

Renewable energy application from waste and biomass: European case study

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Application of
Waste-to-Energy
in Asian Region**

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fundamentals of EU energy policy

reduction of CO₂ emissions

reduction of energy imports by

- **increasing energy efficiency**
- **promotion of renewable energy**
- **special focus on bioenergy**
- **this includes waste-to-energy strategies**

instruments for harmonisation

- **EU directives regulating the energy and waste sector**

legislative framework for the waste sector

Landfill Directive (1999)

- **definition of classes of landfills**
- **regulations on landfill design, operation, and control**
- **reduction of direct disposal of biodegradable waste of 65 % in 2016 compared to 1995**
- ▶ **several countries introduced landfill taxes or banned landfilling**

Waste Incineration Directive (2000)

- **definition of incineration and coincineration plants**
- **operation parameters of these plants**
- **air emission standards**
- **emission limits for discharged waste water**
- **mandatory energy recovery (preferred CHP)**

legislative framework for the waste sector

Waste Framework Directive (2008)

- comprising and updating former directives
- definition of a waste hierarchy
- definition of disposal and recovery operations

actual situation in the EU

- separate MSW collection increasing
- biodegradable waste (approx. 50 – 60 %) for biotreatment (initially composting)
- AD should be first treatment step for biodegradable MSW
- incineration with energy recovery (preferred CHP) for residual MSW

prevention



preparing for re-use



material recycling



other recovery
(e.g. energy recovery)



disposal

EU 28 data

inhabitants:
508.5 mill.

