## Cyprus2016

## 4th International Conference on Sustainable Solid Waste Management

# Technical-economic evaluation of an advanced MBT process to enrich biomass as renewable fuel

marss

MATERIAL ADVANCED RECOVERY SUSTAINABLE SYSTEMS

## Limassol, 23-25 of June 2016

**Holger Giani**

# The MARSS Project

- Demonstration Project
- Biomass fuel from dried MMSW (MBT output)

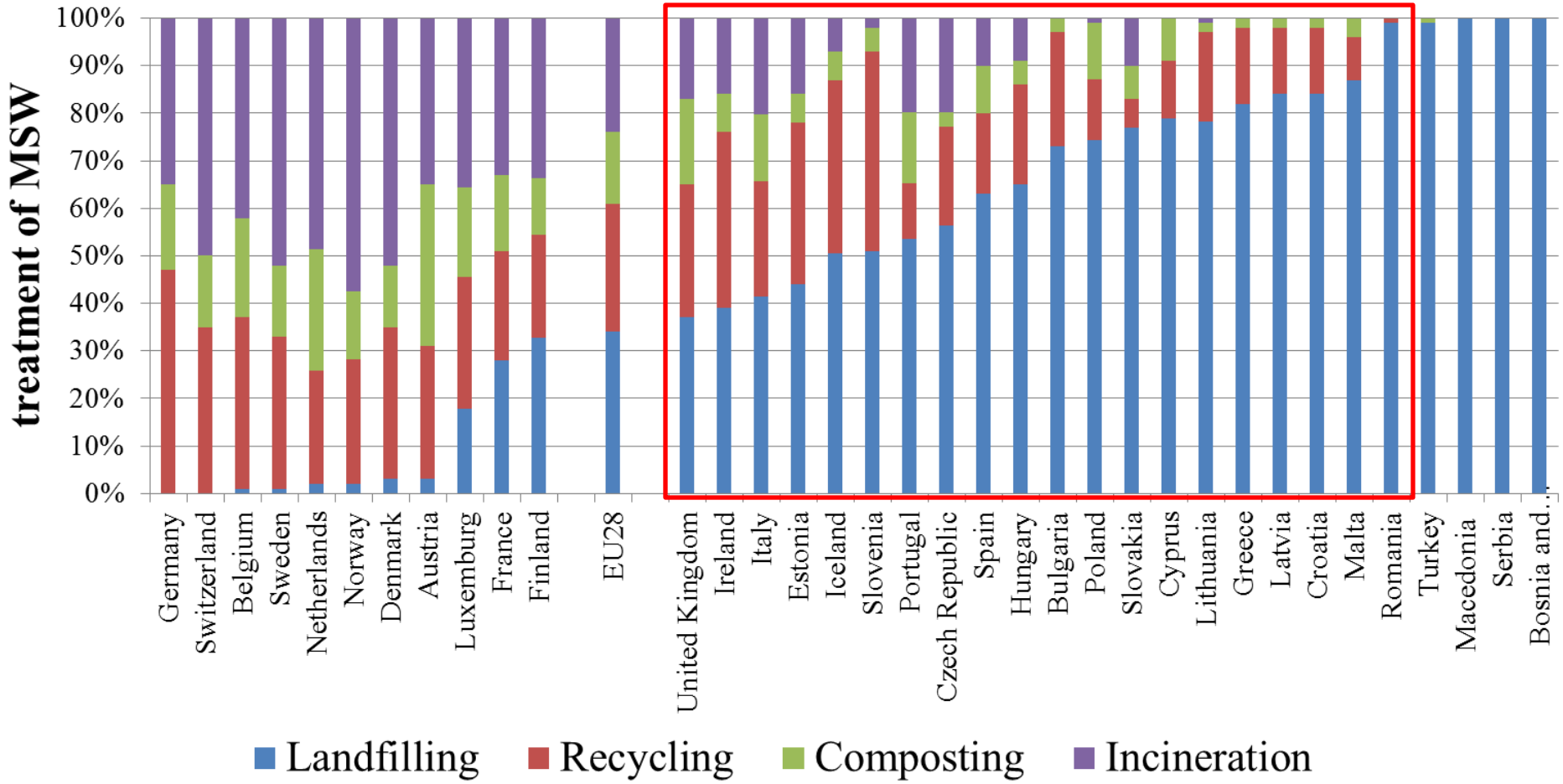
# Background of the MARSS project

- **M**unicipal **S**olid **W**aste **(MSW)** contains >50% bio waste

- **EU Landfill Directive**
  - Avoidance of **B**iodegradable **M**unicipal **W**aste from being landfilled by at least 65% in comparison to the production of BMW in 1995

- **M**echanical **B**iological **T**reatment is one option to fulfill the EU demand
  - In many EU countries MBT plants are the basic technology for the MSW treatment prior to landfilling

# Europe: waste treatment in 2012




Reference: Eurostat 2014

# Aim of the MARSS project

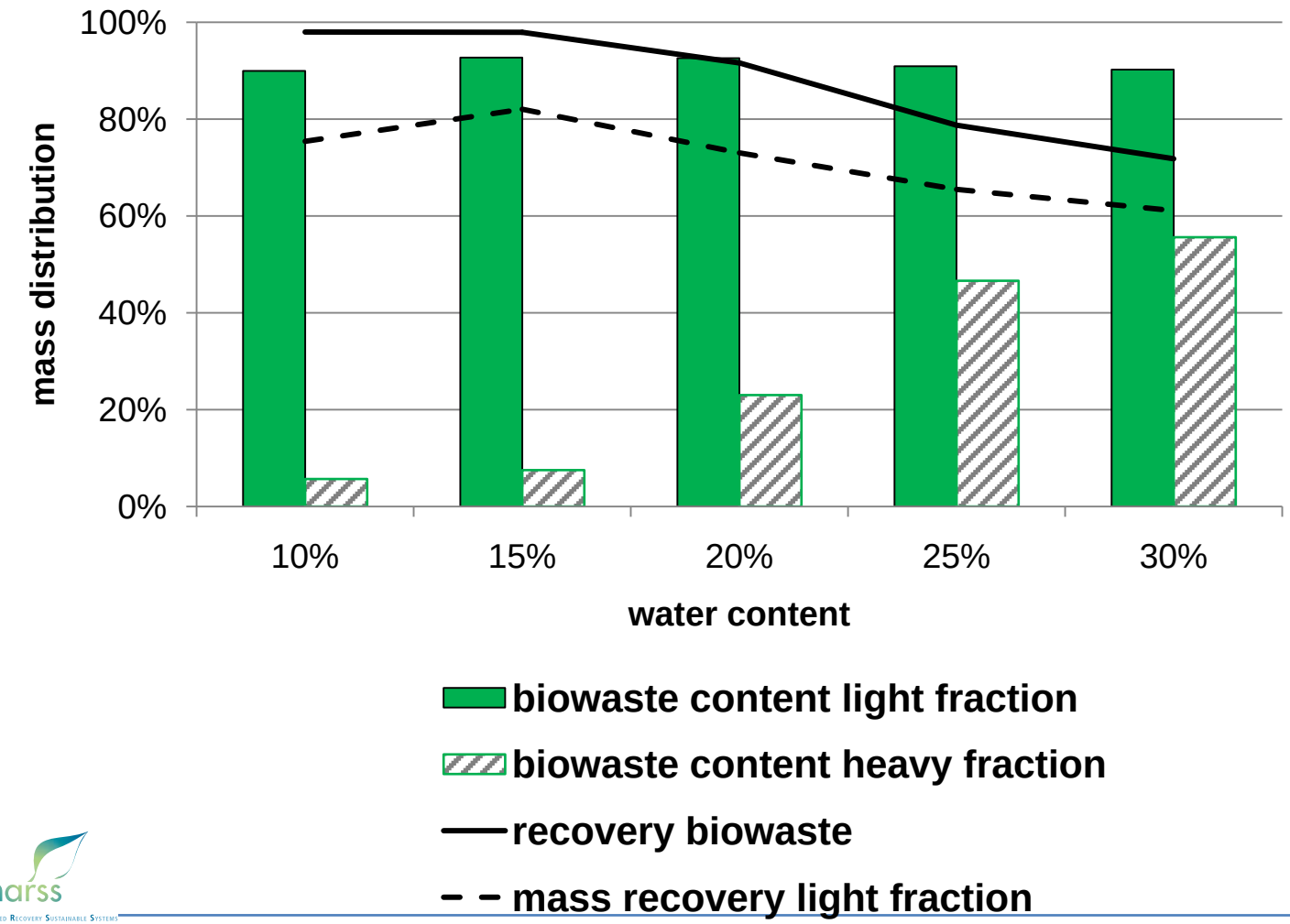
- Enhance the efficiency of MBT by connected post-treatment module

