



SCREENING LCA OF MUNICIPAL WASTE INCINERATION IN S. MIGUEL, THE AZORES. Two Scenarios on Incineration and Separate Collection

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02. GOAL AND SCOPE



03. DESCRIPTION AND RESULTS OF SCENARIOS 1 & 2



04. DISCUSSION AND CONCLUSIONS

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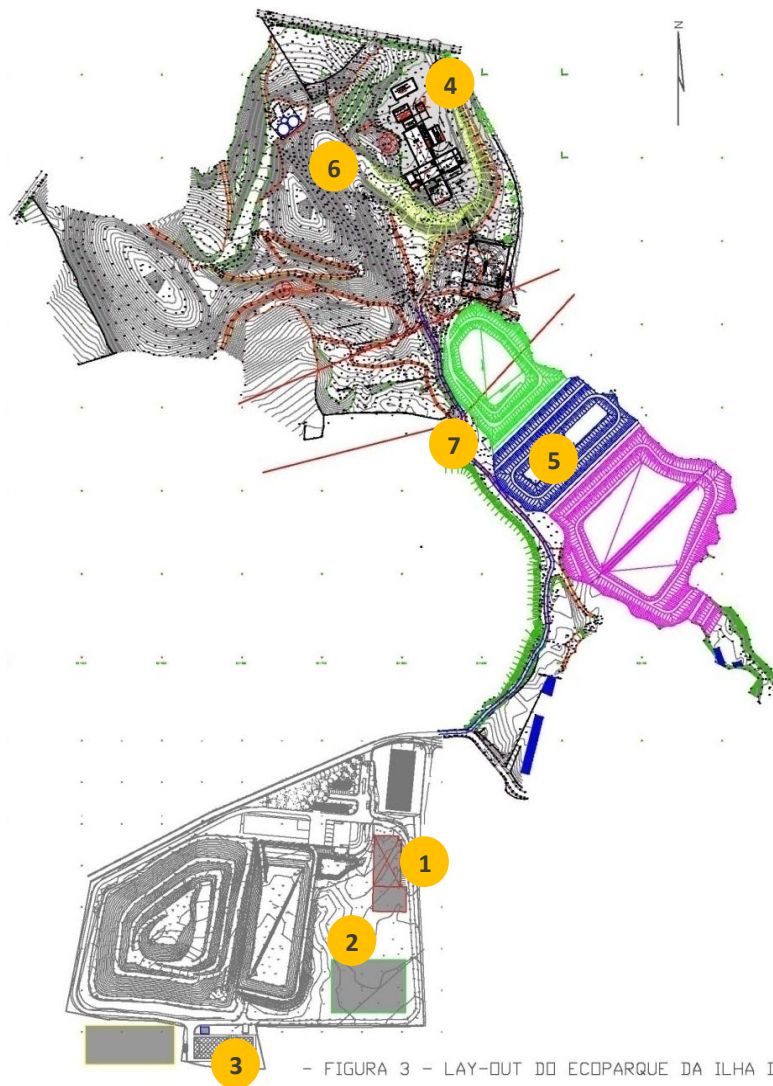
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DISCUSSION AND CONCLUSIONS








- ✿ PROFICO AMBIENTE has developed a **Screening Life Cycle Assessment** (LCA) of incineration of MSW in S. Miguel, the Azores based on a project of AMISM (Association of Municipalities of S. Miguel, the Azores)
- ✿ **Two Scenarios:**
 - (1) Scenario 1 (base scenario) describes incineration of MSW and other high calorific value waste (with energy and heat recovery) and the current waste separation and recycling of plastics, metals and paper
 - (2) Scenario 2 (alternative scenario) describes incineration of MSW and incineration of the formerly separated waste fractions, as well as other high calorific value waste (with energy and heat recovery).
- ✿ Waste management operations included: waste collection, transportation to AMISM facility and recyclers in mainland, sorting and treatment/final destination as applicable, operations regarding energy and heat production, landfilling of residues.

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Legenda:

-  Célula de confinamento técnico de cinzas volantes inertizadas
-  Célula de confinamento técnico de escórias
-  Célula de confinamento técnico de resíduos urbanos
(A célula só irá receber resíduos durante os períodos de paragem programada da instalação)

-  1 Estação de Triagem
-  2 Estação de Valorização Orgânica
-  3 Estação de Tratamento de Lixiviados (actual)
-  4 Central de Valorização Energética
-  5 Aterro de Apoio
-  6 Parque Ecológico
-  7 Via de circulação interna da instalação



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- FIGURA 3 - LAY-OUT DO ECOPARQUE DA ILHA DE S. MIGUEL

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- ✿ **Goal** - to determine if recycling stays the best option or if the advantages of incinerating these waste streams can make up for the environmental benefit of recycling
- ✿ The unique position of the incinerator on the Azores makes the assessment of this question less obvious than in the case that the same amounts of waste would be managed on the mainland.
- ✿ LCA method – not a full-fledged LCA study as described in ISO 14040, but a so called **screening LCA** (LCA not externally reviewed and part of the inventory data is from general LCA databases).
- ✿ Ecoinvent as main source of background data and SIMAPRO software has been used for the calculations of the results
- ✿ ReCiPe impact assessment used as the default assessment method (*Goedkoop et al., 2008*)

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➤ STRUCTURE OF RECIPE METHOD (www.lcia-recipe.net)