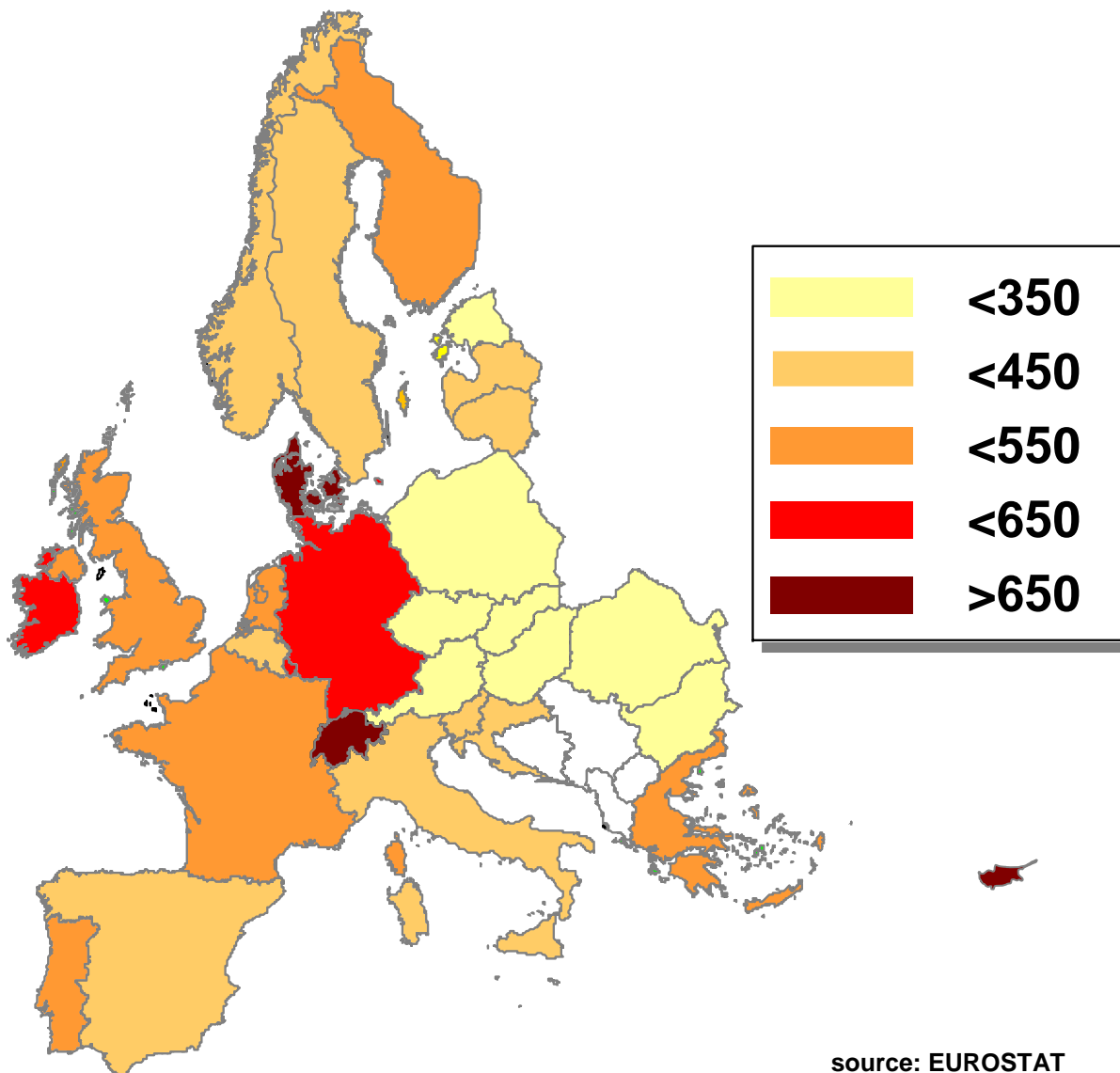
MSW:
235 mill. Mg

material recycling:
69 mill. Mg

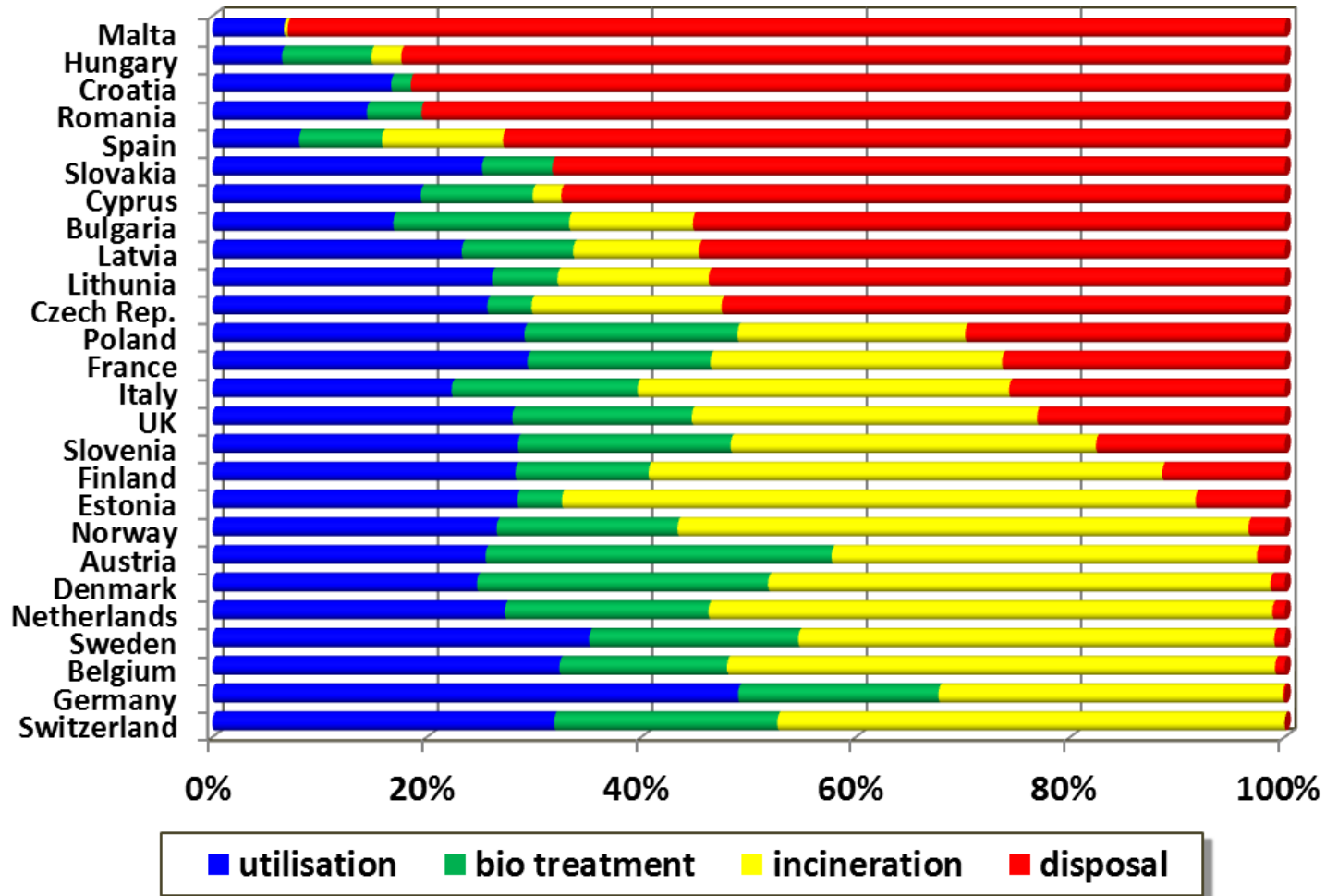
biotreatment:
40 mill. Mg

incineration:
64 mill. Mg

landfilling:
62 mill. Mg

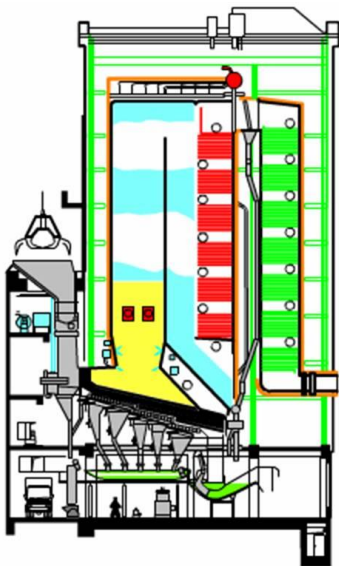


annual per capita generation of MSW in 2016 (kg)



