



EUROPEAN UNION



Committee of the Regions



# BioRes Project

## Presentation on the DSS

P. Raxis

[raxis@atlantisresearch.gr](mailto:raxis@atlantisresearch.gr)



biores





# Scope, objectives and approach

- **Objective**

- Support authorities and stakeholders to invest in energy production units based on biogas from waste (municipal, agriculture, etc).

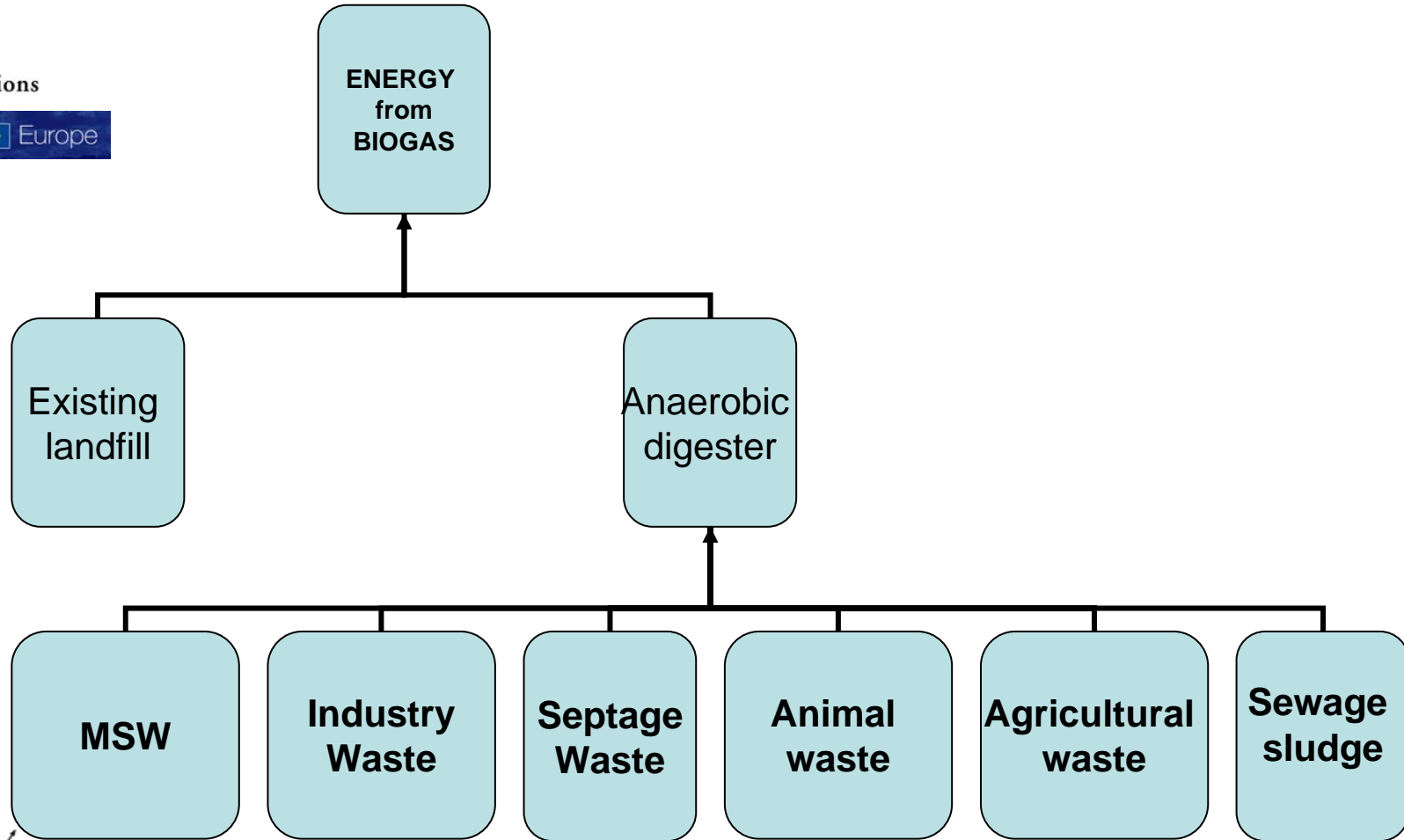
- **Scope**

- WEB based interactive tool to support decision making

- **Approach**

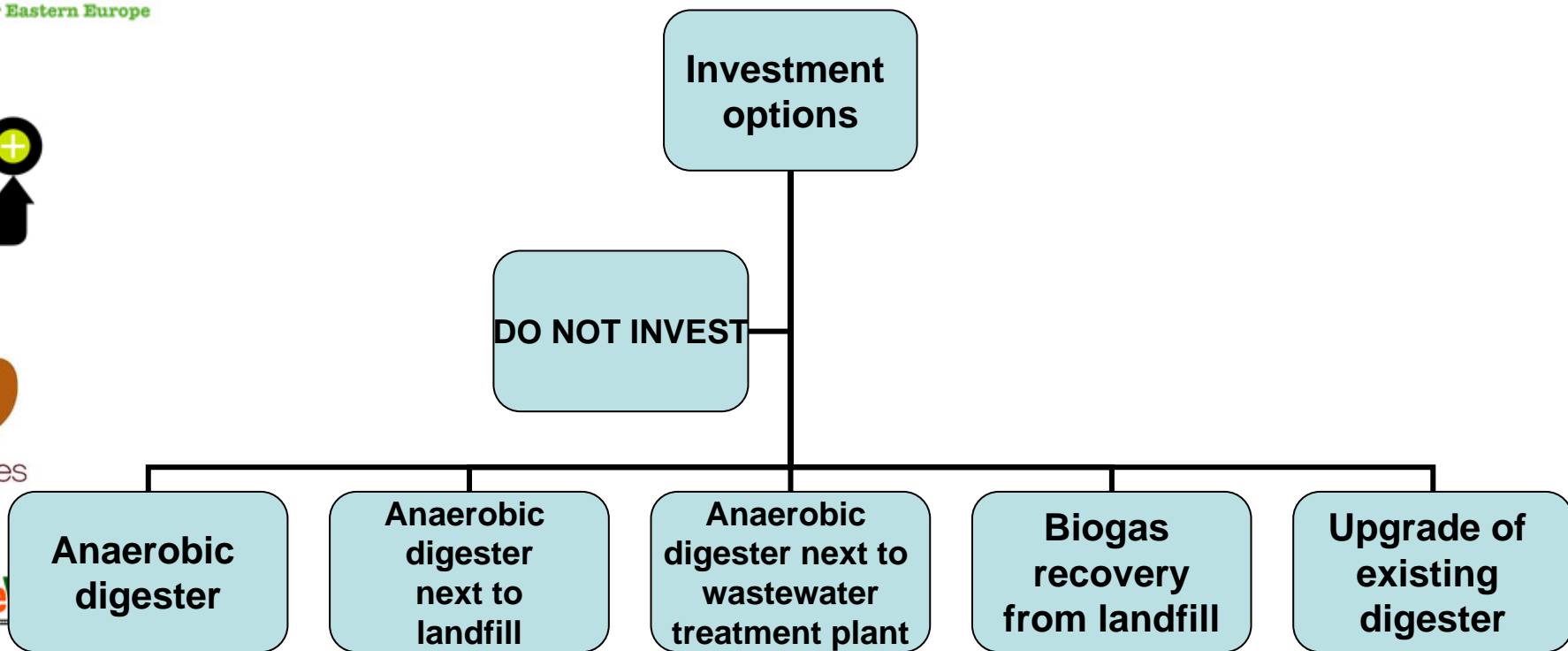
- Use MCDA to rank all possible technological / investment options against predefined weighted criteria

# Options and types of waste considered




# Pre-modeled technological/investment opts

- 5 options, could be combined any or all of them (depending on user input wrt current situation)



# Criteria groups: Financial, socio/environmental

- **Financial**

- 
- NPV (accumulated investment net income over the investment period, if had been received today)
  - IRR (benefit received compared to a risk free long-term investment)
  - Pay-Back Period, Investment Capital Cost

- **Social – Environmental**

- GHG emission reduction (thous m<sup>3</sup> / y)
- Fossil fuel savings (tons oil equivalent / y)
- Replaced tons of chemical fertilizers
- Odour reduction & sanitation improvement (qualitative)
- Employment creation (# of jobs)
- Energy coverage (% of island energy needs)

# Criteria groups: NTBs

Severity ranking 1-9

- NTBs: selection from a pre-defined list (internal/external)