- The MARSS module has been designed to separate an Refined Renewable Biomass Fuel (RRBF) from biological dried MSW with
  - **High calorific value**
  - **High purity**
  - **High mass recovery**


1.31

# Data collection and parametrization

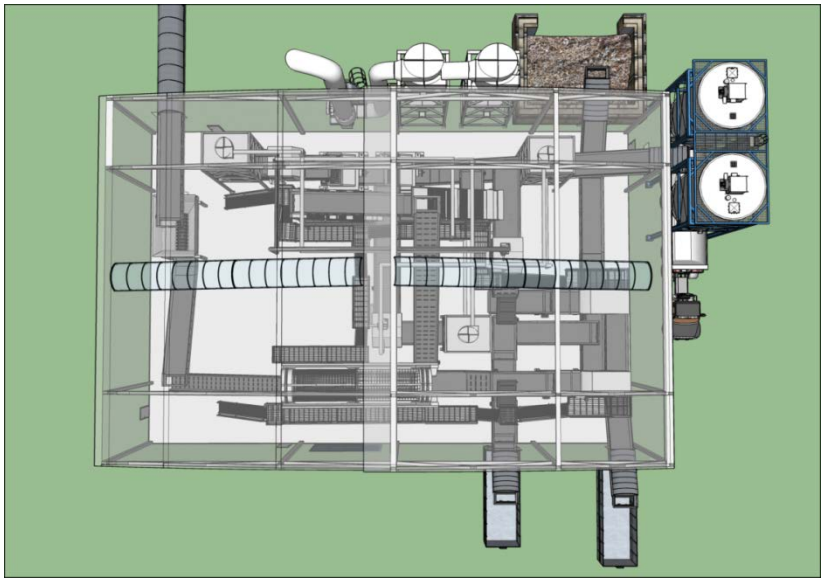
- Example: Losses by air sifting due to water content



# Demonstration plant ⇨ MARSS module

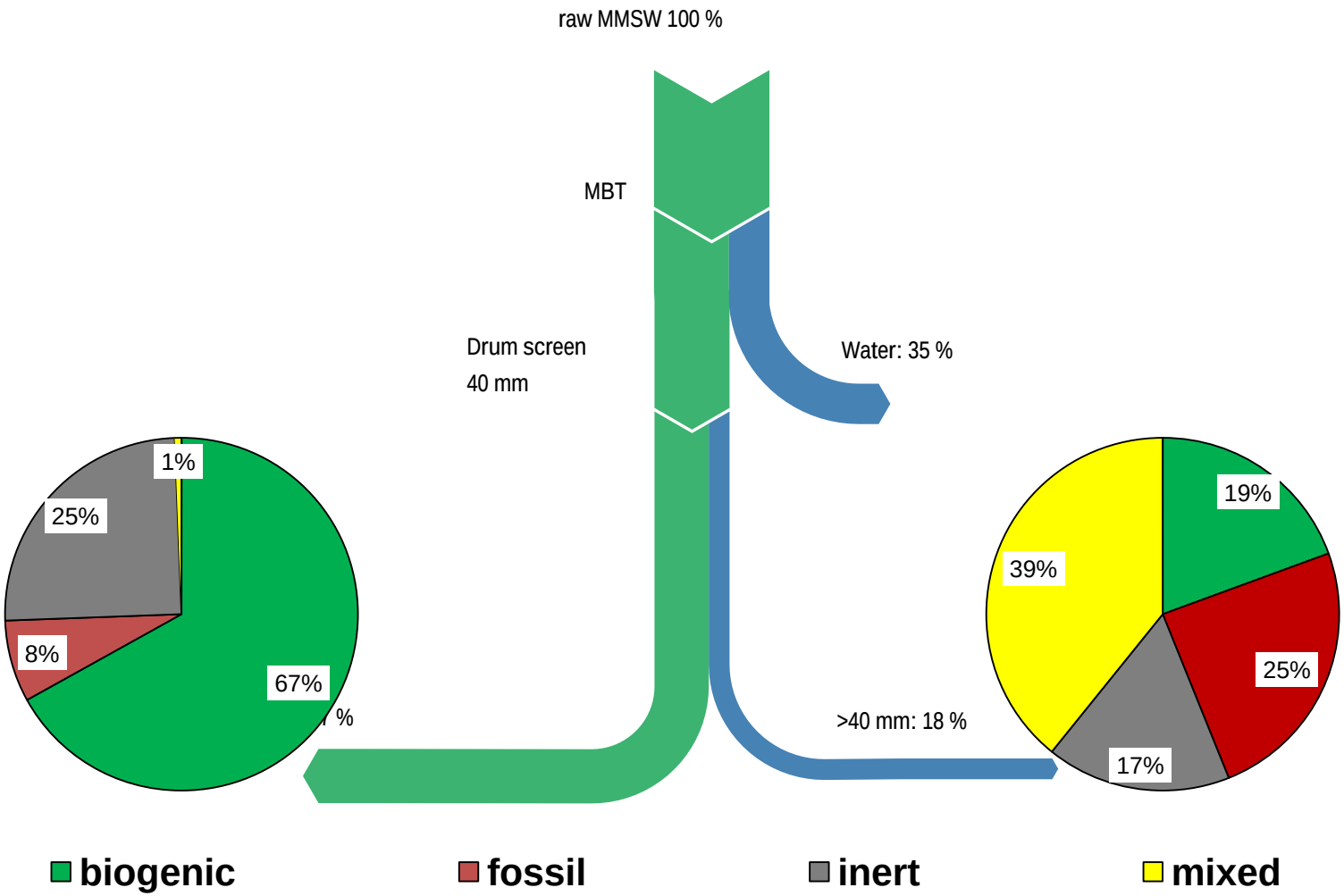
- Data collection and process parameterisation
- Extrapolating MARSS module (industrial size)