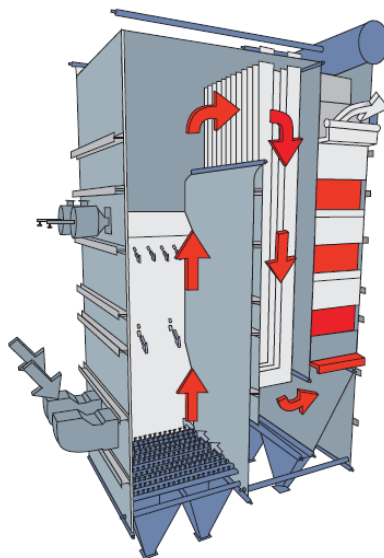
source: EUROSTAT

waste management in Europe in 2016



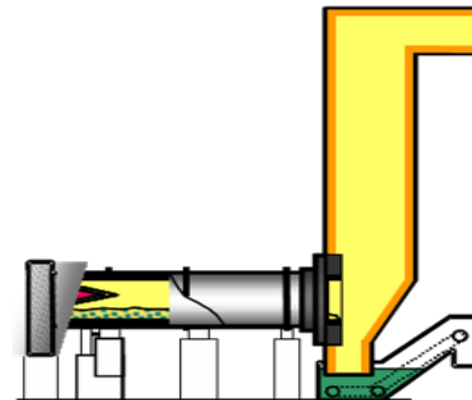
grate

- **MSW**



fluidised bed

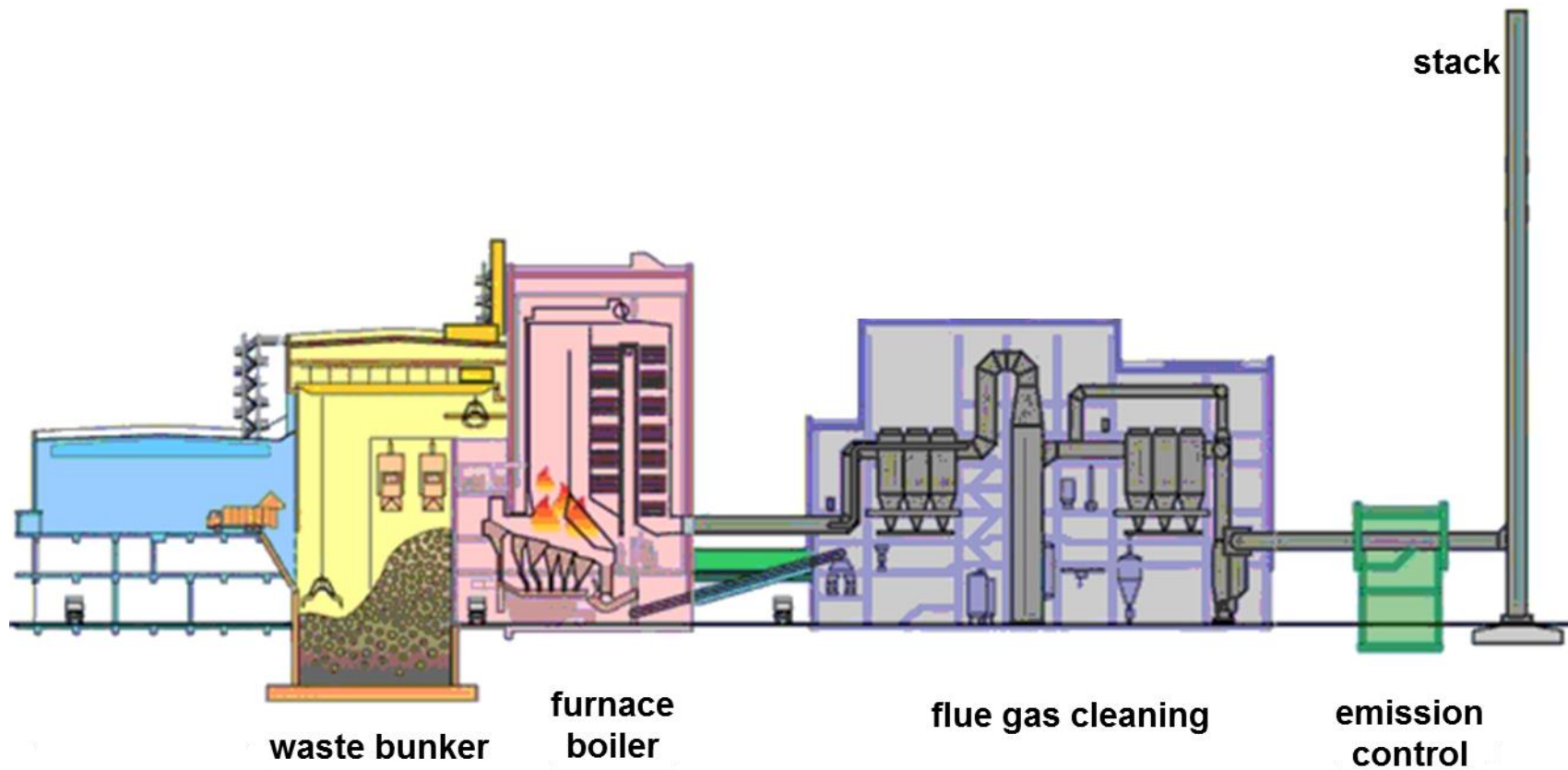
- **RDF/SRF**
- **biomass**



rotary kiln/post comb.