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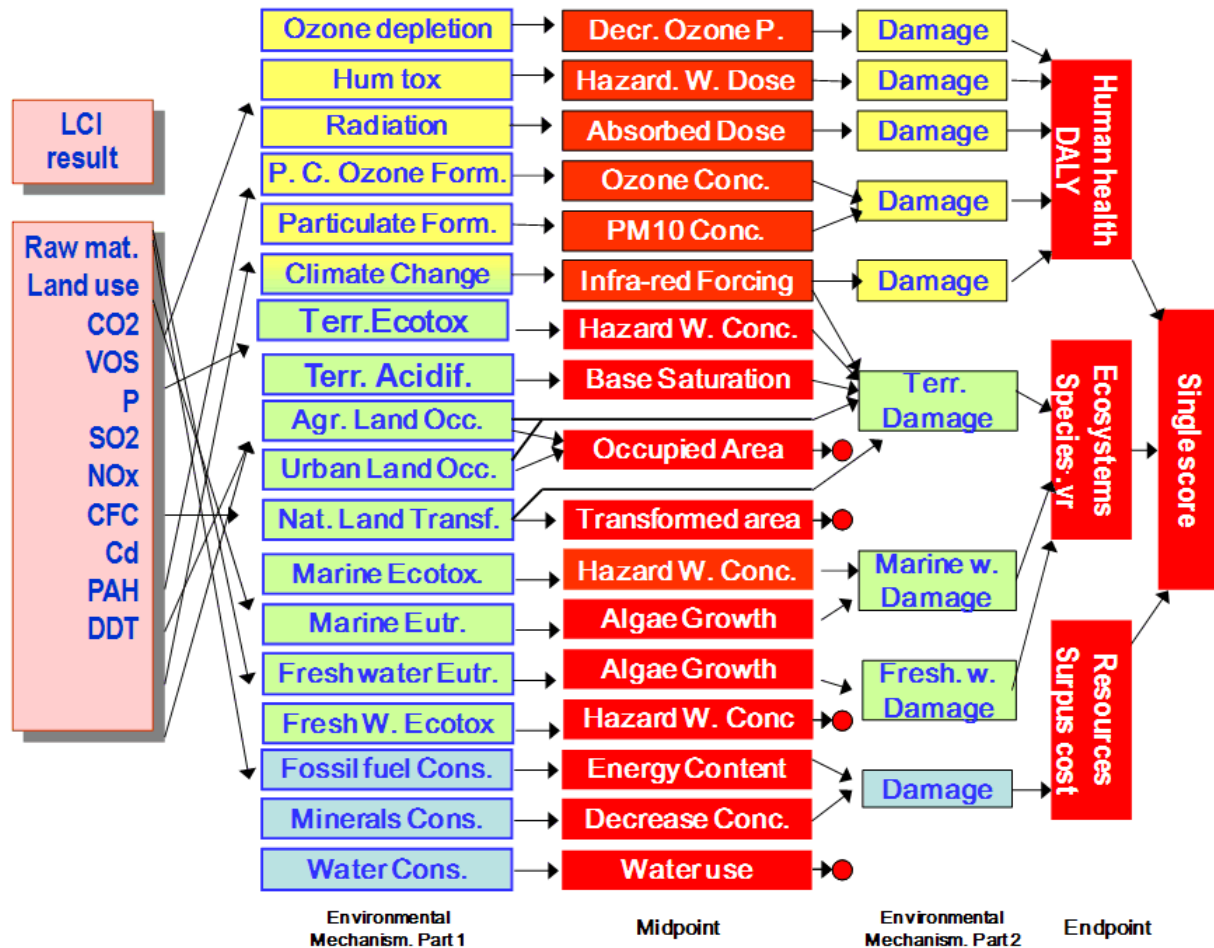
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✿ Interested Parties – Data Collection

- ✿ AMISM – Municipalities Association
- ✿ EDA – Electricity Producer in the Azores
- ✿ TRANSINSULAR – Sea Transportation
- ✿ RECOLTE – Waste Collection in S. Miguel, the Azores
- ✿ SPV – Green Dot
- ✿ CIMENTAÇOR – Cement production in S. Miguel, the Azores



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- ✿ **Scope** – waste collection and treatment of municipality solid waste and separately collected waste streams of metals, plastics and paper
- ✿ Waste streams considered regarding their energy content, as they are incinerated: industrial waste, tyres, waste oils, biowaste, slaughter waste.
- ✿ Other waste streams such as glass, batteries, etc. not considered
- ✿ Approach for the two scenarios: gate-to-grave life cycle of waste



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☀ Phases:

- Transportation (MSW Collection)
- Sorting of separate collected waste streams at AMISM, in the Azores (no sorting of MSW)
- Recycling of separate collected waste streams in mainland (no recycling of MSW)
- Incineration of MSW
- Landfill (bottom ashes and slags from MSW incineration)
- Avoided production (for electricity, heat and metals from MSW incineration)



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➤ AMOUNTS OF WASTE TREATED WITHIN THE FUNCTIONAL UNIT

Waste	Mg
Incinerated waste (future estimate)	88.874
Plastic (separate collection, 2011)	644
Metal (separate collection, 2011)	66
Paper (separate collection, 2011)	2.079
TOTAL	91.663