⇨

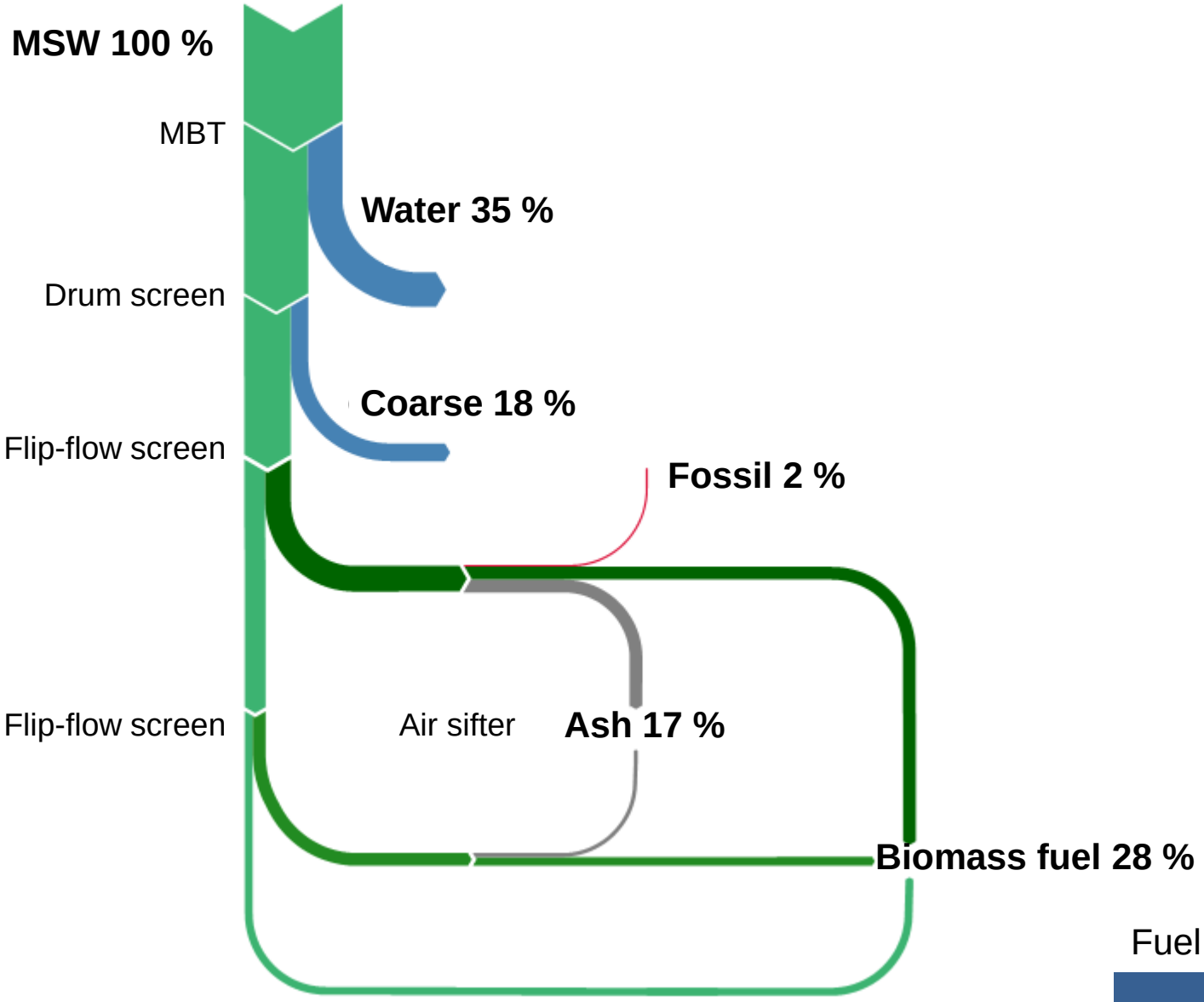


Movie

# Enrichment of biomass by screening

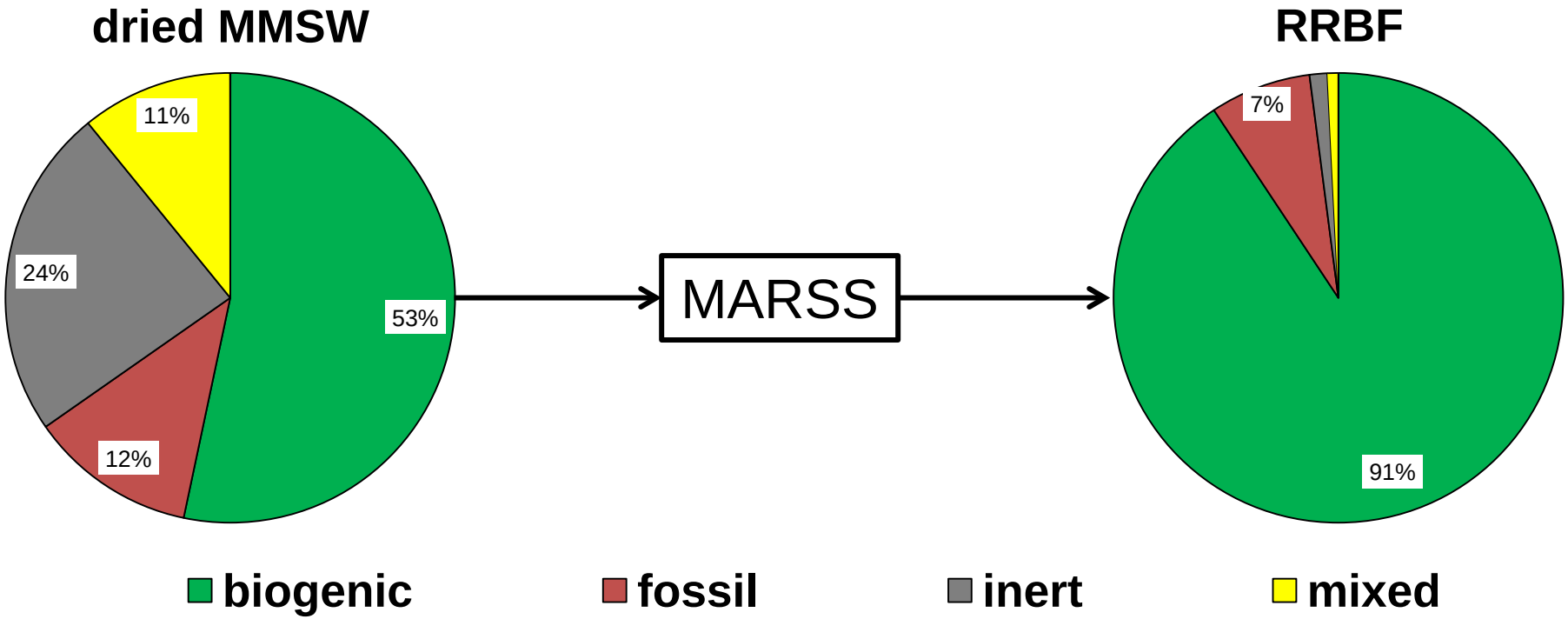


# Plant mass flow




Fuel test 3

# Output streams




Fuel test 3

# Results

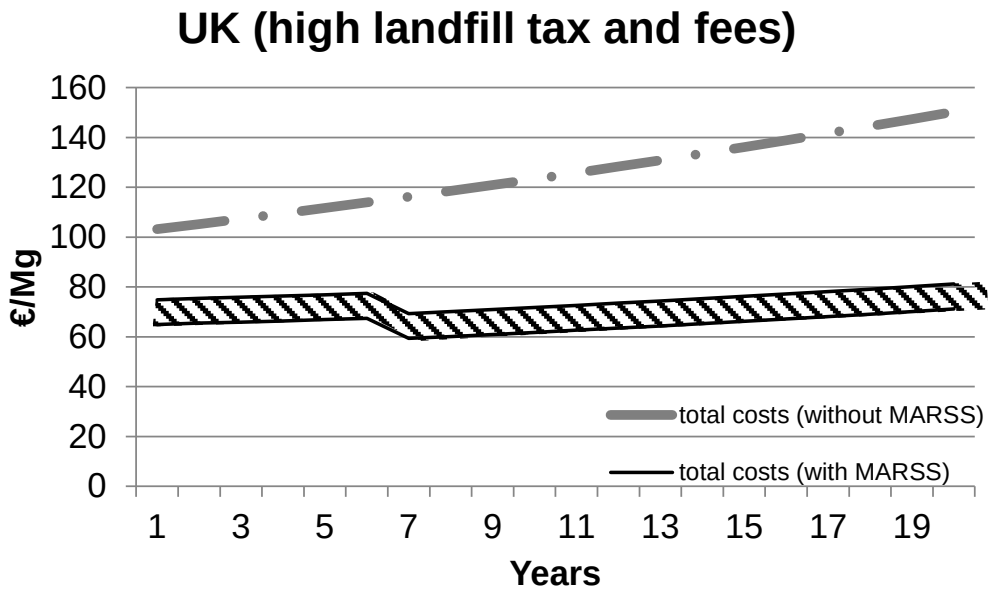
- Biomass fuel recovery ≈ 28% of the MSW input
- Biogenic material recovery ≈ 70-75% of the dried input
- Net calorific value 11.000 ± 1000 kJ/kg
- Ash content ≈ 27% ± 5
- Fossil content ≈ 6-9 %
- Feasible for industrial combustion using fluidized bed technology

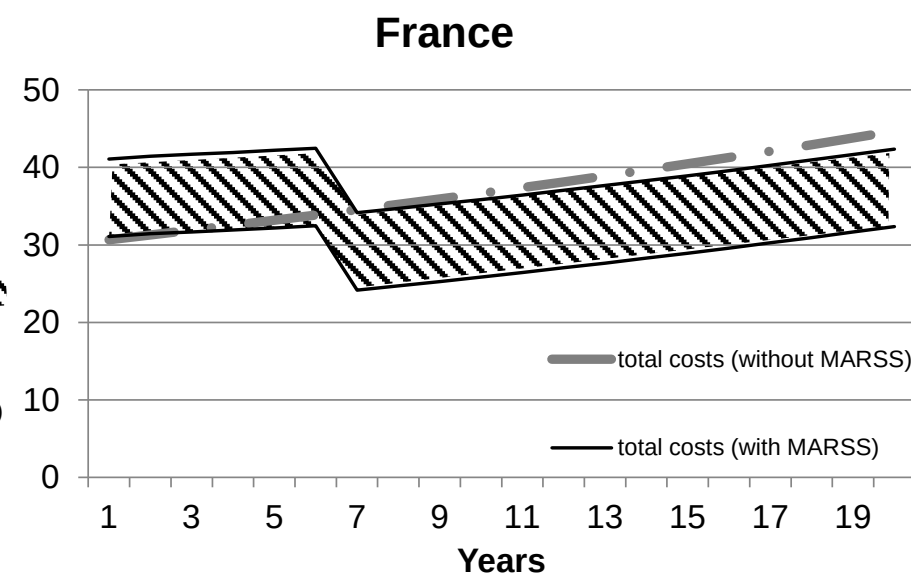
# Economic results

- A combination of RRBF sorting and metal sorting is increasing the economical efficiency of the additional treatment step
- Specific treatment costs ≈ 24-25 €/t