6 main clusters + user defined

2 values carried forward through averaging

1. Administrative barriers
  2. Regulatory barriers
  3. Financial barriers
  4. Economic/infrastructure barriers
  5. Public awareness & acceptance barrier
  6. Product markets/competition/risk perception barrier
- ❖ User defined barrier

# Weighting mechanism

- For each one of the applicable options
  - For each one of the 12 criteria
    - The user provides a weight value, to signify the importance of the criterion
    - The scale is 0 – 100
    - 0 means the criterion is ruled out
  - The system automatically computes the relative importance of criteria
    - Automatic normalization is applied in user weight-values

# Methodological approach

- **We use**

- Input from the user (eg. infrastructures available near the future plant location, availability of land, energy end-uses, feedstock composition)
- Data from a database (eg. Population per island, technology cost)
- Model calculations to derive values of synthetic parameters (eg. Operational cost, biogas production, transportation cost)

- and we apply PROMETHEE II MCDA method to obtain a complete preference ranking amongst applicable options



# Output presented to the user

- **Financial data**
  - NPV, IRR
  - Capital cost, Pay-back Period
- **Preference Ranking of the available options**
  - [-100 ... +100]
- **Bar-chart to compare the available options**
- **Financial details of the best option**
- **“What-if” analysis, for the best option**
  - *List with differences (in %) for some basic elements (e.g. income, cost, energy produced), if the user had had a different selection with regards to “final usage” type and technology*

## Situation Analysis

Is there an existing AD plant?  YES  NO

Is there an existing Landfill?  YES  NO

[Next](#)

**Note on the space required for a new Anaerobic Digester Plant**

Below is the average required space for a new AD Plant, based on the amount of waste the Plant is intending to service:

Small Capacity Plant: 3000 m<sup>2</sup>

Medium Capacity Plant: 6500 m<sup>2</sup>

Large Capacity Plant: 15000 m<sup>2</sup>



Print



Contact us



EUROPEAN UNION



Committee of the Regions



Step Number :1

Note: \* indicates mandatory field

### GENERAL INPUT

Project Location:

Harpesdal

Country:

Denmark \*

Which currency do you want to use?

Euro

Other

Municipal Solid Waste generated (kg/capita/day):

1.5

Year of Investment:

2011

Investment Lifetime:

20 \*

Permanent Population:

4000 \*

Additional Seasonal Population:

36000

Average number of days seasonal visitors / tourists stay on the island:

7.0

MSW Organic Matter (fraction in range [0..1]):

0.2

Cost of Land to be bought for the new Plant (Currency/m<sup>2</sup>):

0.0 \*

Fuel cost (Currency/lt) for feedstock transportation (e.g. MSW, manure etc):

9.0 \*

Fuel Type	Used?		Percentage of Fuel Used (eg. for transportation, heating, etc.)
Propane	<input type="radio"/> YES	<input checked="" type="radio"/> NO	<input type="text"/>
Coal	<input type="radio"/> YES	<input checked="" type="radio"/> NO	<input type="text"/>
Renewable Energy	<input checked="" type="radio"/> YES	<input type="radio"/> NO	<input type="text" value="100"/>
Natural Gas	<input type="radio"/> YES	<input checked="" type="radio"/> NO	<input type="text"/>
Diesel	<input type="radio"/> YES	<input checked="" type="radio"/> NO	<input type="text"/>
Gasoline	<input type="radio"/> YES	<input checked="" type="radio"/> NO	<input type="text"/>

### INPUT RELATED TO FINANCING

Investment Capital Cost Subsidy (%):	<input type="text" value="20.0"/>
Investment Discount Factor (discount rate %):	<input type="text" value="3.0"/>
Estimated Annual Avg. Inflation Rate over the Investment lifetime (%):	<input type="text" value="1.0"/>
Tax Rate on Profits (%):	<input type="text" value="0.0"/>

Back Step

Next Step

Step Number :2

Note: \* indicates mandatory field

---

### LANDFILL RELATED INPUT

Permanent Population served by Landfill (%):  \*

Year landfill Opened:  \*

Last Year Landfill Used:  \*

Landfill Surface Area (m2):  \*

Landfill Average Height (m):  \*

Is there an existing Collection System?  YES  NO

Area to be bought next to Landfill (m2):