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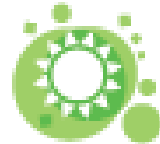
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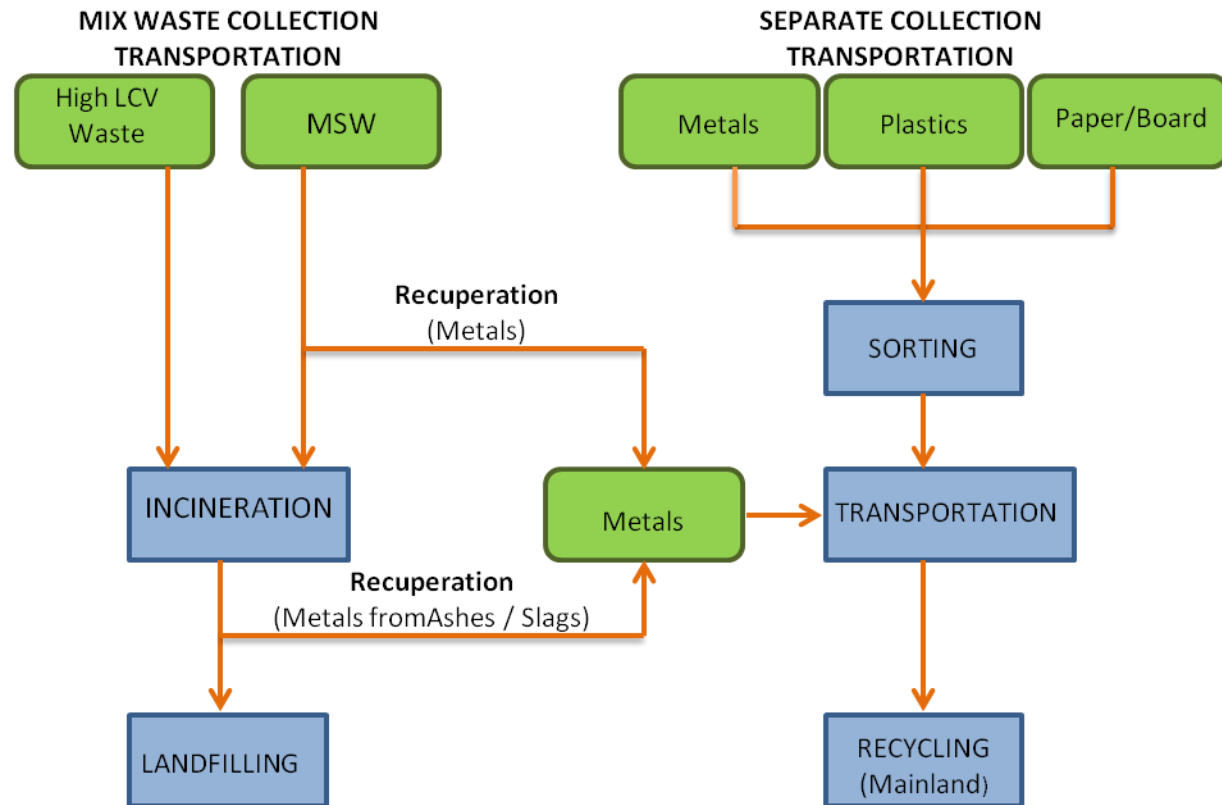


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SCENARIO 1



MSW – Municipal Solid Waste
High LCV Waste – High Lower Calorific Value Waste (industrial waste, tyres, waste oils, biowaste, slaughter waste)

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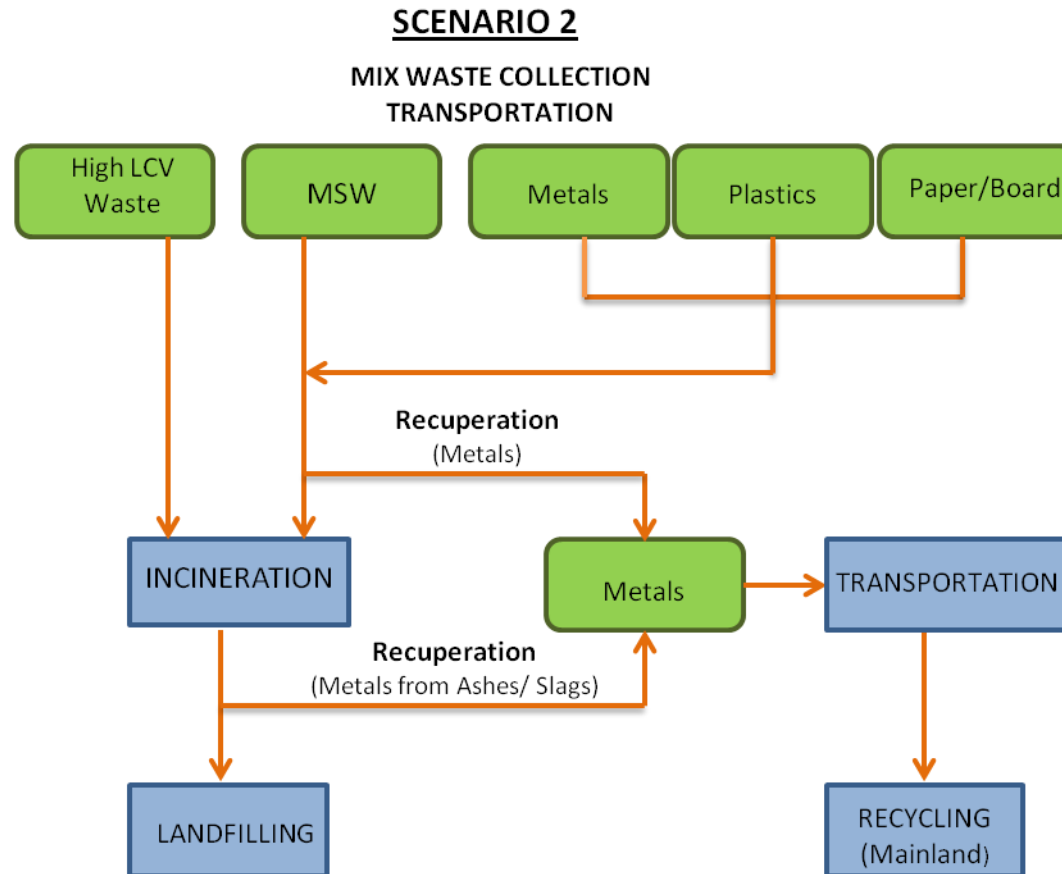
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MSW – Municipal Solid Waste
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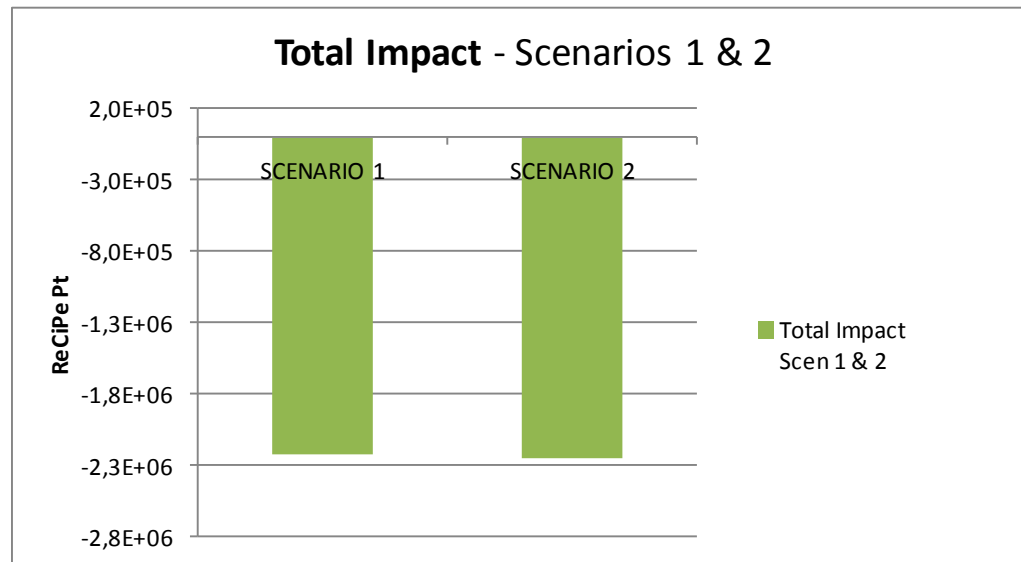
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*(positive score indicates an environmental impact, in ReCiPe Points)