- **hazardous waste**

types of furnaces



source: <http://www.mvr-hh.de>
(modified)

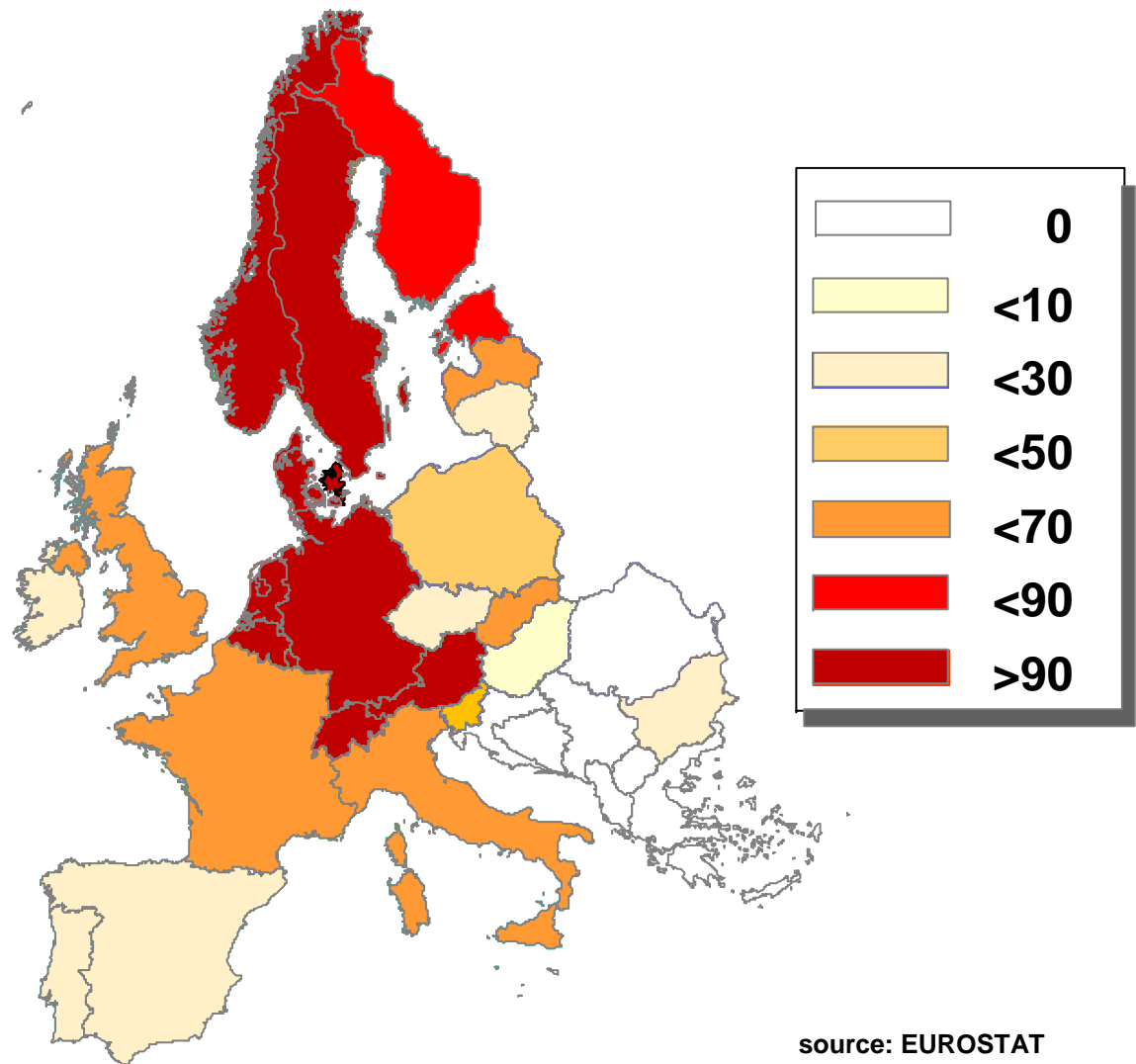
scheme of a waste incineration plant

EU 28 data

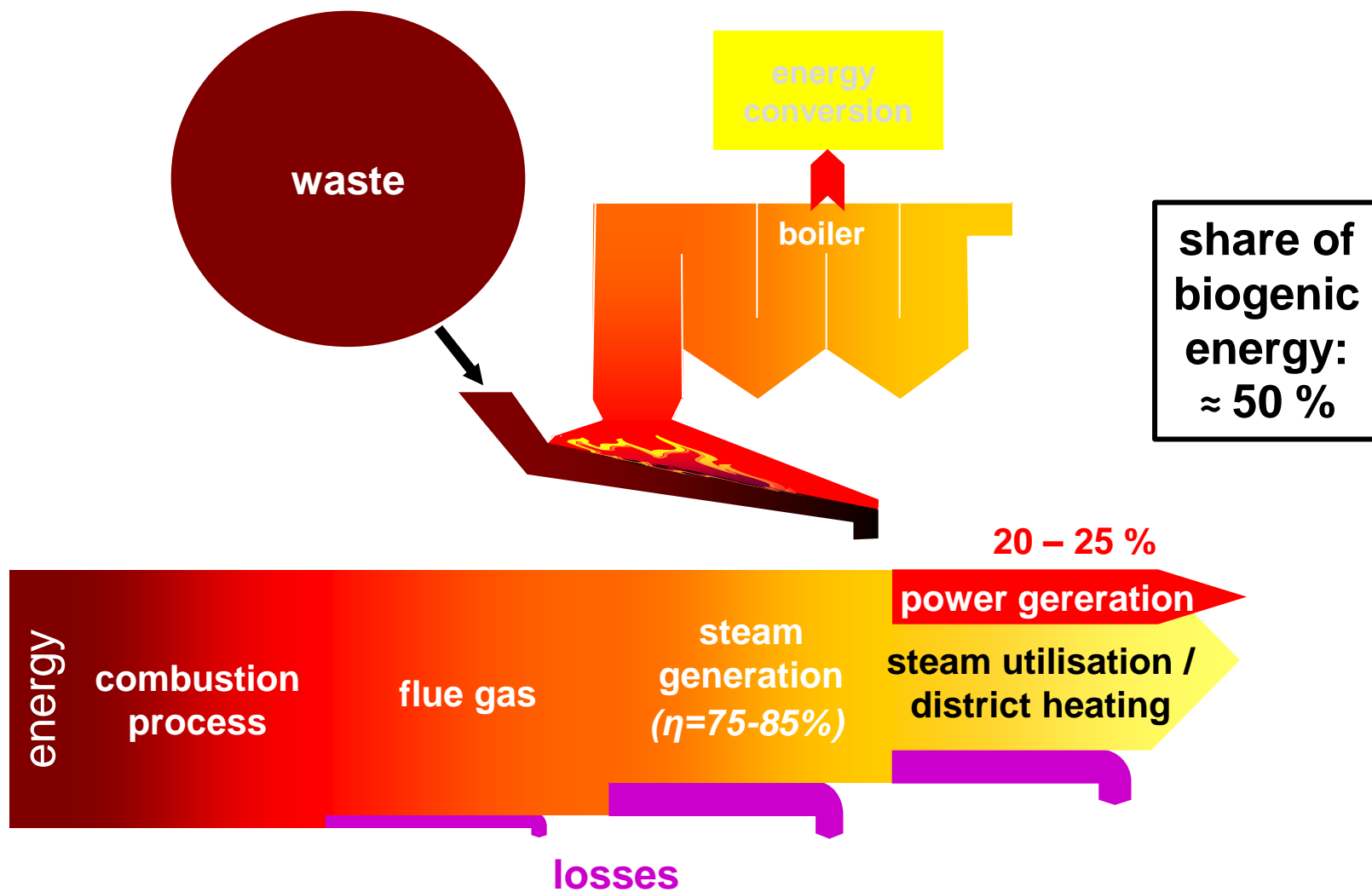
inhabitants:
508.5 mill.