- The total economic opportunities of MARSS depends on
  1) the local landfill costs and
  2) the local market demand for renewable energy

| fraction | costs / revenues | |
|---|---|---|
| RRBF | 0 - 20 €/Mg | |
| NF-Metals | *-570 €/Mg* | |
| Fe-Metals | *-80 €/Mg* | |
| RDF (only if costs landfill > RDF) | 70 €/Mg | |
| **examples of landfill costs** | **fees** | **taxes** |
| France | 0 €/Mg | 20 - 40 €/Mg |
| Greece | 0 - 48,50 €/Mg | 40 €/Mg |
| United Kingdom (UK) | 4 - 29 €/Mg | 3 - 97 €/Mg |
| Italy | 1 - 10 €/Mg | 79 - 94 €/Mg |

# Economic results



# Thank you for your attention!

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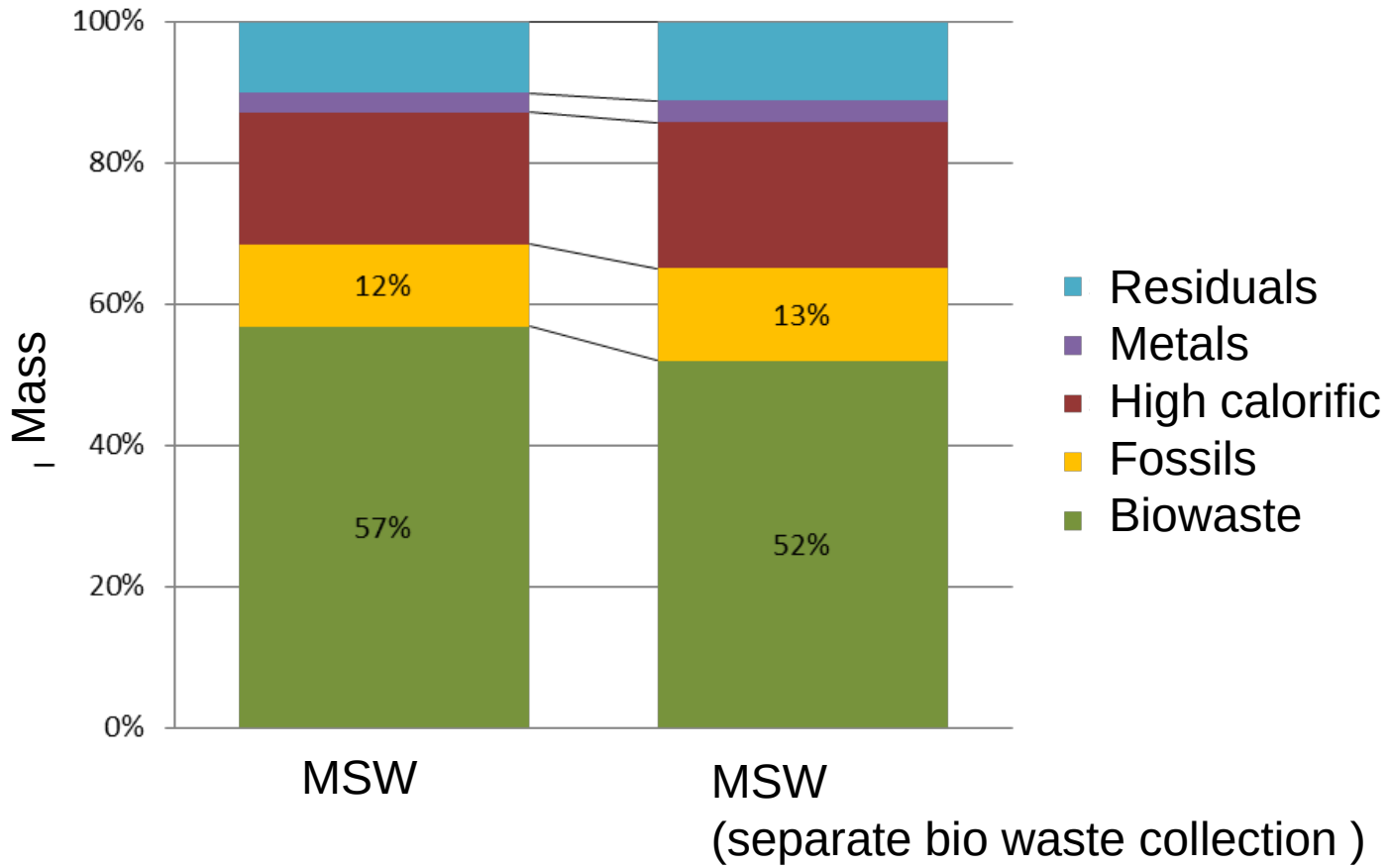
# References

