

# Sustainable waste management in the context of a circular economy

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IEEE  
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ITALY CHAPTER



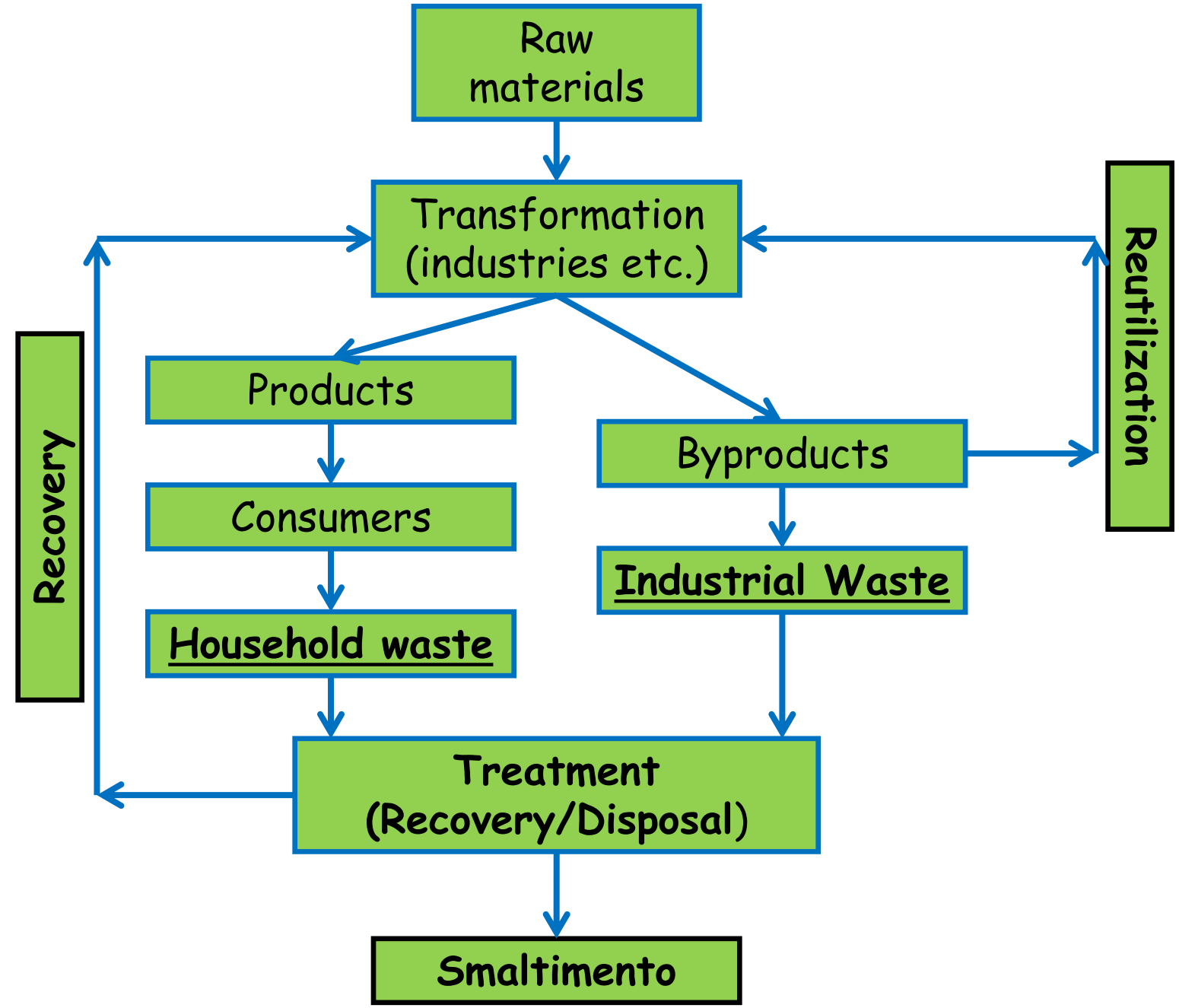
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Waste management is an essential function in modern societies