Figure 3 - Overall environmental impact of Scenario 1 and 2 (in ReCiPe Pt)*

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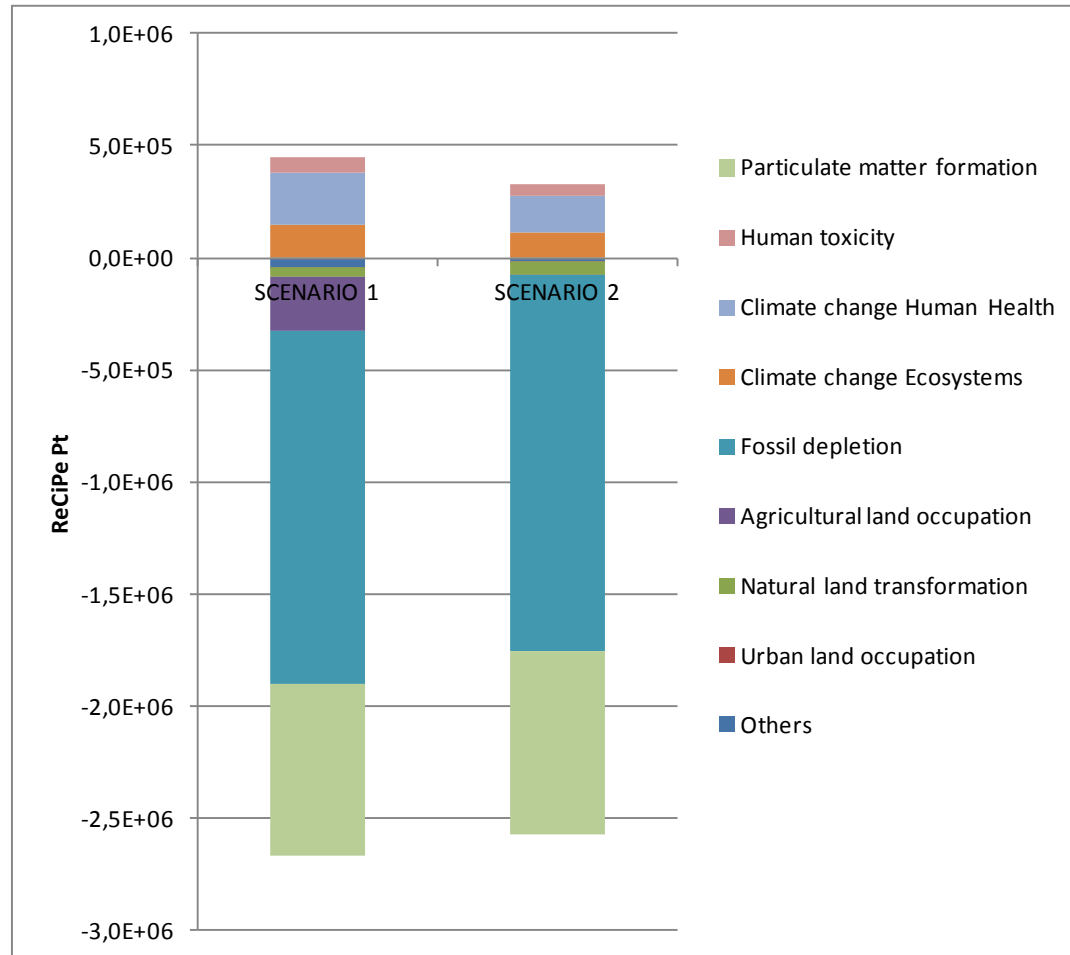
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*(positive score indicates an environmental impact, in ReCiPe Points)