### LANDFILL RELATED INPUT

Would you like to apply Digestate Treatment?  YES  NO

---

### Step Number :3

Note: \* indicates mandatory field

#### FEEDSTOCK COMPOSITION:

MSW:  YES  NO

Manure:  YES  NO

Agricultural:  YES  NO

Sewage Sludge:  YES  NO

Industrial:  YES  NO

Septage:  YES  NO

#### MSW INFORMATION

Solid Waste to be used (%):  \*

What will be the separation method?  Separation at Source  Mechanical Separation

#### MANURE INFORMATION

Animal Type	Included?	Animal Population
-------------	-----------	-------------------

Buffalo	<input type="radio"/> YES <input checked="" type="radio"/> NO	<input type="text"/>
---------	---	----------------------

Chicken	<input type="radio"/> YES <input checked="" type="radio"/> NO	<input type="text"/>
---------	---	----------------------

Cattle	<input checked="" type="radio"/> YES <input type="radio"/> NO	<input type="text" value="1100"/>
--------	---	-----------------------------------

Pig	<input checked="" type="radio"/> YES <input type="radio"/> NO	<input type="text" value="3700"/>
-----	---	-----------------------------------

Vehicle Operation time to transport manure to the plant (hr/day):  \*

Vehicle Power needed for the Manure transportation:  \*



## INPUT RELATED TO THE FINAL BIOGAS USAGE:



Final usage type: \*  CHP  Electricity Production  Gas Upgrade

Type of Technology:

[Back Step](#)

[Next Step](#)

Step Number :4

Note: \* indicates mandatory field

Electricity Selling Price (Currency/KWh):  \*

Thermal Energy Selling Price (Currency/KWh):  \*

Gas Selling Price (Currency/m3):

Estimated average Gate-fee (Currency/tn):

[Back Step](#)

[Next Step](#)

[Proceed](#)



## DSS

Current Situation  
 Input Wizard  
 NTBs Specification

## MCDA Criteria: Assign Weights

For each criterion below, please specify a weight value in the range [0..100]. Note that weights do not have to add up to 100!

### ECONOMIC CRITERIA AND NTBS

Criteria	NPV	IRR	PP	Investment Cost	Internal Barriers	External Barriers
Weight:	<input type="text" value="10"/>	<input type="text" value="10"/>	<input type="text" value="30"/>	<input type="text" value="40"/>	<input type="text" value="5"/>	<input type="text" value="10"/>

### SOCIAL CRITERIA

	GHG Emission Reduction	Fossil fuel savings	Replaced tons of Chemical fertilizers	Improve Odour Reductions and Sanitation	Employment Creation	Energy Coverag
Weight:	<input type="text" value="10"/>	<input type="text" value="10"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="20"/>	<input type="text" value="0"/>

#### Note on Criteria:

- *NPV: Net Present Value. General interest financial criterion. Widely used*
- *IRR: Internal rate of return (%). General interest financial criterion. Widely used along with NPV.*
- *PP: Payback period. It presents particular interest for project finance or third party finance initiatives*

# Performance Matrix

## ECONOMIC CRITERIA AND NTBS

Valid Options	NPV	IRR	PP	Investment Cost	Internal Barriers	External Barriers
Weight:	100	0	100	100	0	0
Option 3	65496210,8	37,34	4	15059500,7	0	0
Option 4	5106019,3	23,25	7	2345438,9	0	0
Option 6	0	5	0	0	0	0

## SOCIAL CRITERIA

Valid Options	Odour Reductions and Sanitation Improvement	Employment Creation	Energy Coverage
Weight:	0	80	0
Option 3	6	9	0,09
Option 4	1	3	0,04
Option 6	0	0	0

## ENVIRONMENTAL CRITERIA

Valid Options	GHG Emission Reduction	Fossil fuel savings	Replaced tons of Chemical fertilizers
Weight:	0	0	0
Option 3	57734,6	464,4	0
Option 4	25259,8	203,2	0
Option 6	0	0	0