On the other hand, wastes are dirty, smelly, polluting

Exactly for this reason, appropriate waste management is expensive

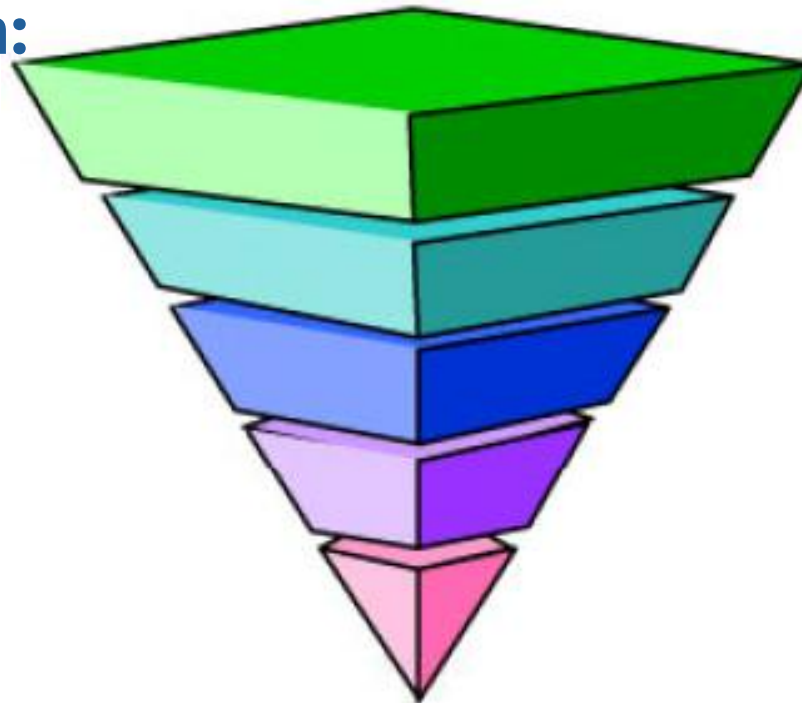
And exactly for this reason, inappropriate management approaches are always behind the corner...



**Due to this reason, EU (and Italy) adopted a very strict legislation on waste management, and put forward a number of important principles and general criteria for waste management**

**Protection of human health and environment, minimization of the use of resources...**

**Main point of EU approach:**  
***Waste hierarchy***



**Prevention**

If you can't prevent, then....

**Prepare for reuse**

If you can't prepare for reuse, then....

**Recycle**

If you can't recycle, then....

**Recover other value (e.g. energy)**

If you can't recover value, then....

**Disposal**

Landfill if no alternative available.

## An important application: management of Municipal Waste

**Municipal Waste (MW) is the waste produced in households, and other wastes that can be assimilated to these (offices, schools, canteens...)**

**It is not "THE" waste, but it is the kind of waste that most easily we see, since it is produced around us**

- *after all, there are other kinds of waste that are much more dangerous due to their composition!*

**The main issue with MW management is its heterogeneity**

## An important application: management of Municipal Waste

The composition of household waste strongly depends on a number of factors, such as family income, consumption habits etc.

Representative –yet generic!– data on MW composition	
Waste fraction	% weight
Organic/green	25% – 40%
Paper	20% - 30%
Plastics	10% - 14%
Glass	7% - 10%
Wood & textiles	5% - 7%
Metals	4% - 6%
Others	9% - 12%