Figure 4 - Overall environmental impact of Scenario 1 and 2, stacked environmental effects (in ReCiPe Pt)*

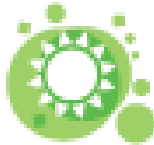
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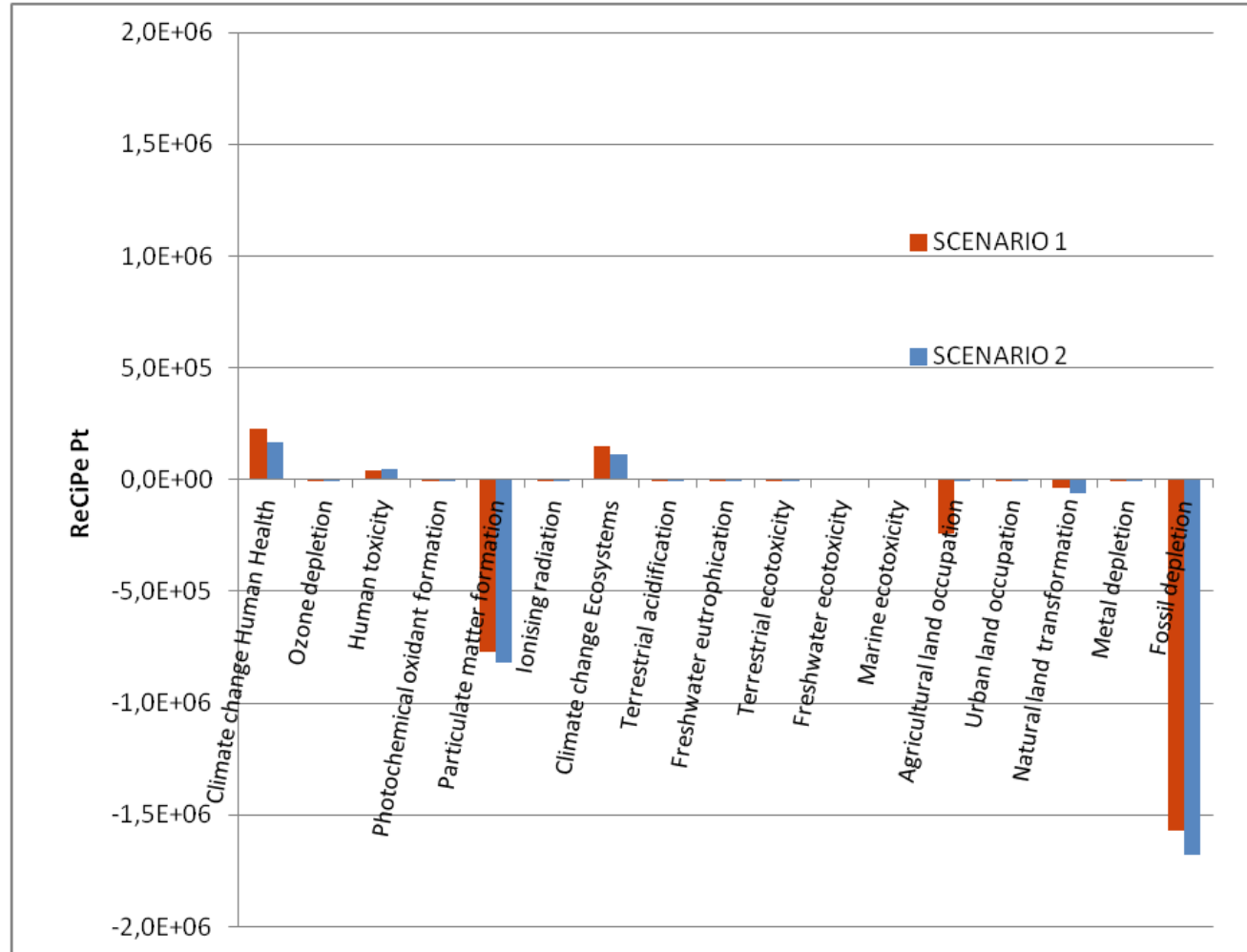
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*(positive score indicates an environmental impact, in ReCiPe Points)

Figure 5 - Overall environmental impact of Scenario 1 and 2, broken down in environmental effects (in ReCiPe Pt)*