### Note on Options:

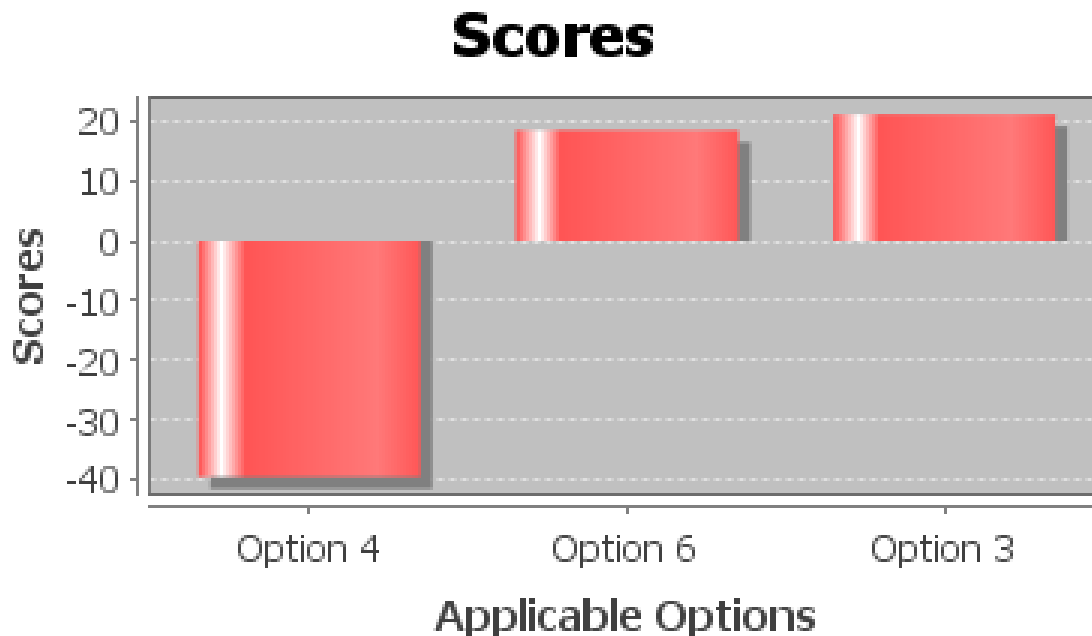
- Option 1: Upgrade existing anaerobic digestion biogas plant
- Option 2: Anaerobic digestion biogas plant
- Option 3: Anaerobic digestion biogas plant next to landfill
- Option 4: Landfill biogas recovery plant
- Option 5: Anaerobic digestion biogas plant next to wastewater treatment plant
- Option 6: Do NOT invest

### Note on Criteria:

- NPV: Net Present Value. General interest financial criterion. Widely used
- IRR: Internal rate of return (%). General interest financial criterion. Widely used along with NPV.
- PP: Payback period. It presents particular interest for project finance or third party finance initiatives

# MCDA Results

The chart below displays the overall scores of the applicable Options. View the chart in [normal size](#).



---

Valid Options	Results
---------------	---------

Option 3	21,1
----------	------

Option 4	-39,5
----------	-------

Option 6	18,4
----------	------

---

Some important notes on the MCDA scores for the applicable Options:

- A positive score represents a preferred option when compared to the alternative options.
- If more than one options have a positive score, a higher value indicates a better (more preferred) investment option.
- *In general, the higher the better !*



EUROPEAN UNION



Committee of the Regions



The Optimum investment Option is: Option 3. Some of its criterion results may be found in the table, below.

Criteria	Scores
Net Present Value	65496210,8
Investement Cost	15059500,7
Payback Period	4
External Non-Technical Barrier	0
Internal Non-Technical Barrier	0
Biogas Produced	1316793,39

What-If analysis based on different combination of Final Biogas Usage Types (eg. CHP, Electricity Production) and Technologies (eg. Industrial, Microturbines) has taken place for Option 3. The analysis focused on income and cost (%) difference with respect to your energy choices. The results are shown below:

Usage Type / Technology	Difference in expected income from energy (%)	Difference in required technology implementation cost (%)
CHP / Industrial	76,07	-244,9
EP / Microturbine	-14,29	-30,61
EP / Turbine	0	0
CHP / Microturbines	83,43	-65,31

*Note on Options:*

- Option 1: Upgrade existing anaerobic digestion biogas plant
- Option 2: Anaerobic digestion biogas plant
- Option 3: Anaerobic digestion biogas plant sent to landfill



# Bioures project – DSS



[http://athcon.static.otenet.gr:4455/BioRes\\_DSS/CurrentSituation.jsf](http://athcon.static.otenet.gr:4455/BioRes_DSS/CurrentSituation.jsf)



**Polivios RAXIS**

ATLANTIS Consulting SA

Athens, Greece

[raxis@atlantisresearch.gr](mailto:raxis@atlantisresearch.gr)