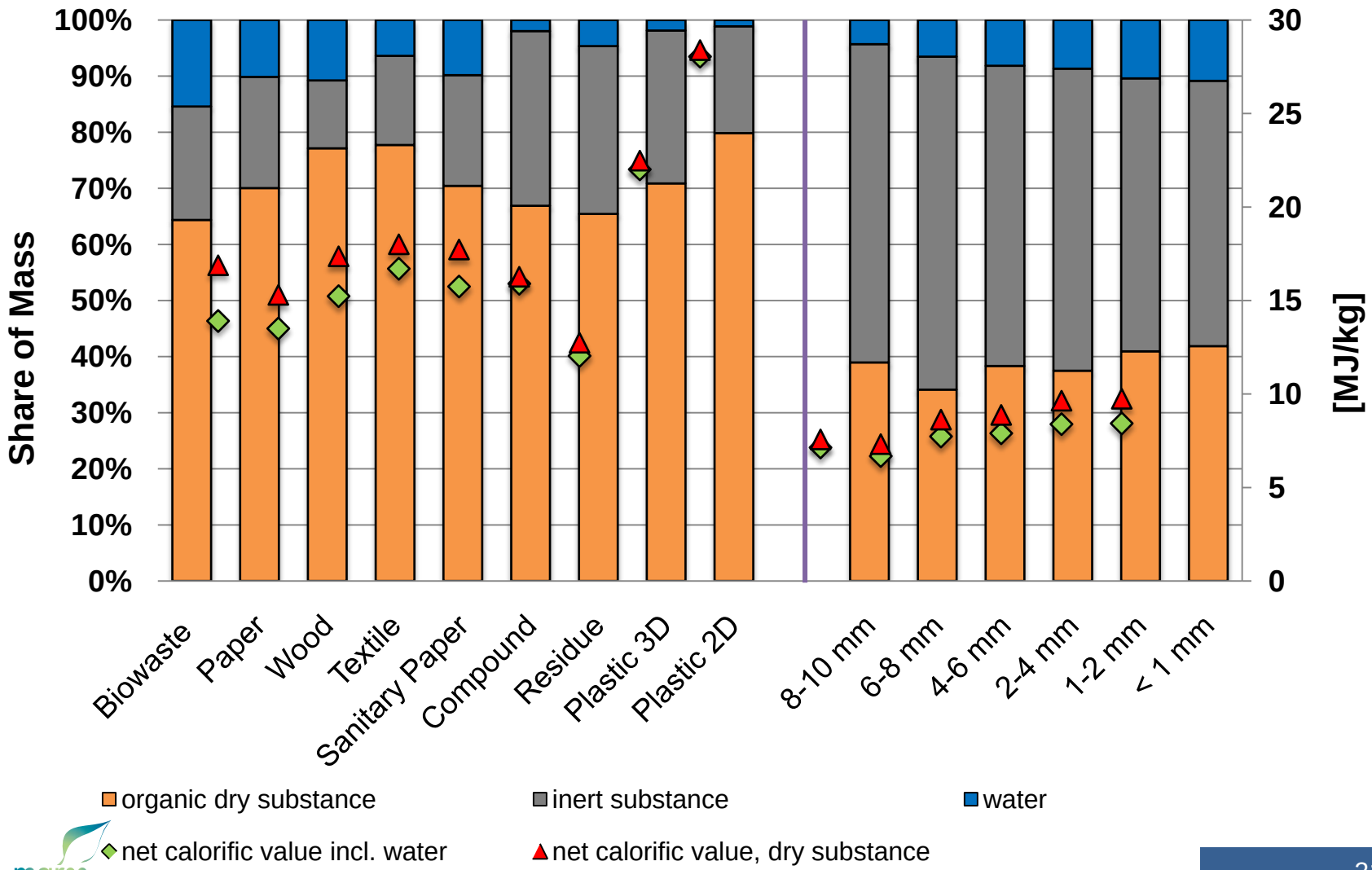

- Eurostat (2014). Press release. In the year 2012 42% of the treated municipal waste was recycled or composted; Product code: KS-EI-14-001, issued on 16-Dec 2014, http://ec.europa.eu/eurostat/documents/