MSW:
235 mill. Mg

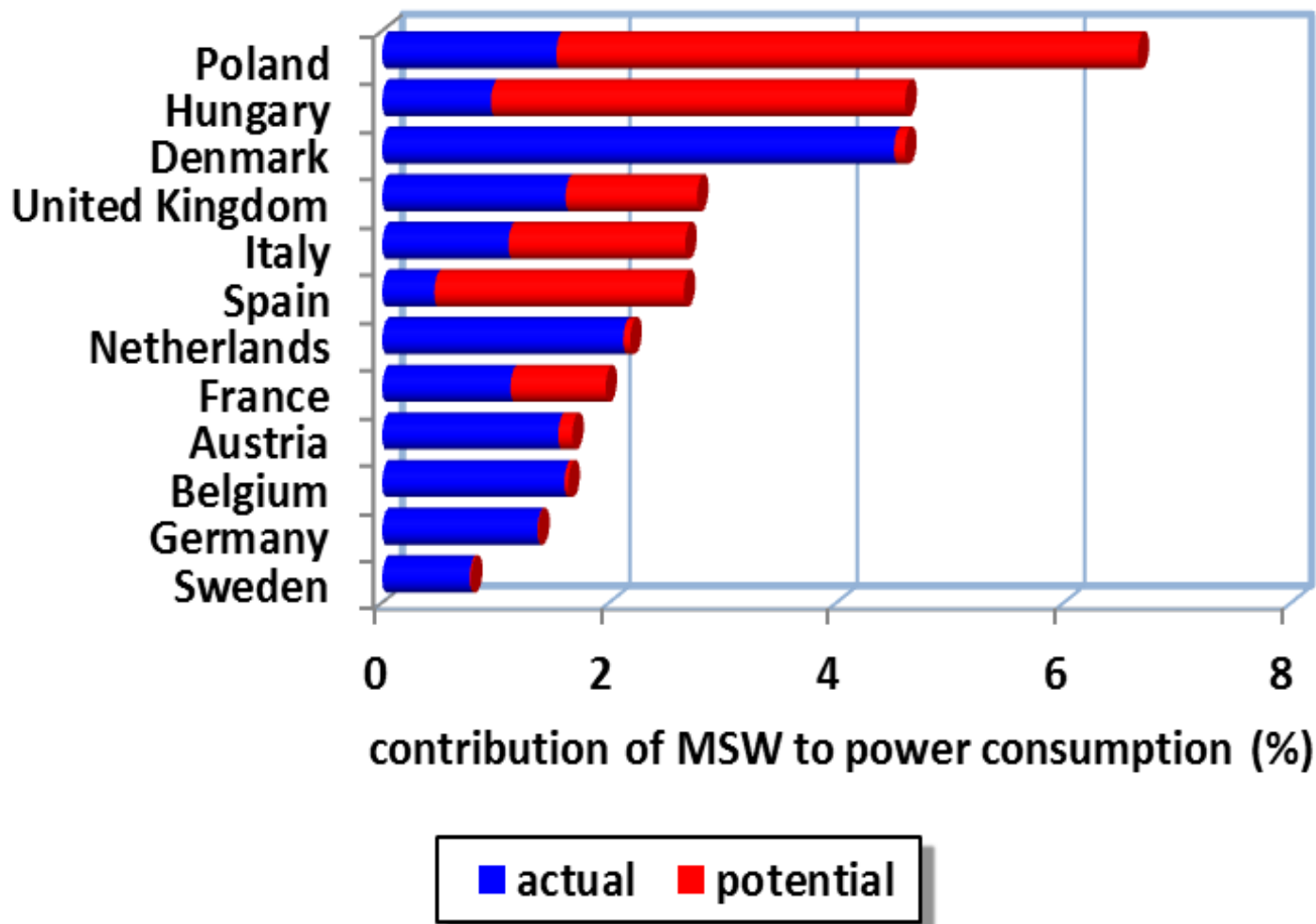
incineration:
64 mill. Mg
>450 plants



incineration of residual waste in Europe in % (2016)



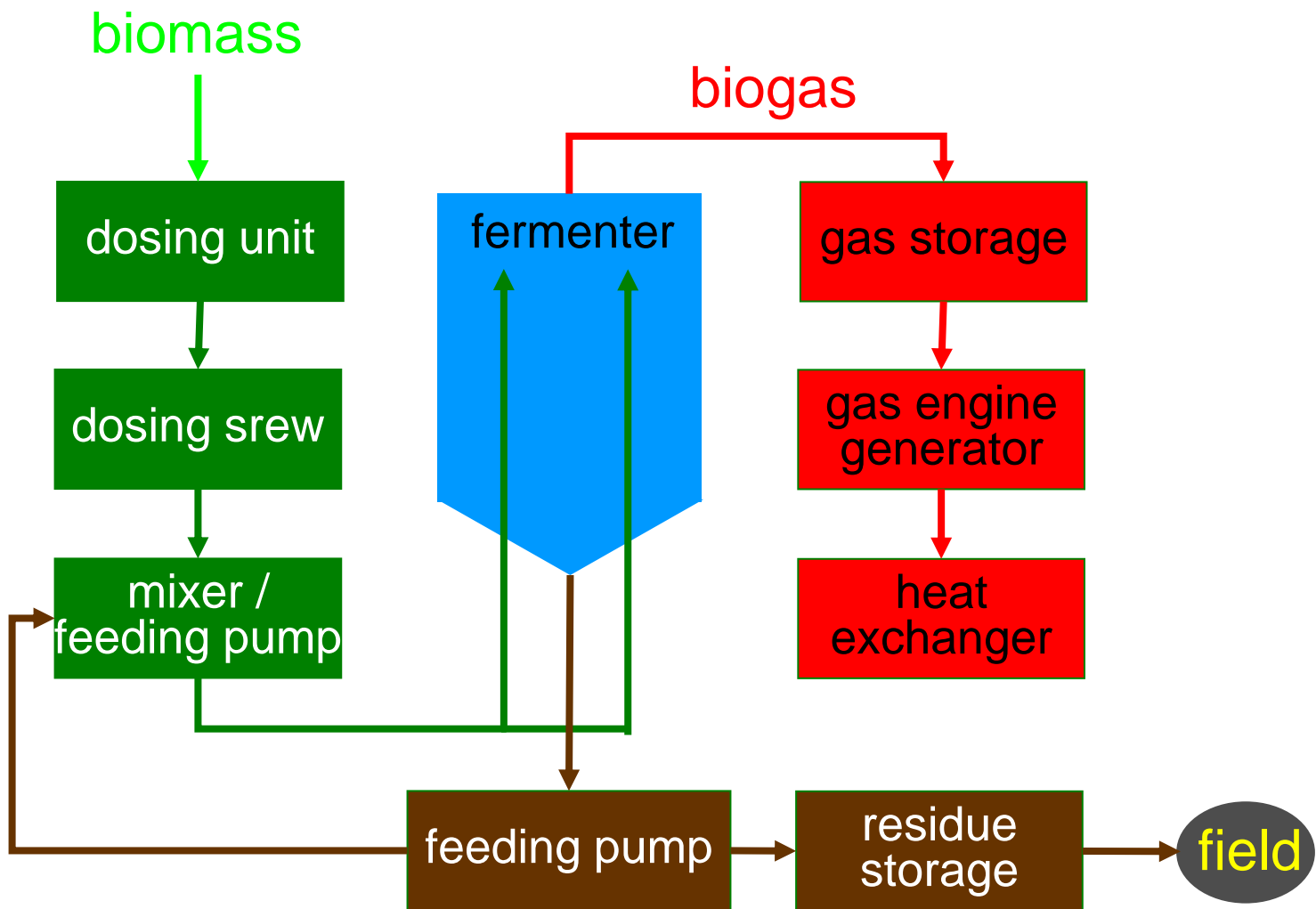
energy flow in a waste incineration plant



