



Using the
**Regio1st Multi-Criteria
Decision Analysis (MCDA) tool**
in
Stage 6 (practical feasibility assessment)
Stage 7 (defining actions and developing
the regional energy plan)

George Konstantopoulos
Decision Support System Laboratory
(ICCS - NTUA)

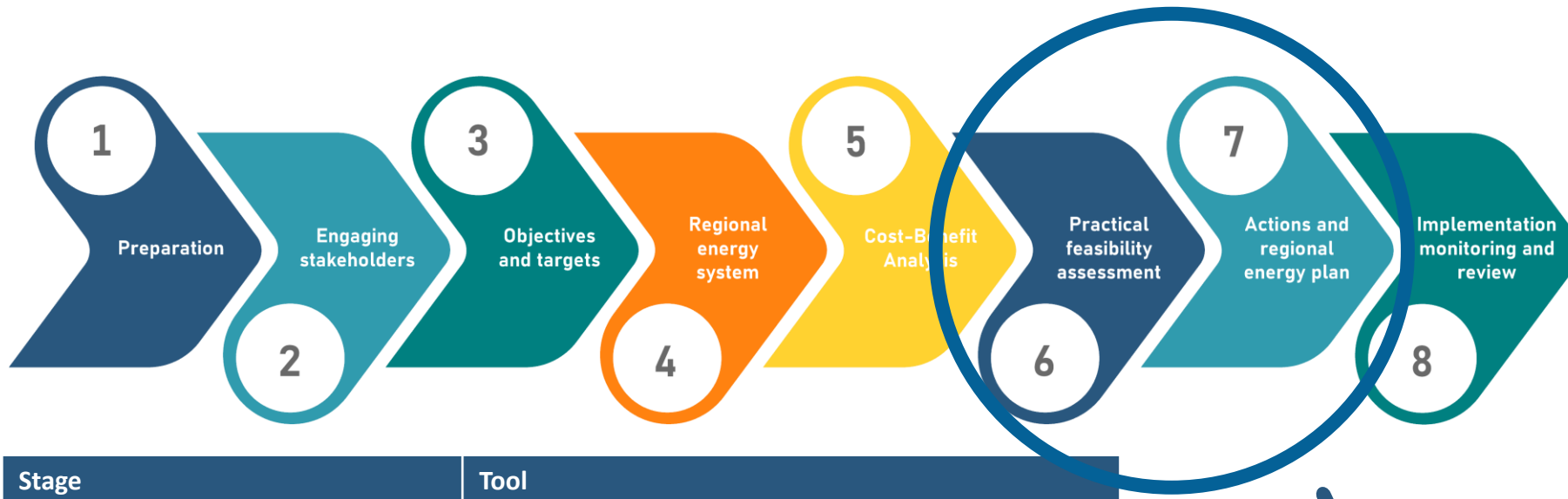


Co-funded by the European Union under project ID101076088. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

Contents

- ❑ Introduction
 - Objective
 - Theoretical Background
 - Methodology of the Regio1st MCDA Tool
 - Features
- ❑ Demonstration
- ❑ Final remarks

Introduction



Stage	Tool
1 Preparation	Roles and Responsibilities Matrix
2 Engaging stakeholders and building partnerships	Stakeholder Identification and Analysis Template
	Stakeholder Engagement Plan Guidance
3 Reviewing energy objectives and targets	National and Regional Targets Comparison Template
	Participatory Priorities Ranking (PPR) Tool
4 Exploring the current regional energy system	Energy Inventory Data Collection Template
5 Cost-benefit analysis	Technology Catalogue Tool
	Cost-Benefit Analysis Tool
6 Assessing the practical feasibility of least-cost energy solutions	Multi-Criteria Decision Analysis Tool (Stages 6 and 7)
7 Defining actions and developing the regional energy plan	Monitoring Template

The Regio1st
Multi-Criteria
Decision Analysis
(MCDA) tool

**Enhance the
decision-making
process**

of regional and local energy
and climate planning by

- bringing together diverse perspectives
- ensuring that decisions are based on a broad set of criteria

Theoretical Background

Consider **multiple criteria** across four impact dimensions (Economy, Environment, Society, Practical feasibility)

Incorporates the previous stages' activities and the respective tools' results.

Flexible enough to incorporate both qualitative and quantitative aspects & assessments.

