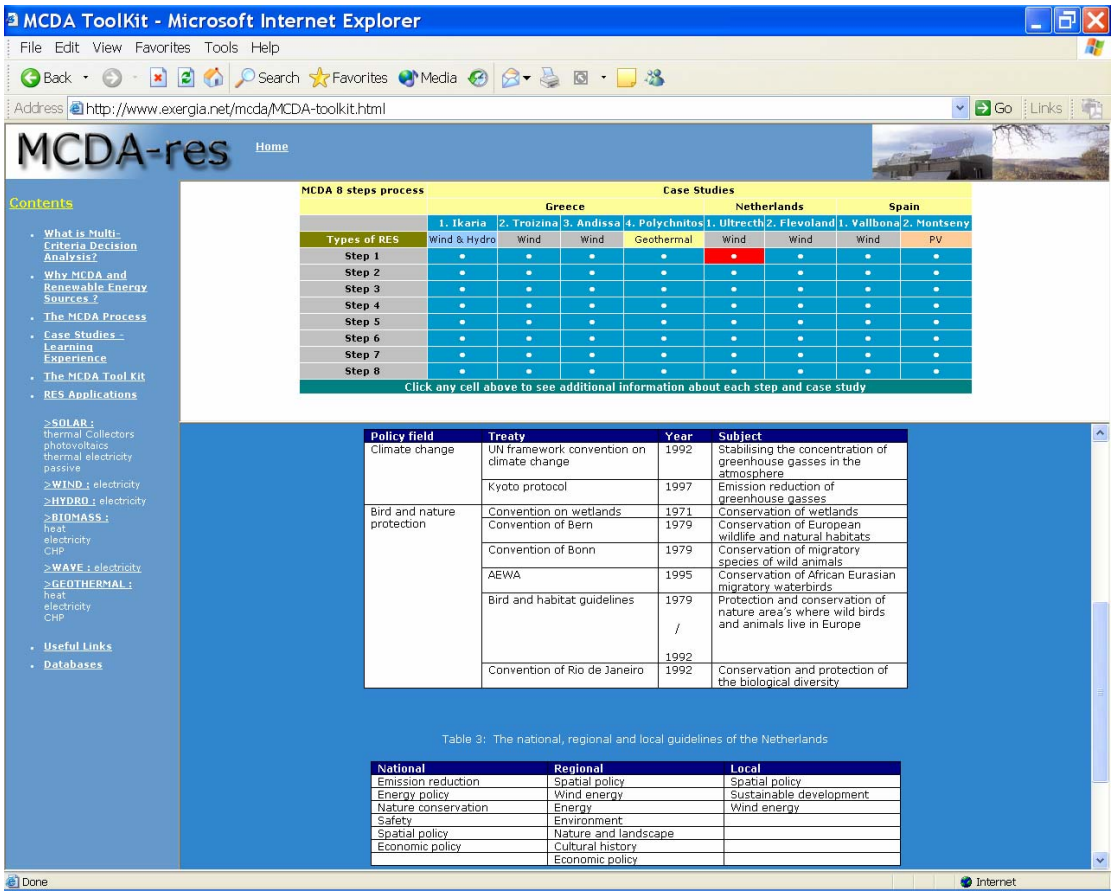
For the 4th Greek case-study, both the ELECTRE III and the PROMETHEE II MCDA techniques have been selected and applied.