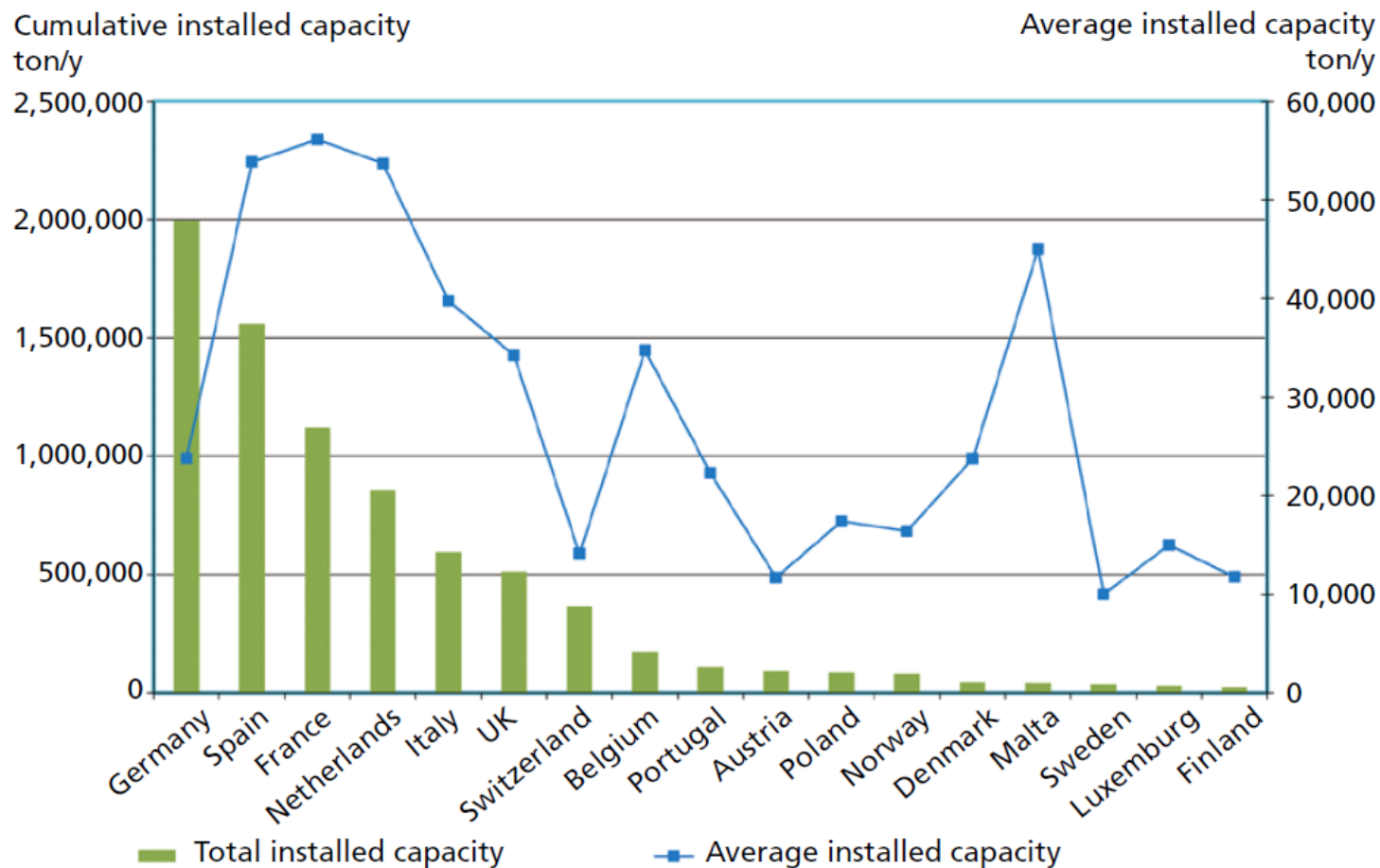
substitution of power by MSW in 2015

anaerobic digestion

- **common practice for sewage sludge and agricultural residues like manure**
- **strong increase for mixed MSW and separated biodegradable MSW since mid 1990s**
- **EU requires AD as first step of biowaste treatment**
- **2015 situation in Europe:**
 - **almost 250 plants**
 - **capacity approx. 7.8 mill. Mg ($\approx 6 - 7$ % of biodegradable MSW)**