Open to assessments quantified by **participatory decision-making methods**

Why to use Multi-criteria Decision Analysis



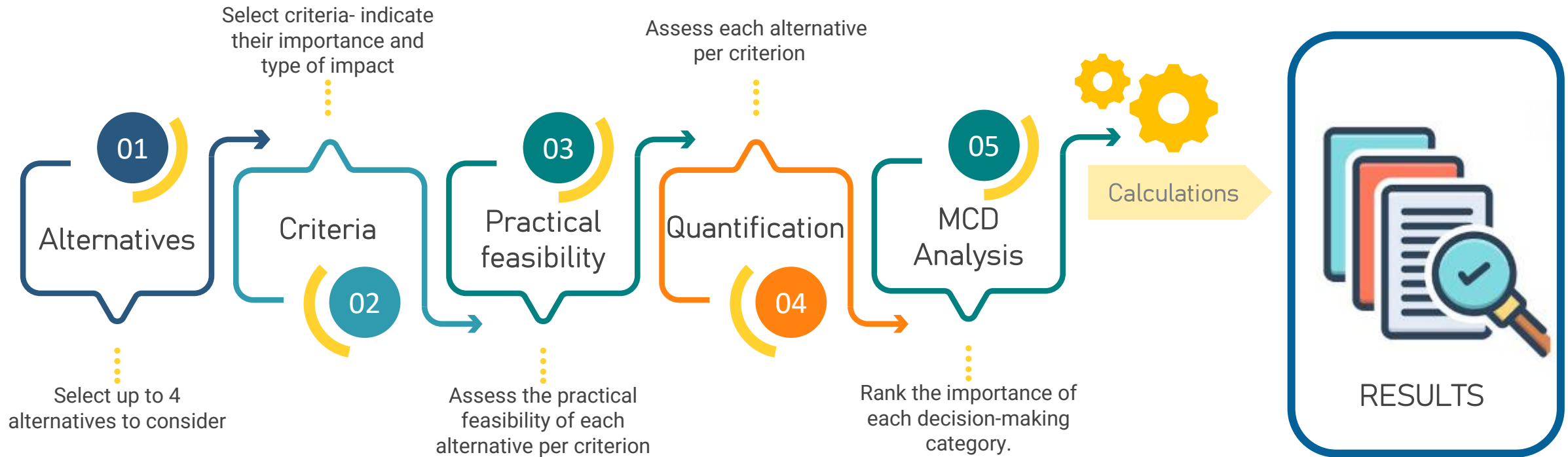
Complex decisions	• Many alternatives • Multiple criteria • Multiple weights
Flexibility	• Quantitative criteria • Qualitative criteria • Mix
Transparency	• Transparency in scoring of criteria and weights • Clarity in results
Participatory	• Enables stakeholders participate in decision-making process.
Integrative	• Facilitates a broad range of type of impacts • Considers different perspectives



Ideal for
decision
making in
**Regional
Energy and
Climate
Planning**

Regio1st MCDA Tool

Methodology



Regio1st MCDA Tool

Features



Excel-based format

Four (8) tabs

- Cover
- Instructions
- 1 – Alternatives
- 2 – Criteria
- 3 – Feasibility
- 4 – Quantification
- 5 – MCDA
- Final Results

Scientific base

The algorithm used is based on the **TOPSIS method** (Technique for Order of Preference by Similarity to Ideal Solution)

- indicates the most favourable alternative against multiple criteria.
- complex decision-making problems in the energy sector.
- a systematic and quantitative approach to evaluate and rank alternative solutions.



Multi-Criteria Decision Analysis Tool (Regio1st MCDA tool)

REGIO1st Planning Framework

Stage 6 - Assessing the practical feasibility of least-cost energy solutions

Stage 7 - Defining actions and developing the regional energy plan

<https://fedarene.org/project/regio1st/>

Date of last update 3/2/2024

Version number 2

Prepared by ICCS - National Technical University of Athens
Contact gkonstantopoulos@epu.ntua.gr



Co-funded by the European Union under project n°101076088. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

Instructions



Multi-Criteria Decision Analysis Tool (Regio1st MCDA tool)

User instructions

Guidance

Objective

The purpose of this tool is to enhance the decision-making process of regional and local energy and climate planning, by bringing together diverse perspectives and ensuring that decisions are based on a broad set of criteria/indicators. Given that involving all relevant parties, including public authorities, planners, stakeholders, and society, is vital for creating a meaningful plan, this tool incorporates features that facilitate collaborative decision-making.