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

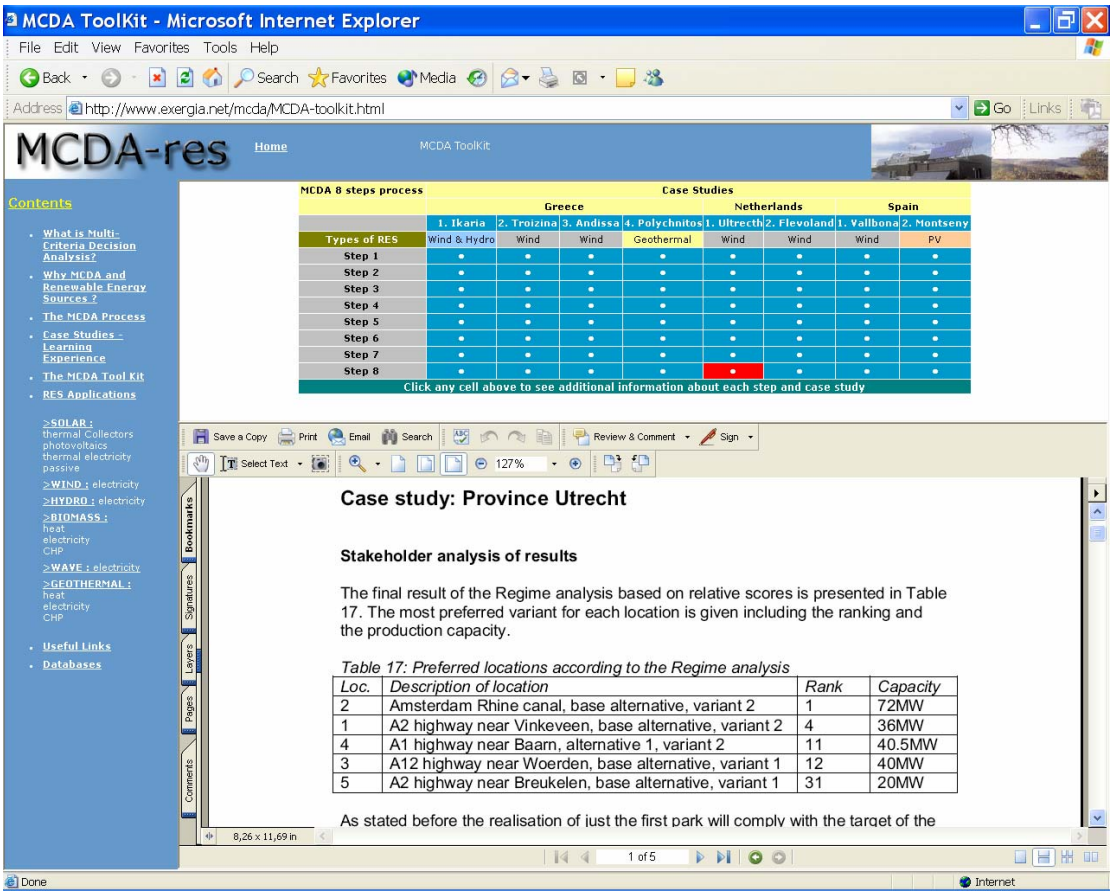


Screen 4.2.1: Dutch case-study No.1 – STEP 1

Problem Identification and Initial Data Collection; Policy Data

Type of RES: Wind Energy

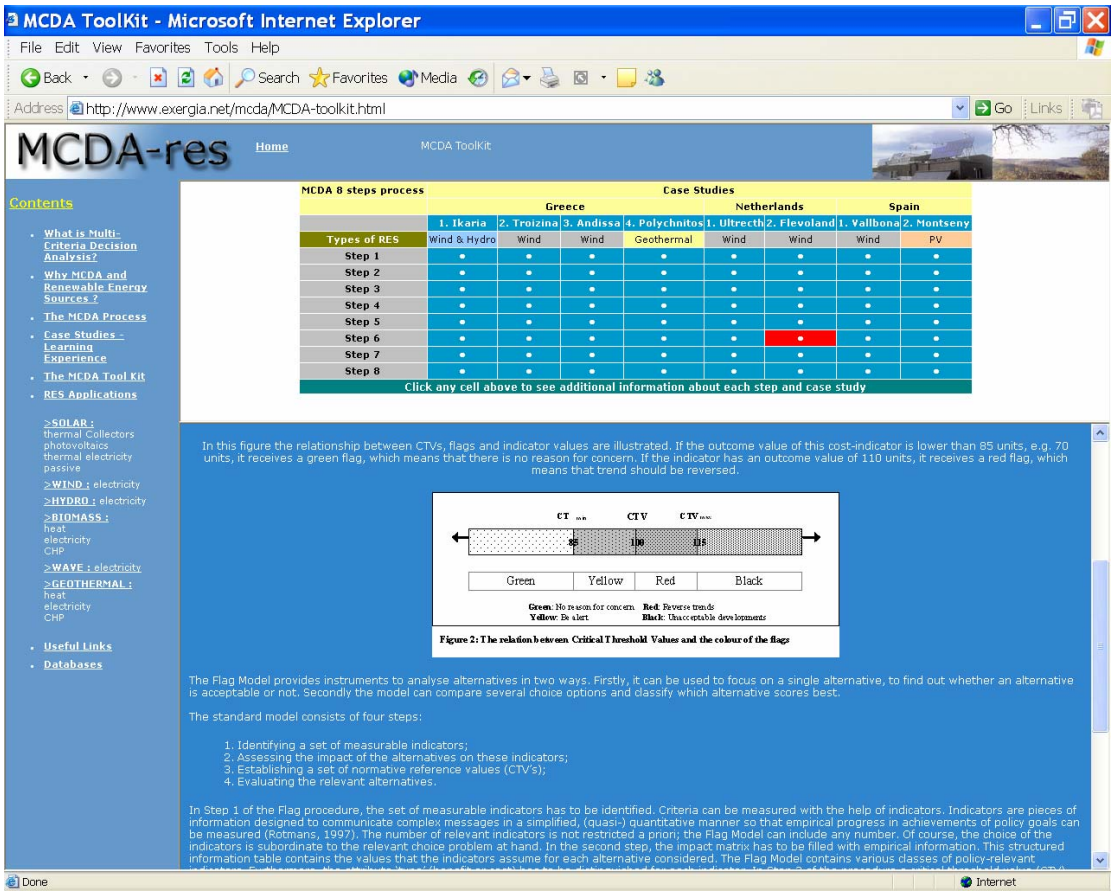