## **An important application: management of Municipal Waste**

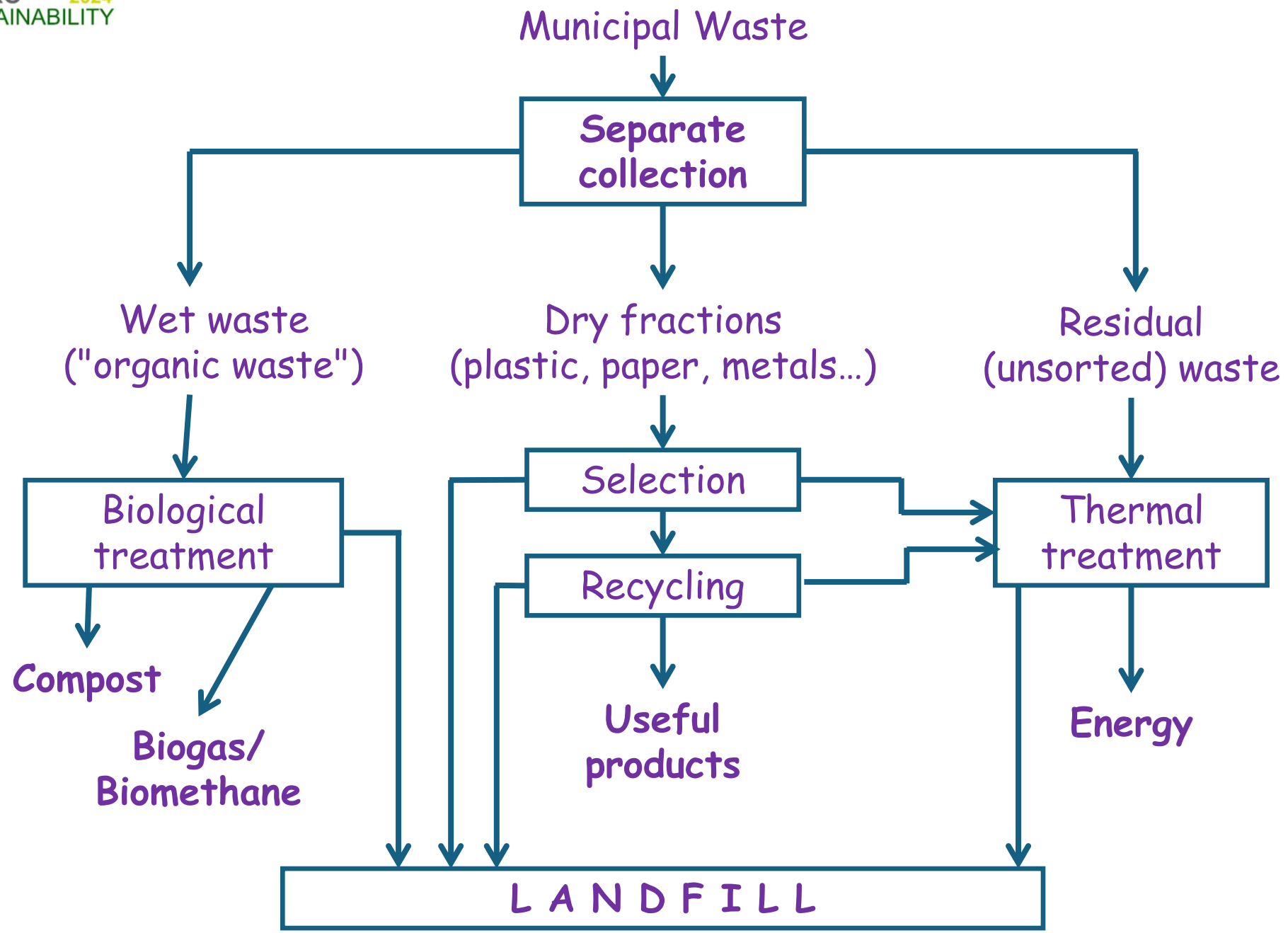
**How can we deal with heterogeneity of MW? By separate collection**