Description

This tool (Multi-Criteria Decision Analysis Tool) is a structured tool designed to streamline the complex process of regional energy and climate planning. The tool empowers regions and their planners to make informed decisions by following a 5-step methodology. It provides a structured and efficient approach for regions and planners to extract, evaluate, and rank regional actions/investments, facilitating a data-driven, and impactful energy and climate planning process. This 5-step methodology enables the incorporation of views and priorities identified in the

Methodology

In order to extract, evaluate and rank regional activities, regions and their planners need to:

1. Select up to 4 alternatives (investment options, scenarios of actions, stand-alone actions for energy and climate).
2. Define the criteria to evaluate the selected alternatives, along with their respective importance and type of impact. There are four categories of criteria to consider: economic, environmental,
3. Evaluate the practical feasibility of the alternative energy solutions
4. Assess the alternatives using the remaining criteria
5. Select the importance of each criteria category
6. The final priorities ranking is presented, as calculated by the MCDA algorithm.

How do I use this tool?

(1) Step 1 - Alternatives (Investments/scenarios/actions)

In this tab, the user selects up to 4 alternatives to consider in their regional energy and climate plan, using the drop-down menu.

Step 1 – Alternatives (investments/scenarios/actions)



Multi-Criteria Decision Analysis Tool

REGIO1ST | Planning Framework

Step 1 - Alternatives (investments/scenarios/actions)

Who: Regional authority & planners

What: Select **up to 4 alternatives** to consider in your regional energy and climate plan. There is a list with indicative alternatives, to help you select and define your

How: Click on cells 1 to 4, in Table 1.1 below. A **drop-down menu** with suggested alternatives is available. You can choose one alternative per cell.

Users should fill in the orange cells only

Table 1.1 Alternative solution selection

Alternatives	
1	
2	
3	
4	

**Users should fill in the orange cells only*

Select alternative(s)

Table 1.2 Alternatives

List of Alternatives
Renovations of residential buildings
New natural gas network
Air heat pumps in buildings
Biomass district heating
Transport (modal shift)
Transport (public transportation)
here you can add an alternative not included above
here you can add an alternative not included above
here you can add an alternative not included above
here you can add an alternative not included above
here you can add an alternative not included above
here you can add an alternative not included above
here you can add an alternative not included above
here you can add an alternative not included above
here you can add an alternative not included above

Cover

Instructions

1-Alternatives

2-Criteria

3-Feasibility

4-Quantification

5-MCDA

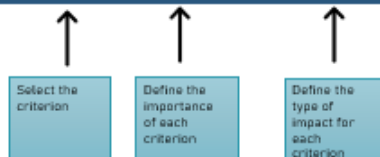
Final Results

Step 2 – Evaluation Criteria

Table 2.1 Economic criteria

Economy		
Criterion	Importance	Type of Impact
1		
2		
3		
4		
5		

*Users should fill in the orange cells only



Impact on GDP	https://open.micrtool.eu/
Impact on employment	https://open.micrtool.eu/
Impact on energy intensity	https://open.micrtool.eu/
Asset value of buildings	https://open.micrtool.eu/
Turnover of energy efficiency goods	https://open.micrtool.eu/
Import dependence	https://open.micrtool.eu/
Avoided investments in additional capacity	https://open.micrtool.eu/
Supplier diversity	https://open.micrtool.eu/
Levelized cost of energy	Regio1st CBA tool
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	