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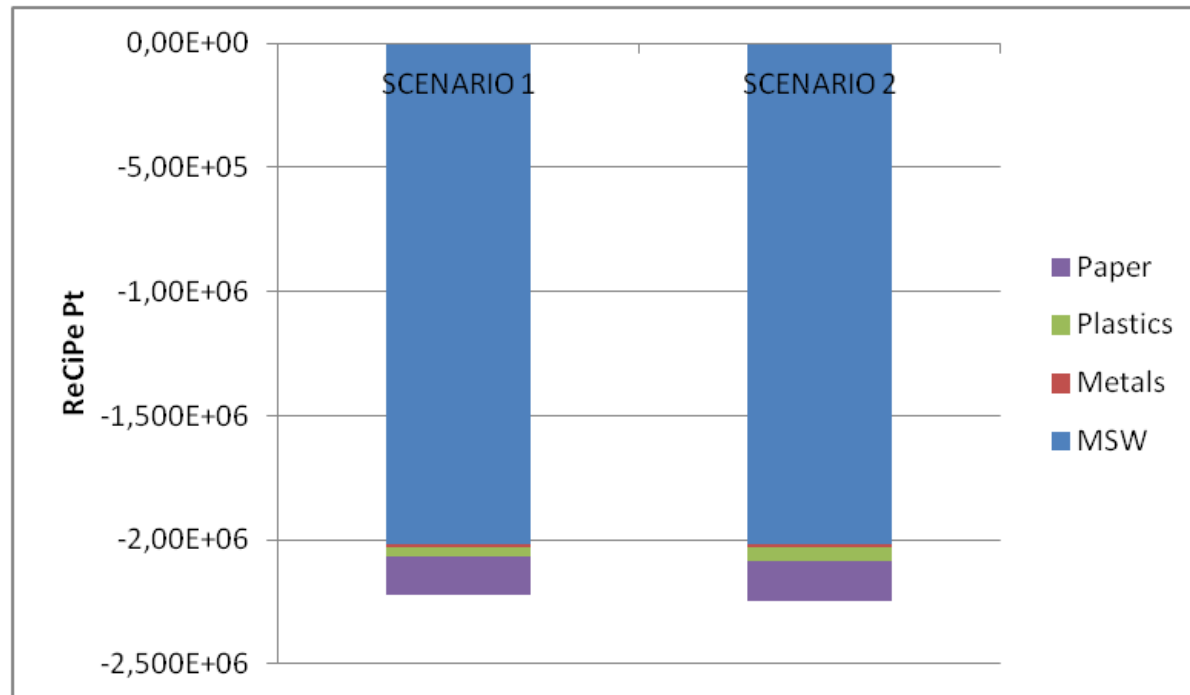
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*(positive score indicates an environmental impact, in ReCiPe Points)

Figure 6a - Overall environmental impact of Scenario 1 and 2, stacked per waste stream type (in ReCiPe Pt)*

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*(positive score indicates an environmental impact, in ReCiPe Points)

Figure 6b - Overall environmental impact of Scenario 1 and 2, stacked per waste stream type, excluding MSW (in ReCiPe Pt)*

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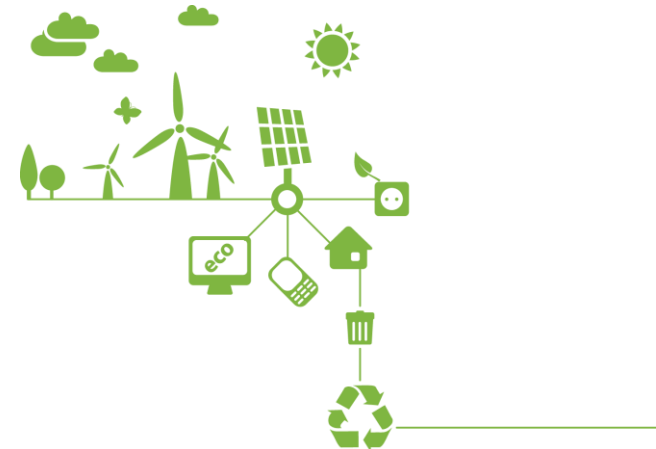


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- Both scenarios show an **environmental improvement** for all the four waste streams.
- There is a slight difference in impact between Scenario 1 and 2 due to the better performance of the paper and plastic waste streams when incinerated in Scenario 2.
- Only a small percentage of the metals that are discarded by households are separately collected  The majority of metal recuperation takes place from the MSW waste stream



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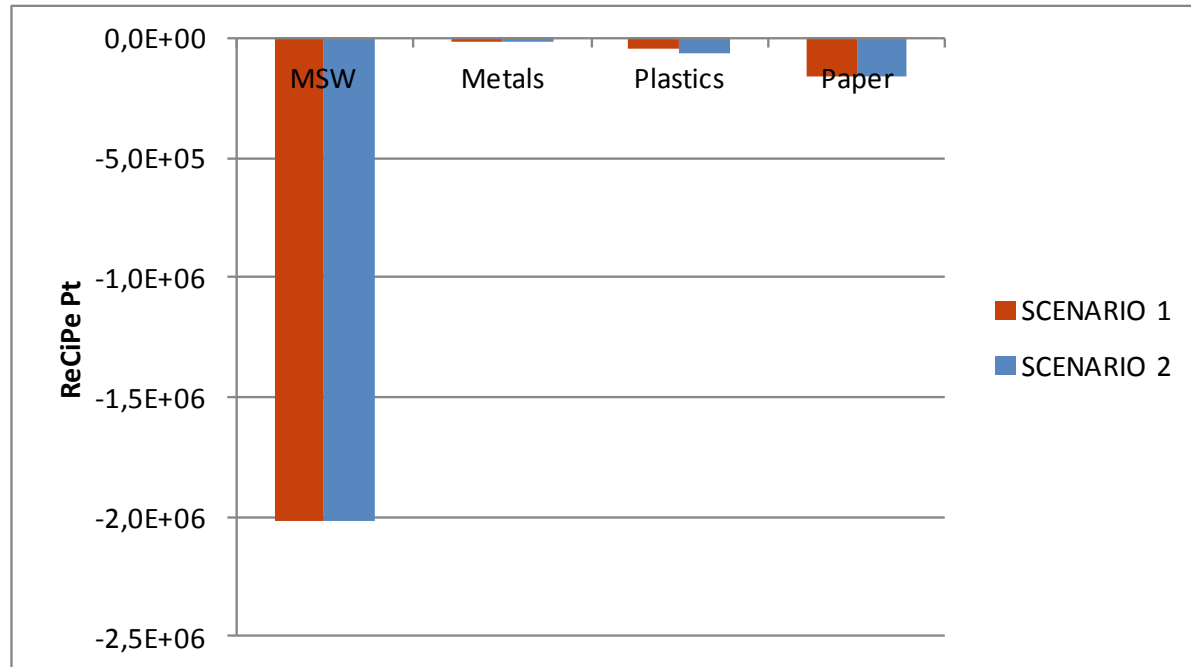
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*(positive score indicates an environmental impact, in ReCiPe Points)