MCDA technique: REGIME Analysis



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

Stakeholders' analysis of results and feedback

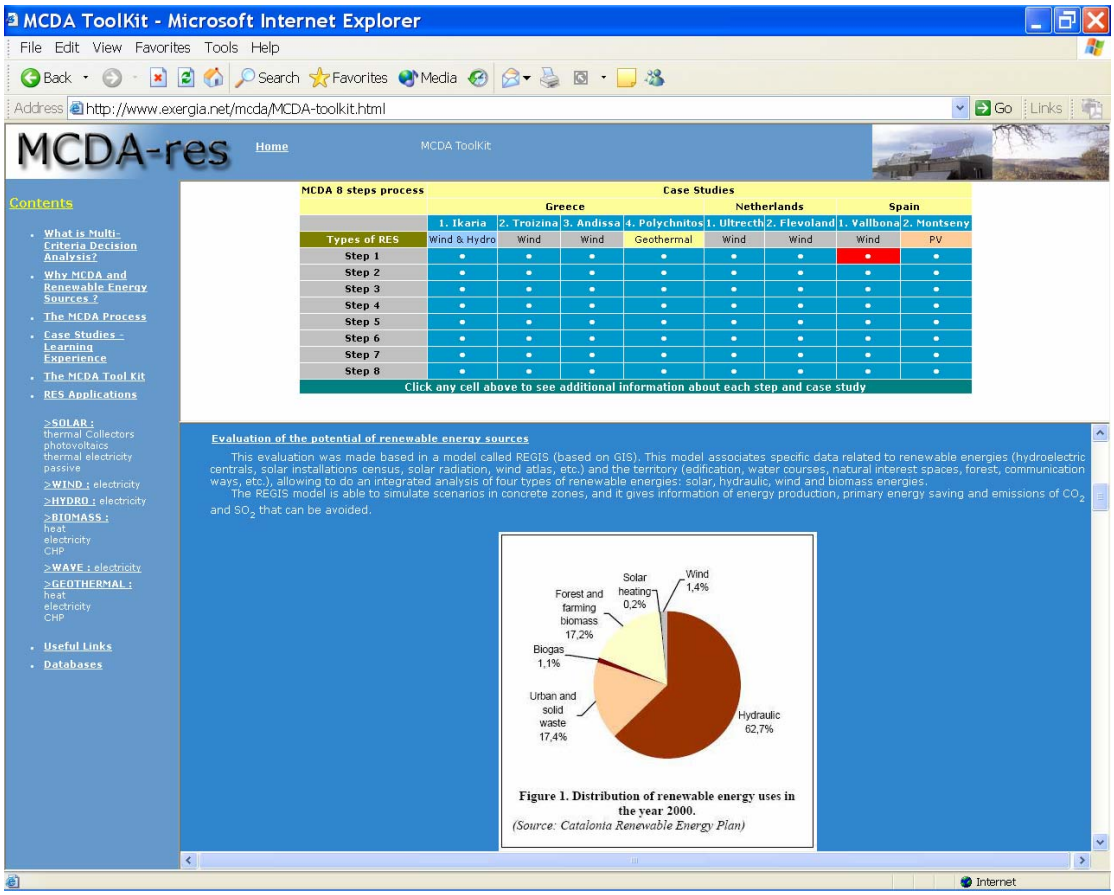
Preferred wind mills locations according to REGIME Analysis