Environment

Table 2.2 Environmental criteria

Environment		
Criterion	Importance	Type of Impact
1		
2		
3		
4		
5		

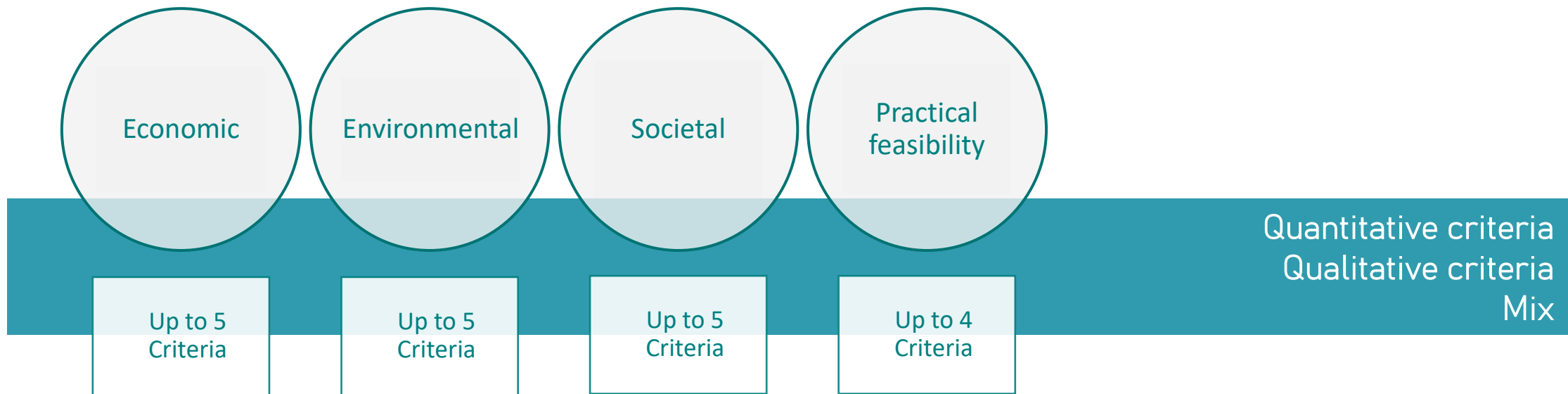
*Users should fill in the orange cells only

List 2. Environmental criteria

List of criteria/indicators	Available resources to quantify the criterion
Energy savings by fuel	Regio1st CBA tool
Reduction in air pollution	https://open.micrtool.eu/
Reduction in greenhouse gas emissions	https://open.micrtool.eu/
Renewable energy produced	https://open.micrtool.eu/
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	
here you can add a criterion not included above	

Society

Decision making dimensions



Step 3 – Practical feasibility assessment



Multi-Criteria Decision Analysis Tool

REGIO1ST | Planning Framework

Step 3 - Practical feasibility assessment

Who: Regional authority & planners

What: Assess the practical feasibility of each alternative per criterion selected in the previous step. For the assessment of each alternative, a linguistic scale is used.

How: A drop-down menu is available when you click on the orange cells in the table below.

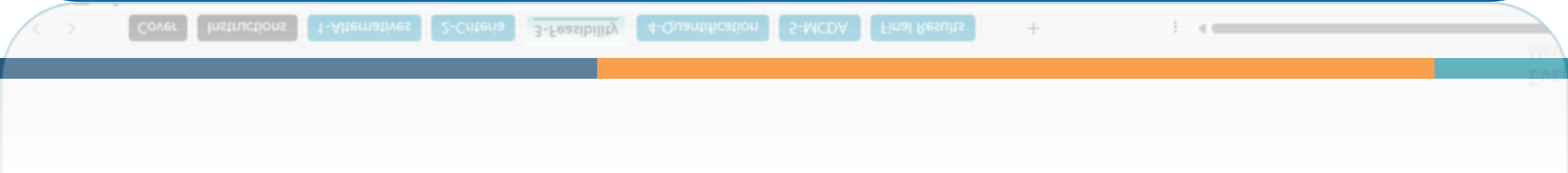
Users should fill in the orange cells only

Table 3. Assessment of practical feasibility

		Alternatives			
Criteria					
1					
2					
3					
4					

CoverInstructions1-Alternatives2-Criteria3-Feasibility4-Quantification5-MCDAFinal Results

EverMet



Step 4 – Impacts' quantification

Step 4 – Impacts' quantification

Who: Regional authority & planners

What: Assess each alternative per criterion selected in Step 2. For the assessment of alternatives, available data can be used (e.g. from studies, publications, scientific databases or even own calculations). If it is not feasible to undertake a quantitative assessment, a qualitative assessment can be undertaken.

How: A drop-down menu is available when you click on the orange cells in the table below

Users should fill in the orange cells only

In case you have chosen criteria that cannot be quantified in numerical terms, you can use a linguistic scale. In particular, assess the respective criterion using the linguistic scale presented in the table below and fill in the quantification matrix using its numerical equivalent. For instance, "5" should be used for an alternative that performs "very high" under a criterion. Please note intermediate values (e.g. 2.5) can also be used.