# backup slides

# Composition of MSW

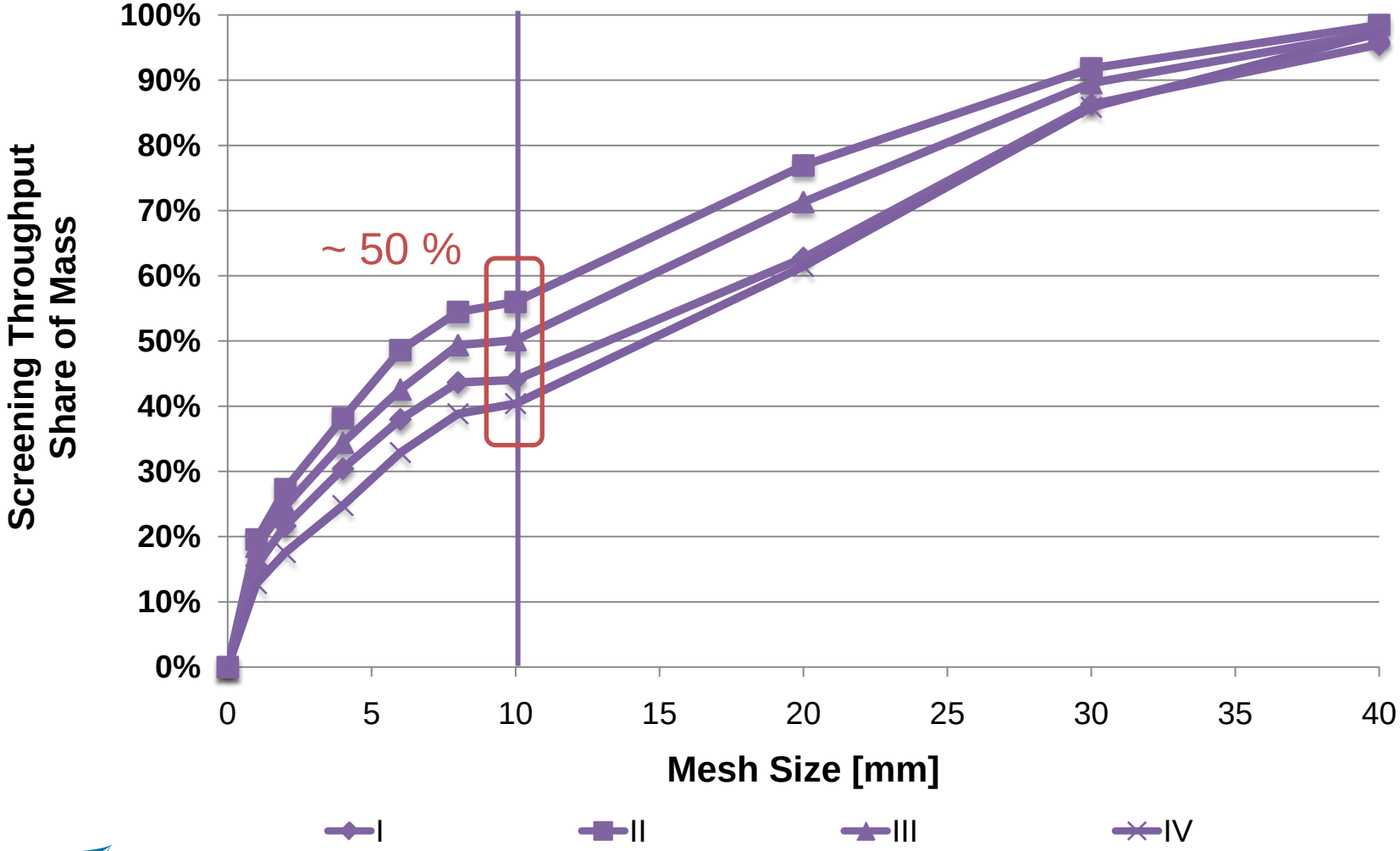


# Analysis of the input material 0-40mm

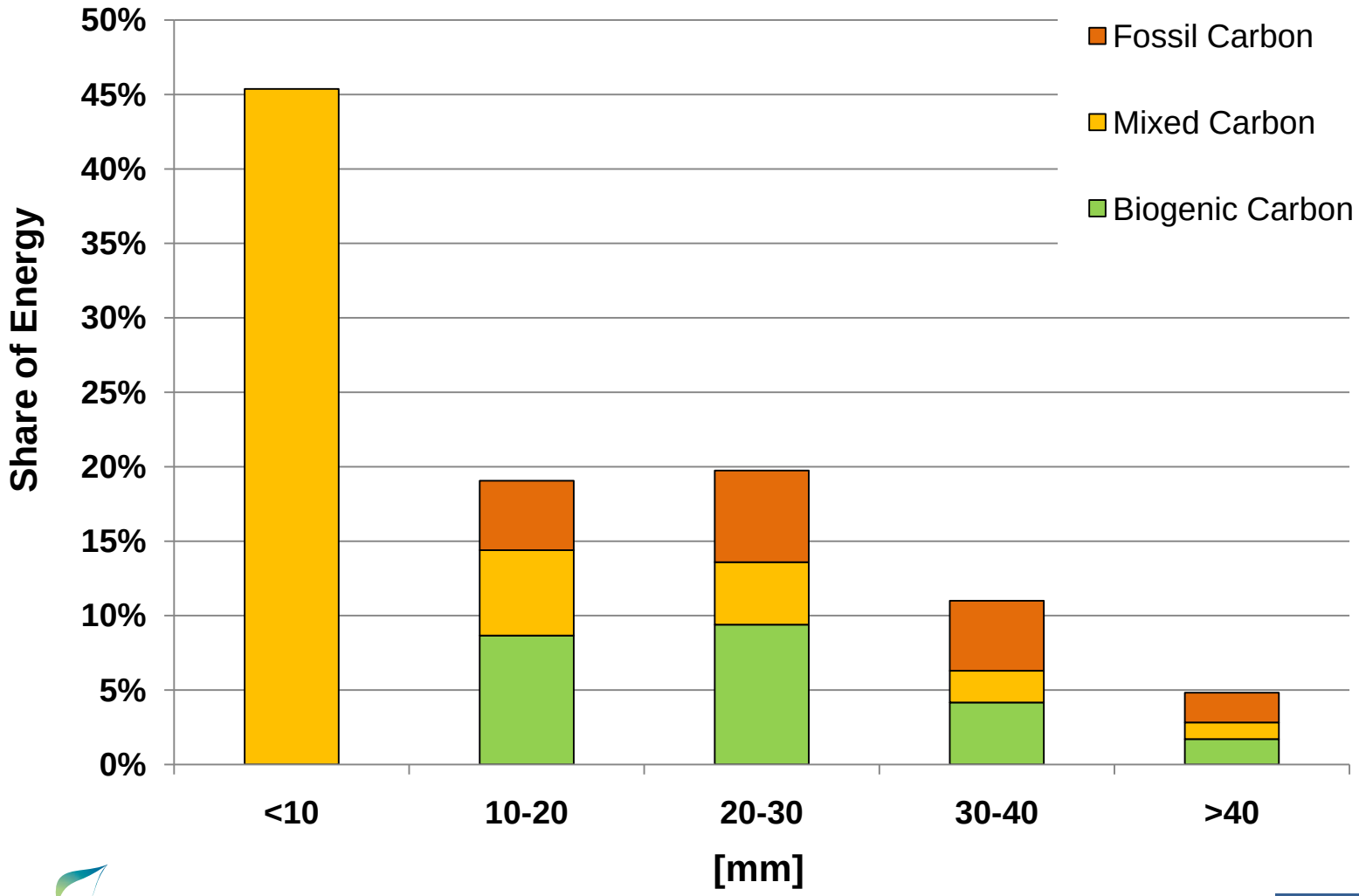