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

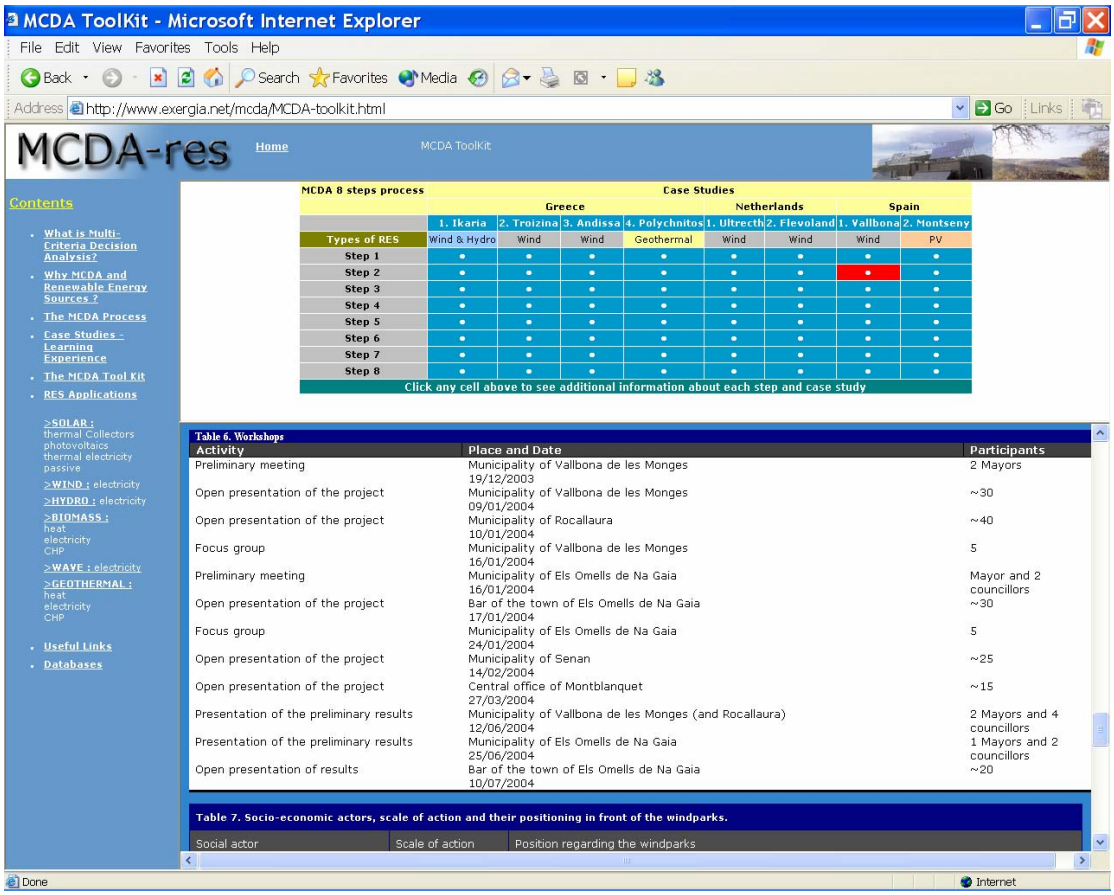
Selected MCDA technique: FLAG model

4.3 Spain



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