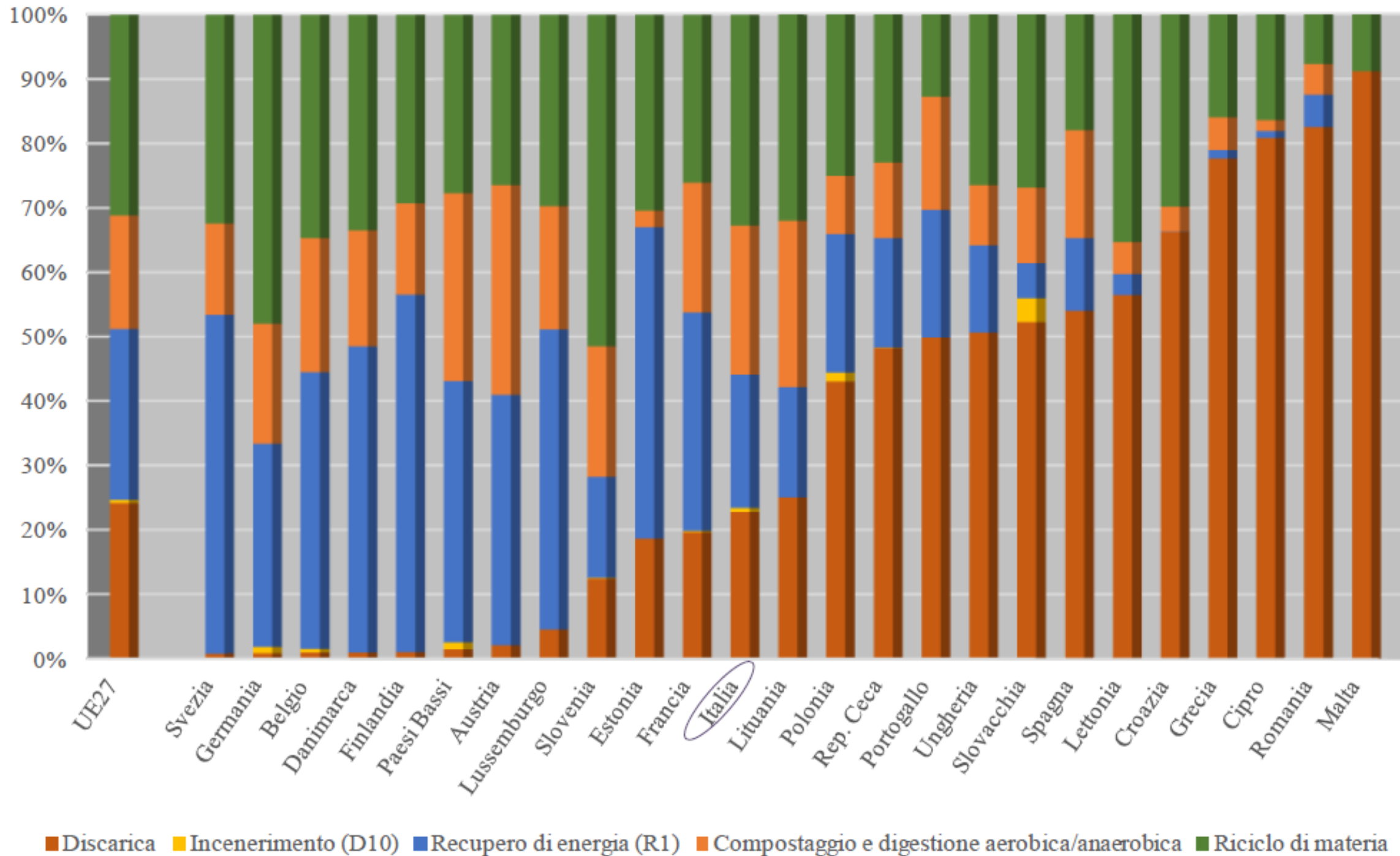
- **citizens are requested not to mix the waste they produce**

**Rather obviously, separate collection collection by itself is not enough**

**A network of waste treatment plants is requested**

- **citizens are requested not to mix the waste they produce**







## A couple of examples on recovery of useful products

### The industrial cycle of waste paper

1. paper waste (packaging, advertising leaflets, newspapers and magazines...) is thrown into separate waste collection containers
2. the waste paper is collected and selected, removing part of the impurities (plastic, improper materials, etc.)
3. The recovered paper/cardboard produced by the selection ceases, under precise conditions, to be a waste (D.M.A.T.T.M. 188/2020)
4. Specialized paper mills transform the recovered material into cardboard for packaging or papers for sanitary uses





## A couple of examples on recovery of useful products

### The industrial cycle of plastic packaging

4. “good” fractions lose their waste status, are shredded, washed and sold
5. the rest (mixed plastics, mainly polyethylene, polypropylene and polystyrene, also coupled) is processed in another plant, and transformed into Solid Recovered Fuel (SRF)
6. To this end, it is essential to remove the PVC (poly vinyl chloride, 57% Cl)