# Particle Size Distribution

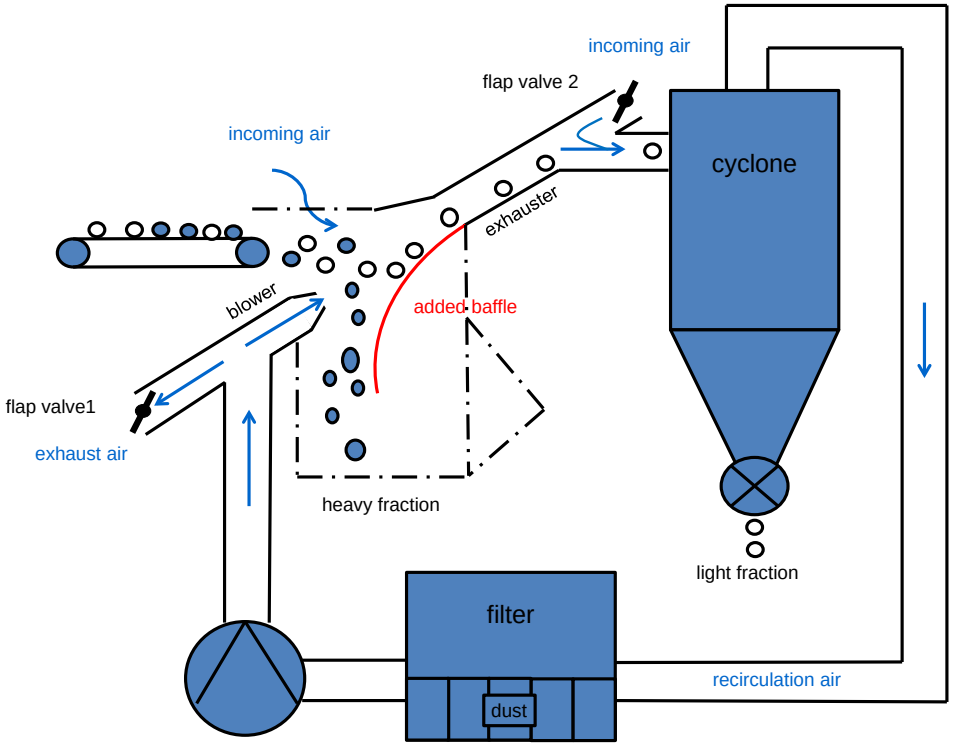
RESULTS



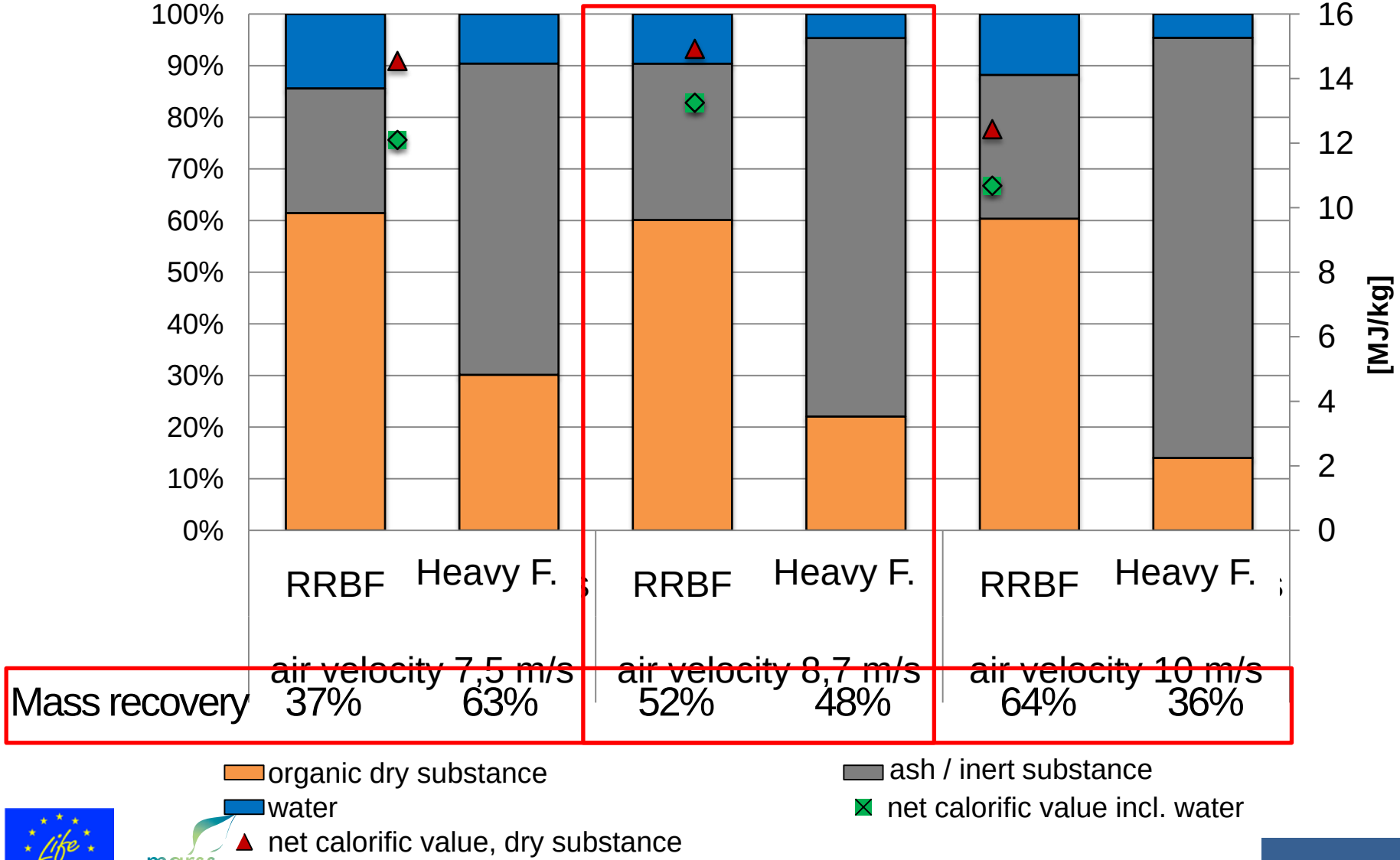
# Absolute Net Energy Content (incl. Water)