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

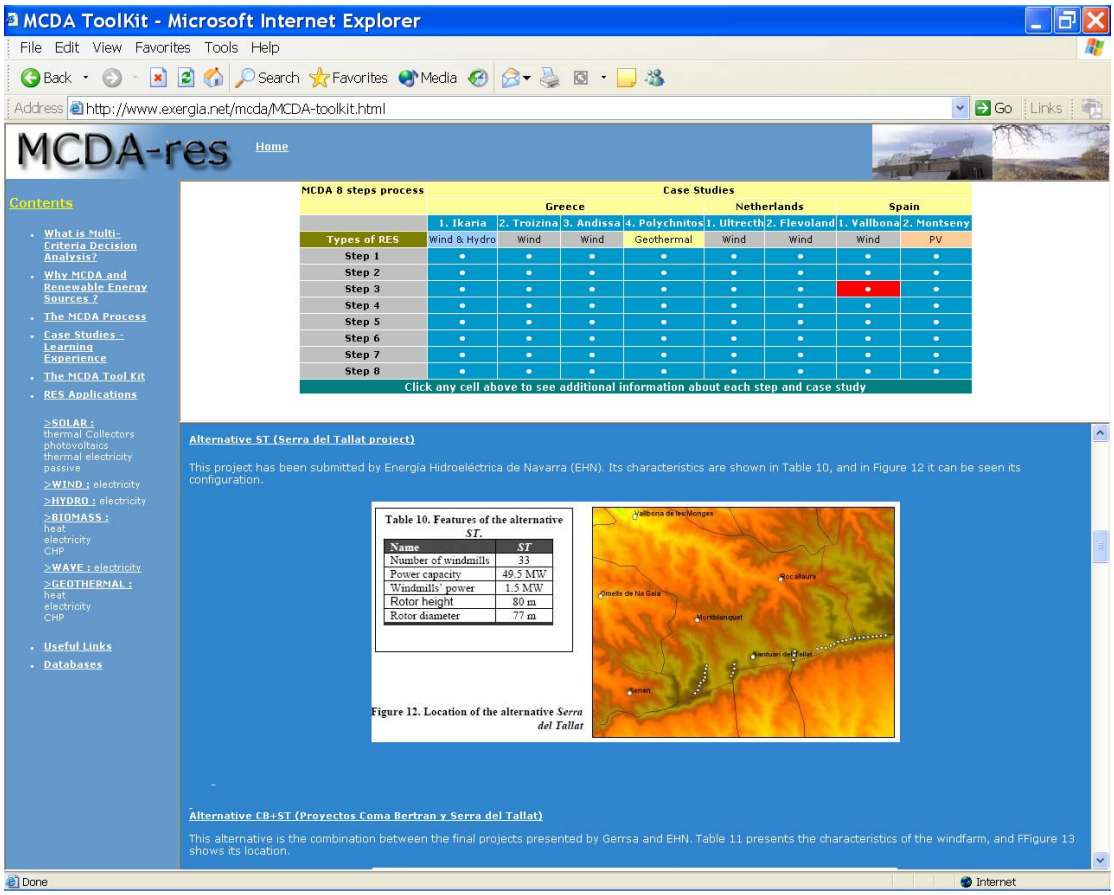


Screen 4.3.2: Spanish case-study No.1 – STEP 2

Identification of Stakeholders

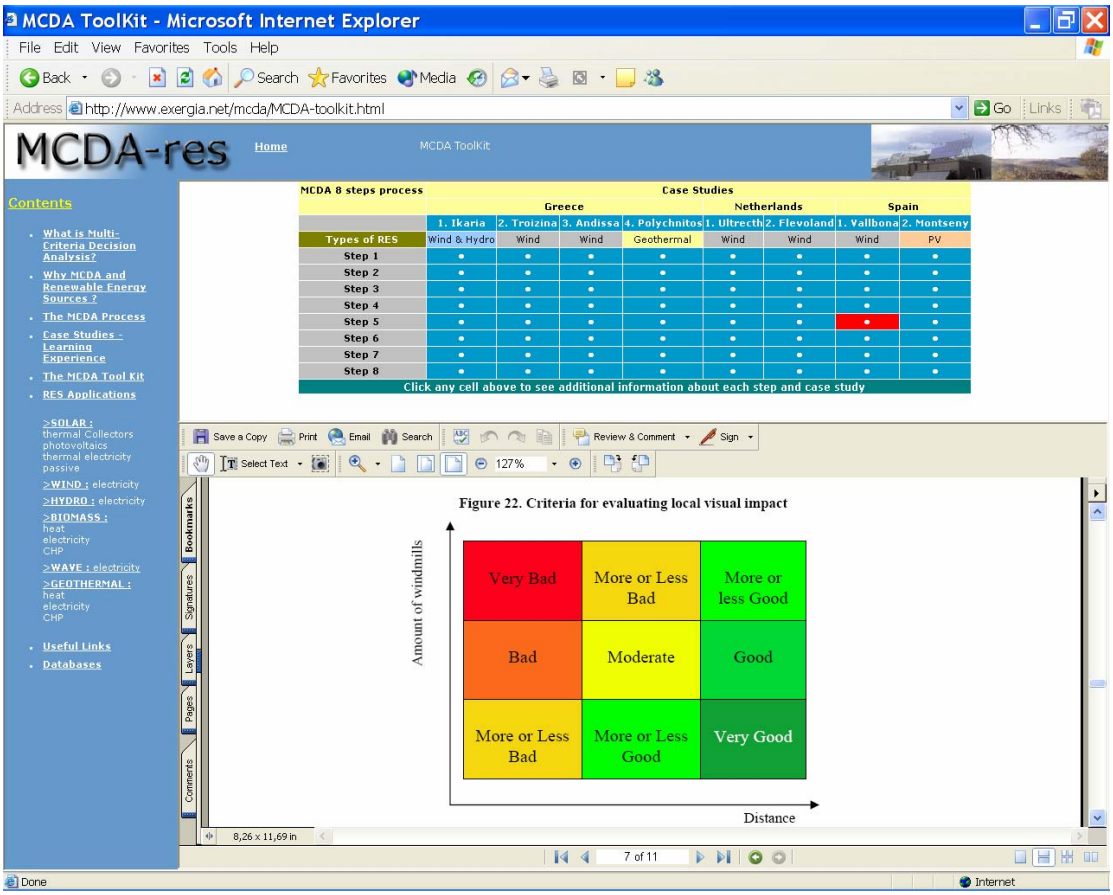