## Management of residual/unsorted Municipal Waste

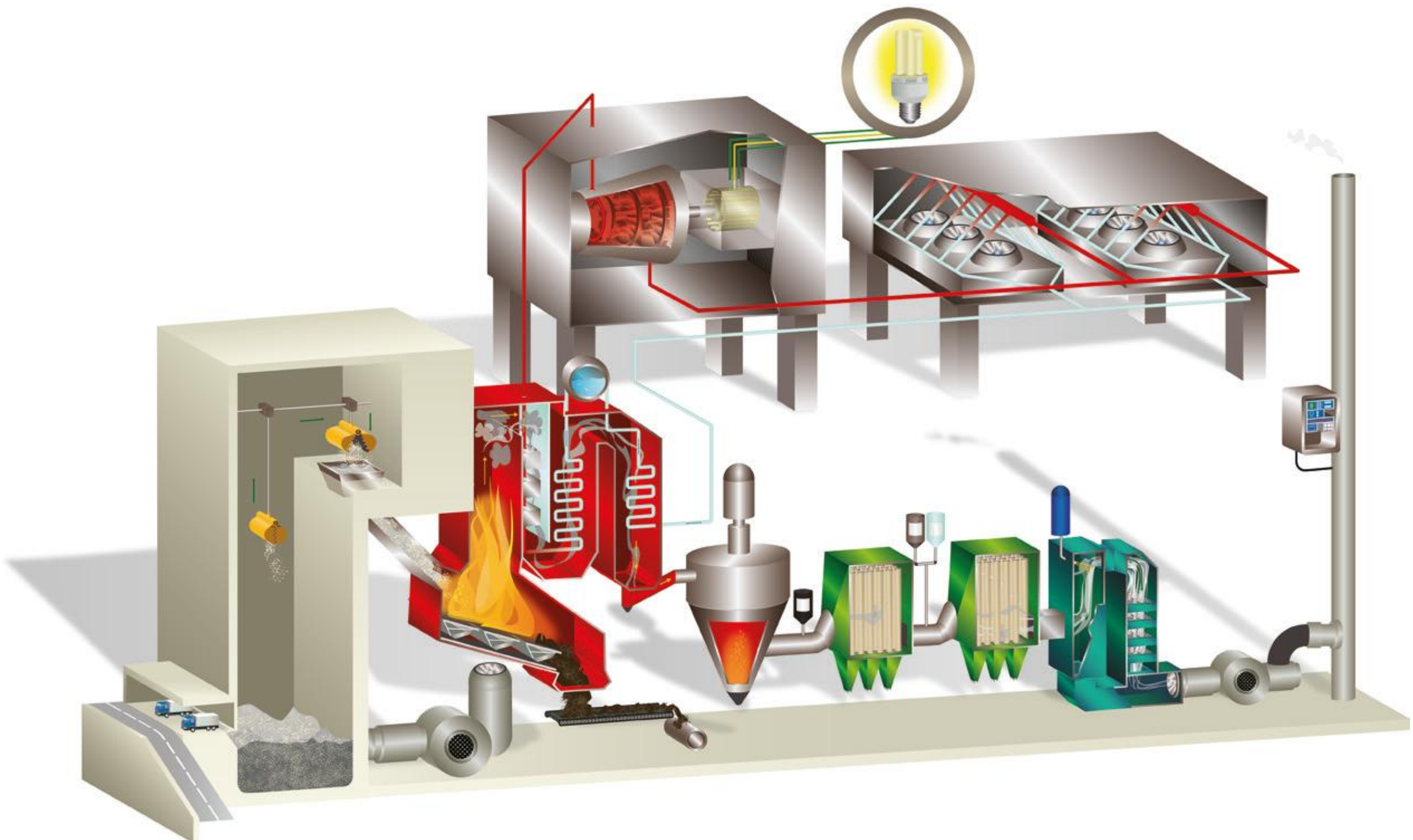
It is a problem, since material recovery from unsorted waste is difficult/expensive

“Less worst” solution: incineration/waste-to-energy:

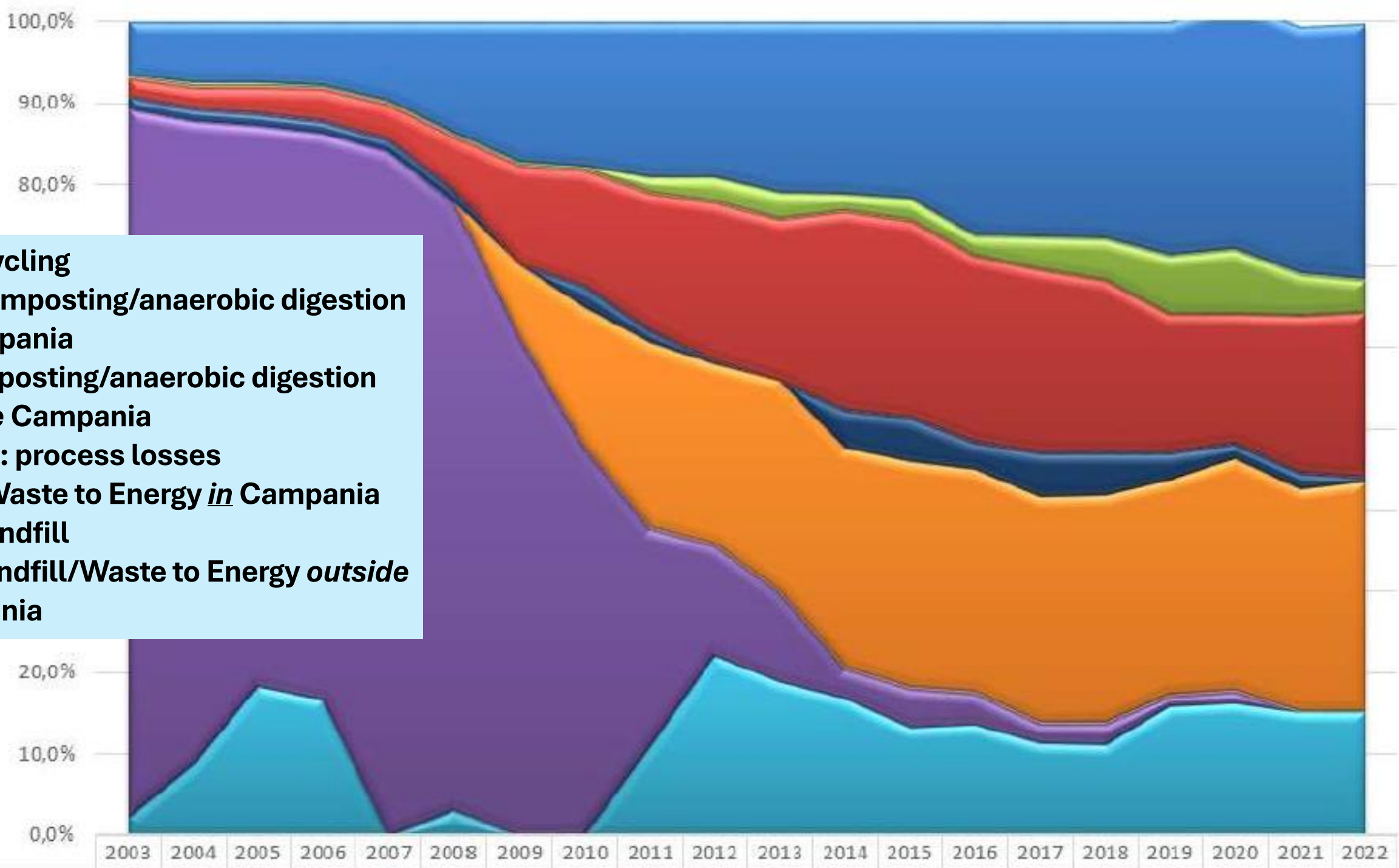
- high temperature oxidation ( $\sim 1000^{\circ}\text{C}$ ) of the waste, either “as is” or pretreated in order to reduce wet fractions and increase heating value
- production of electricity and ( $\sim 500 \text{ kWh/t}_{\text{waste}}$ ) and slag (up to  $300 \text{ kg/t}_{\text{waste}}$ )

Advantages: weight reduction ( $\sim 70\%$ ) and volume ( $\sim 90\%$ ), sterilization,

Disadvantages: high costs, fume emissions, need to manage slag and ash







**Blue:** recycling  
**Green:** composting/anaerobic digestion *in* Campania  
**Red:** composting/anaerobic digestion *outside* Campania  
**Dark blue:** process losses  
**Orange:** Waste to Energy *in* Campania  
**Purple:** landfill  
**Cyano:** landfill/Waste to Energy *outside* Campania