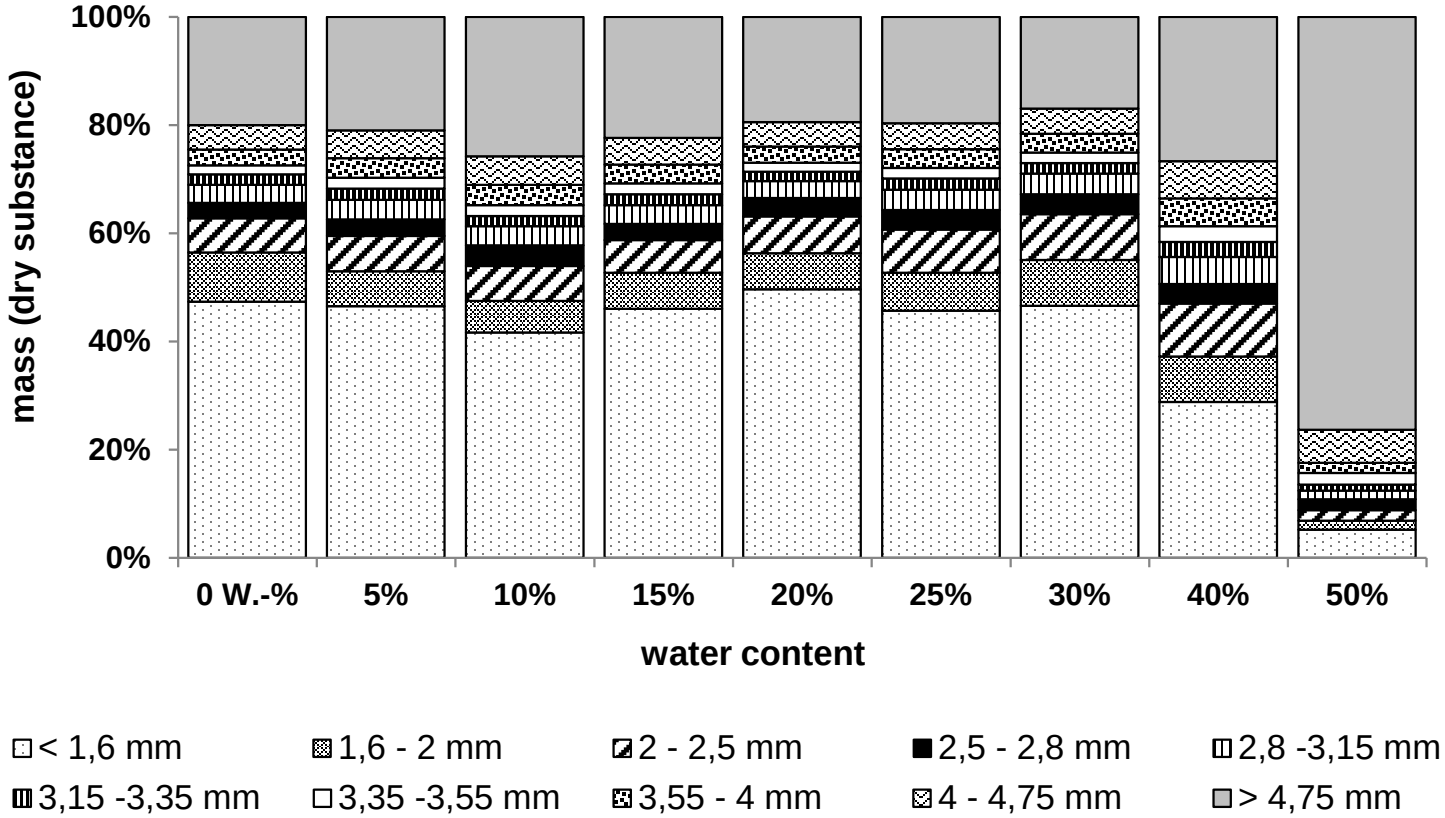
# Air Sifter


incoming air
flap valve 2
incoming air
cyclone
exhauster
blower
added baffle
flap valve1
exhaust air
heavy fraction
light fraction
filter
dust
recirculation air

# Results of air sifter tests



# Influence of water content on screening



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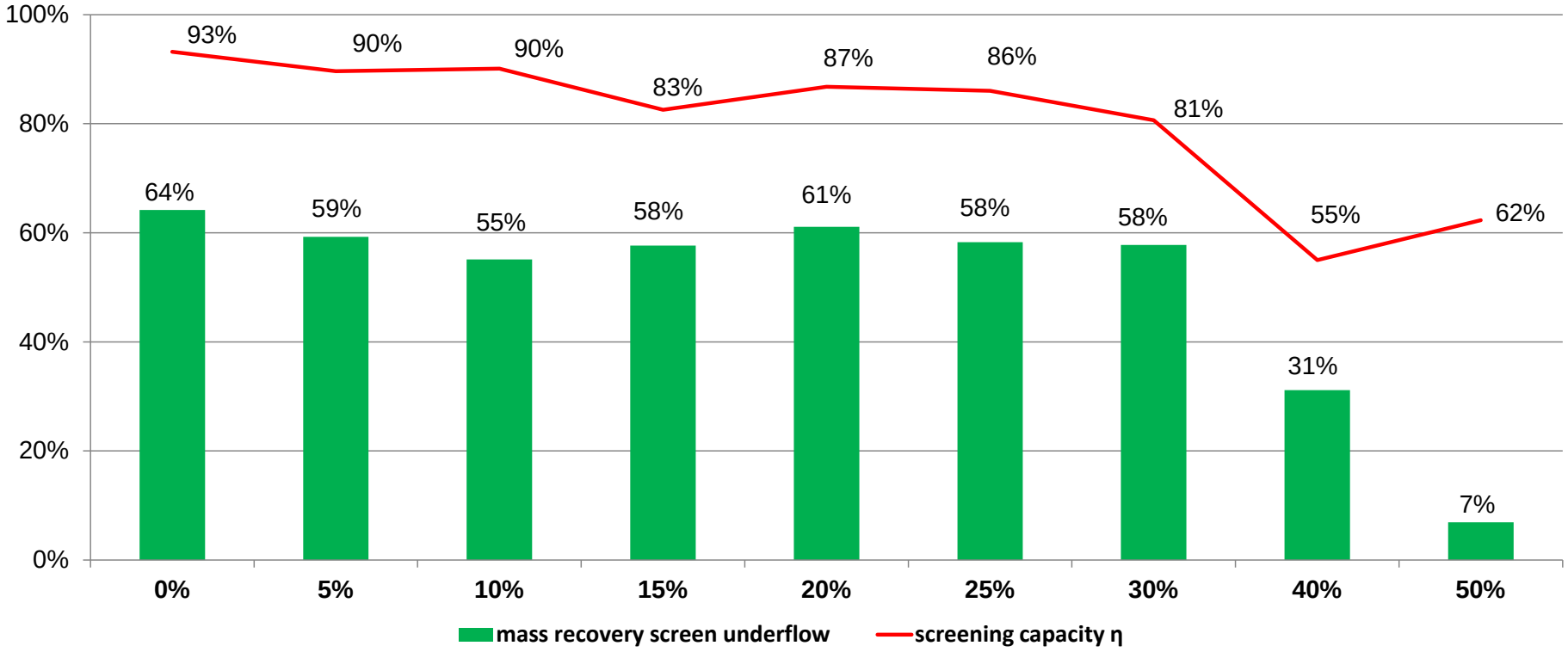

# Proximate and ultimate analysis of RRBF

| Batch | Original matter | | | Dry matter | | | Dry ash-free matter | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 1st | 2nd | 3rd | 1st | 2nd | 3rd |
| Water [%] | 13.2 | 14.99 | 24.5 | | | | | | |
| Ash [%] | 23.3 | 31.88 | 21.74 | 26.84 | 37.5 | 28.8 | | | |
| C [%] | 33.18 | 29.58 | 29.07 | 38.23 | 34.8 | 38.5 | 52.26 | 55.68 | 54.07 |
| H [%] | 5.55 | 5.58 | 5.89 | 4.7 | 4.6 | 4.2 | 6.42 | 7.36 | 5.9 |
| N [%] | 1.56 | 1.19 | 1.43 | 1.8 | 1.4 | 1.9 | 2.46 | 2.24 | 2.67 |
| O [%] | 35.23 | 29.39 | 41.86 | 27.08 | 18.9 | 26.6 | 37.01 | 30.24 | 37.36 |
| S [%] | 0.38 | 0.48 | 0.3 | 0.43 | 0.56 | 0.4 | 0.59 | 0.90 | 0.56 |
| Cl [%] | 0.8 | 0.71 | 0.91 | 0.92 | 0.84 | 1.2 | 1.26 | 1.34 | 1.69 |
| Na [ppm] | 6,290 | 5,326 | 5,616 | 7,250 | 6,265 | 7,439 | | | |
| K [ppm] | 864 | 5,728 | 4,938 | 996 | 6,738 | 6,541 | | | |
| P [ppm] | 2,150 | 1,471 | 2,103 | 2,480 | 1,730 | 2,786 | | | |
| LHV [MJ/kg] | 12.88 | 10.45 | 11.1 | 15.21 | 12.7 | 15.5 | 20.79 | 20.32 | 21.77 |