Participatory tool applied for approaching the social actors involved

Institutional Analysis



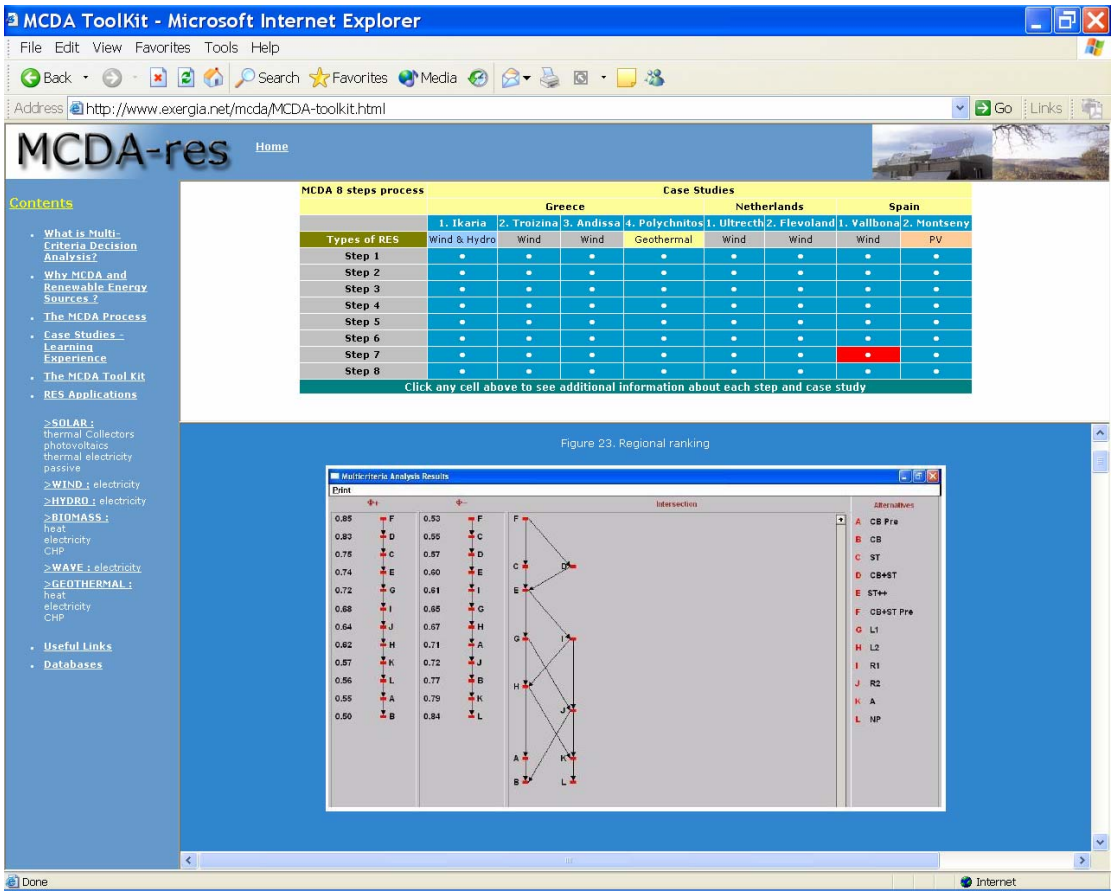
Screen 4.3.3: Spanish case-study No.1 – STEP 3