Figure 7a - Overall environmental impact of Scenario 1 and 2, broken down by waste stream type (in ReCiPe Pt)*

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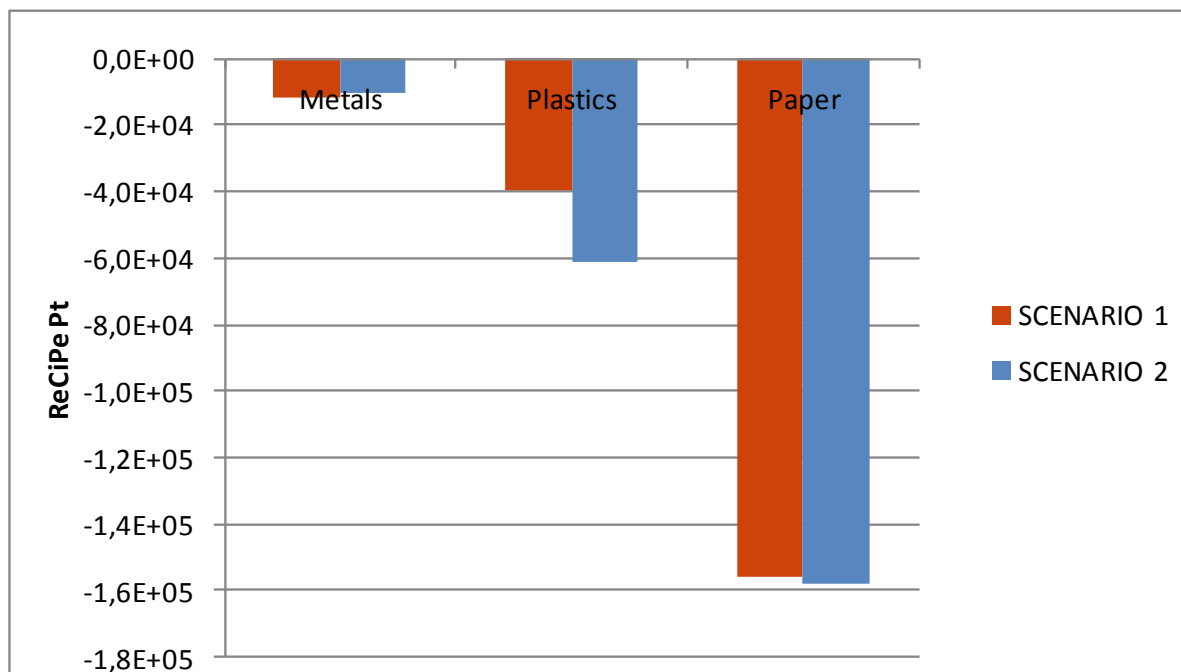
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*(positive score indicates an environmental impact, in ReCiPe Points)

Figure 7b - Overall environmental impact of Scenario 1 and 2, broken down by waste stream type, excluding MSW (in ReCiPe Pt)*

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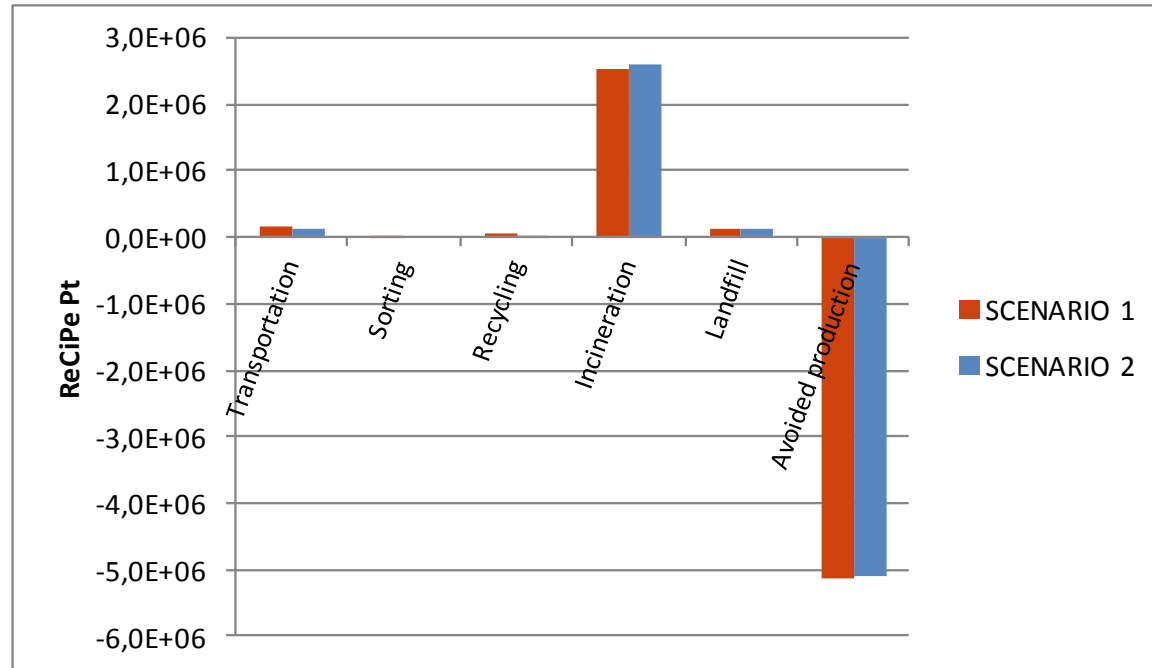
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*(positive score indicates an environmental impact, in ReCiPe Points)