Table 4.1 Numerical representation of the linguistic scale

Indicators estimated performance (linguistic)	Very Low	Low	Medium	High	Very High
Numerical representation	1	2	3	4	5

Table 4.2 Quantification Matrix

		Alternatives			
Criterion		Unit			
Economic	1				
	2				
	3				
	4				
	5				
Environmental	6				
	7				
	8				
	9				
	10				
Societal	11				
	12				
	13				
	14				
	15				
Feasibility	16				
	17				
	18				
	19				

Quantify the indicator(s) for each one of the alternatives. If you cannot quantify this in absolute numbers you can use the linguistic scale proposed above

No action is needed - table filled in in Step 3

Cover Instructions 1-Alternatives 2-Criteria 3-Feasibility 4-Quantification 5-MCDA Final Result

How to quantify criteria

Quantitative



- ☐ (s-)CBA studies
- ☐ Multiple impacts tools (Micat, COMBI)
- ☐ Simulation models
- ☐ Technical studies
- ☐ Literature
- ☐ Databases

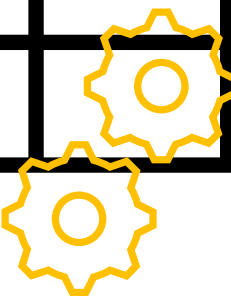
Qualitative



- ☐ Linguistic scale
- ☐ Responses by experts, stakeholders, citizens



Decision matrix

Two interlocking yellow gears are positioned at the bottom right of the decision matrix table.

Step 5 – MCDA's priorities selection



Step 5 – MCDA's priorities selection

Who: Regional authority & planners
What: Rank the importance of each decision making category.
How: A drop-down menu is available when you click on the orange cells in the table below.
Users should fill in the orange cells only

Table 5.1 Categorical importance

Dimensions	Importance (very low to very high)
Economy	
Environment	
Society	
Practical feasibility	

*Users should fill in the orange cells only

Table 5.2 Aggregated decision matrix

		Alternatives			
Criterion	Weights				
Economy					
Environment					
Society					
Practical feasibility					

Final Ranking



Final Ranking

What: In this tab the alternatives' final ranking is presented

Table 6. Final Priorities' Ranking

Regional energy planning Priorities	Performance score	Rank	Rank

REGIO1ST MCDA - Performance score

-

0.200

0.400

0.600

0.800

1.000

-

-

-

-

-

>

Cover

Instructions

1-Alternatives

2-Criteria

3-Feasibility

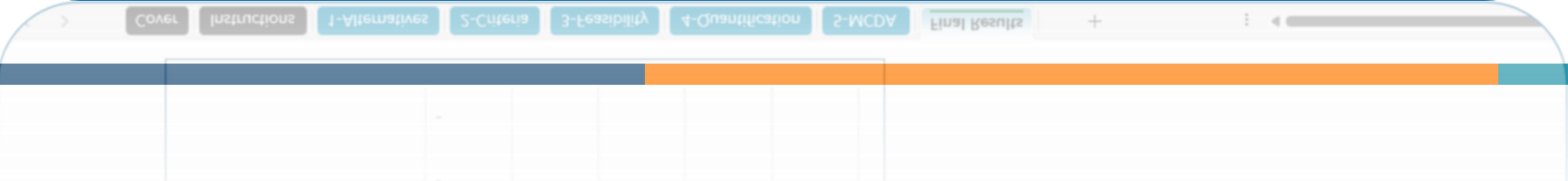
4-Quantification

5-MCDA

Final Results

+

:



Demonstration



Final remarks





The Regio1st MCDA tool

- Does not function as a stand-alone tool only for conducting the practical feasibility assessment (Stage 6)
- Combines the input from Stage 6 and Stage 7. Results can be returned in Stage 7.
- Needs careful selection of criteria and appropriately weighting;
- Choose criteria that are relevant and independent
- Participatory assessment of the alternatives per qualitative criterion is desirable to ensure broad acceptance.



Next steps

- Practical implementation of tool in Regio1st pilot regions
- Evaluation in real assessment and decision-making conditions
- Feedback from testing the tool in real conditions will be key for improvements/adjustments

Thank you!

George Konstantopoulos

Decision Support System Laboratory (ICCS -NTUA)

gkonstantopoulos@epu.ntua.gr



Co-funded by the European Union under project ID101076088. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

For more info, follow our hashtag **#regio1st**, visit our website or contact us:



[Get Started | Regio1st-planning-framework \(fedarene.org\)](https://www.fedarene.org/regio1st-planning-framework)



[Regio1st - Fedarene](mailto:info@fedarene.org)



Co-funded by the European Union under project ID101076088. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.