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



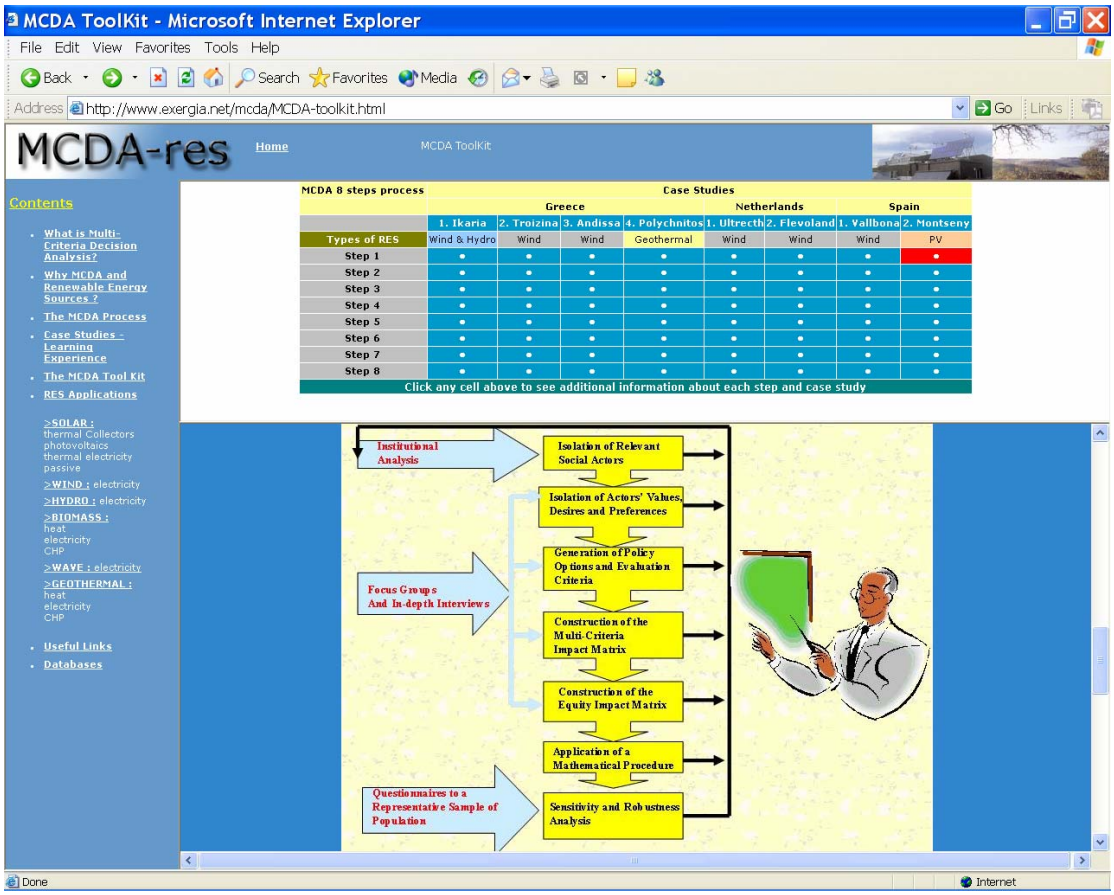
Screen 4.3.4: Spanish case-study No.1 – STEP 5 (PDF version)