Figure 8 - Overall environmental impact of Scenario 1 and 2, broken down in phases in the chain (in ReCiPe Pt)*

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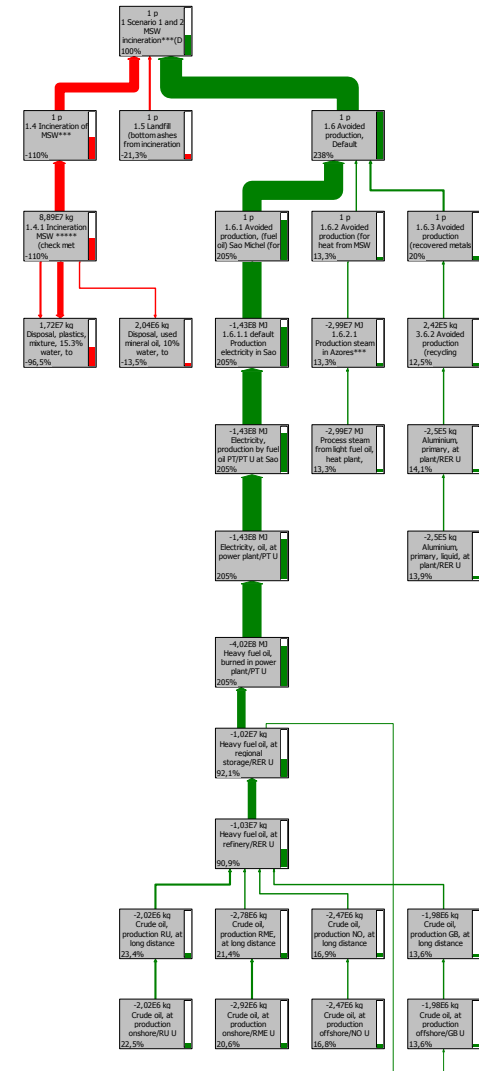
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➤ MAIN CONTRIBUTORS TO THE LCA RESULTS

- Key contributors for environmental improvement are given for each of the waste streams for Scenario 1 and 2
- The environmental improvement for each of the treatment options of each waste stream is set at 100%
- The key contributors are compared to this - Flowsharts from Software SIMAPRO
- These key contributors are summed up in order of relevance. These contributors may be higher than 100% if there are other contributors that are negatively influencing the total score of a specific waste stream.



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➤ MSW



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KEY CONTRIBUTORS FOR ENVIRONMENTAL IMPROVEMENT FOR EACH WASTE STREAM	MSW (> 4%)	
	SCENARIO 1	SCENARIO 2
Avoided production of electricity	205%	205%
Avoided production of heat	13%	13%
Avoided production of metals	20%	20%
Landfill of bottom ashes and slags from paper waste incineration	-21%	-21%

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METALS

KEY CONTRIBUTORS FOR ENVIRONMENTAL IMPROVEMENT FOR EACH WASTE STREAM	METALS (> 10%)	
	SCENARIO 1	SCENARIO 2
Avoided electricity and heat from incineration of non-metal residues	16%	19%
Avoided production of non-ferrous metals (aluminium)	56%	42%
Avoided production of ferrous metals (steel)	39%	52%



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➤ PLASTICS



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KEY CONTRIBUTORS FOR ENVIRONMENTAL IMPROVEMENT FOR EACH WASTE STREAM	PLASTICS (> 10%)	
	SCENARIO 1	SCENARIO 2
Avoided production of electricity and heat	—	194%
Avoided production of plastics	232%	—
Emissions from incineration of recycling residues	-26%	—
Emissions from incineration of plastic waste	—	-83%
Electricity use for recycling process on mainland of Portugal	-64%	—
Transport processes	-30%	—

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KEY CONTRIBUTORS FOR ENVIRONMENTAL IMPROVEMENT FOR EACH WASTE STREAM	PAPER (> 5%)	
	SCENARIO 1	SCENARIO 2
Avoided production of electricity and heat	—	108%
Avoided paper production	414%	—
Emissions from incineration of recycling residues	-26%	—
Transport processes	-23%	—
Recycling process of waste paper with deinking	-268%	—
Landfill of bottom ashes and slag from paper waste incineration	—	-6%

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➤ CONCLUSIONS

- ✿ Usually recycling is a better option than incineration from an environmental point of view however in the case of the Azores this isn't necessarily the case



- Recycling transportation from the Azores to the mainland of Portugal in some cases is unprofitable for the environment
- The energy that is generated from the incineration of waste is replacing a much less efficient and environmental more unfriendly electricity production from fuel oil at the Azores.



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➤ CONCLUSIONS

- ✿ All waste stream treatments lead to an environmental improvement for both Scenario 1 and 2
- ✿ Scenario 1 and 2 are very close in terms of environmental impact and environmental performance, but better for Scenario 2 even with slight differences
- ✿ The environmental performance of Scenario 1 and 2 is dominated by the performance of the incineration of MSW, which is equal in both scenarios.
- ✿ Small changes in the MSW treatment can therefore result in larger differences, than potentially can be achieved with the separately collected waste streams. Examples of that include small increases in energy efficiency and recuperation rate of metals from MSW



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THANK YOU

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