Criteria for evaluating local visual impact – relevant parameters



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

Model Application: NAIADE method



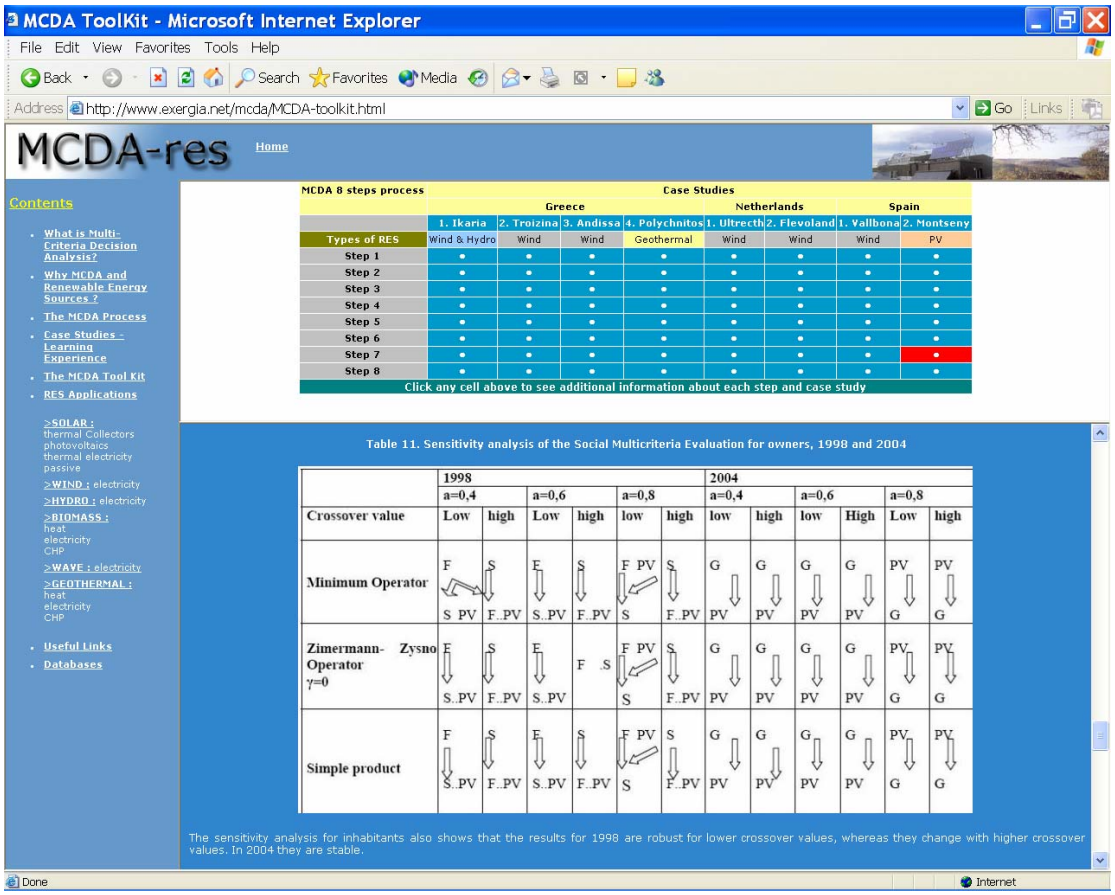
Screen 4.3.6: Spanish case-study No.2 – STEP 1

Ideal problem structuring in Social Multi-Criteria Evaluation

Type of RES: Solar Energy

Application: PV systems

Selected MCDA Technique: NAIADE



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.