scheme of an anaerobic digestion plant



source: De Baere & Mattheeuws

capacity of AD plants for biodegradable MSW in Europe

legislative framework for the energy sector

Renewable Energy Directive (2009)

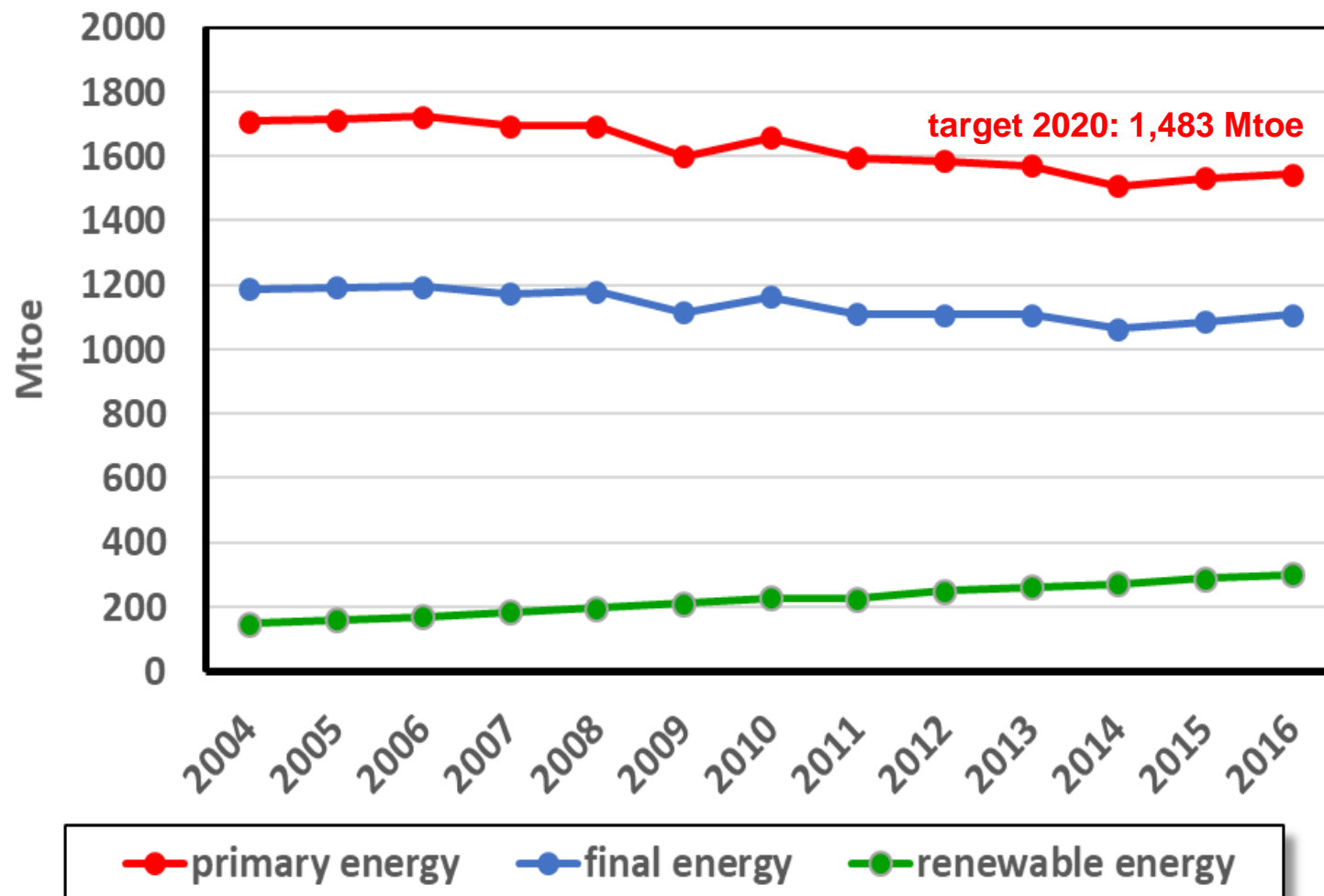
- **2020 target for renewable energy: 20 % (of final consumption)**
- **national targets from 10 % (Malta) to 49 % (Sweden)**
- **2020 target for renewables in transportation: 10 %**

updated targets for 2030 (2016)

- **40% cut in GHG emissions compared to 1990 levels**
- **target for renewable energy: 27 %**
- **annual 1.5 % energy savings from 2021 to 2030**
- **in total at least 27% energy savings**

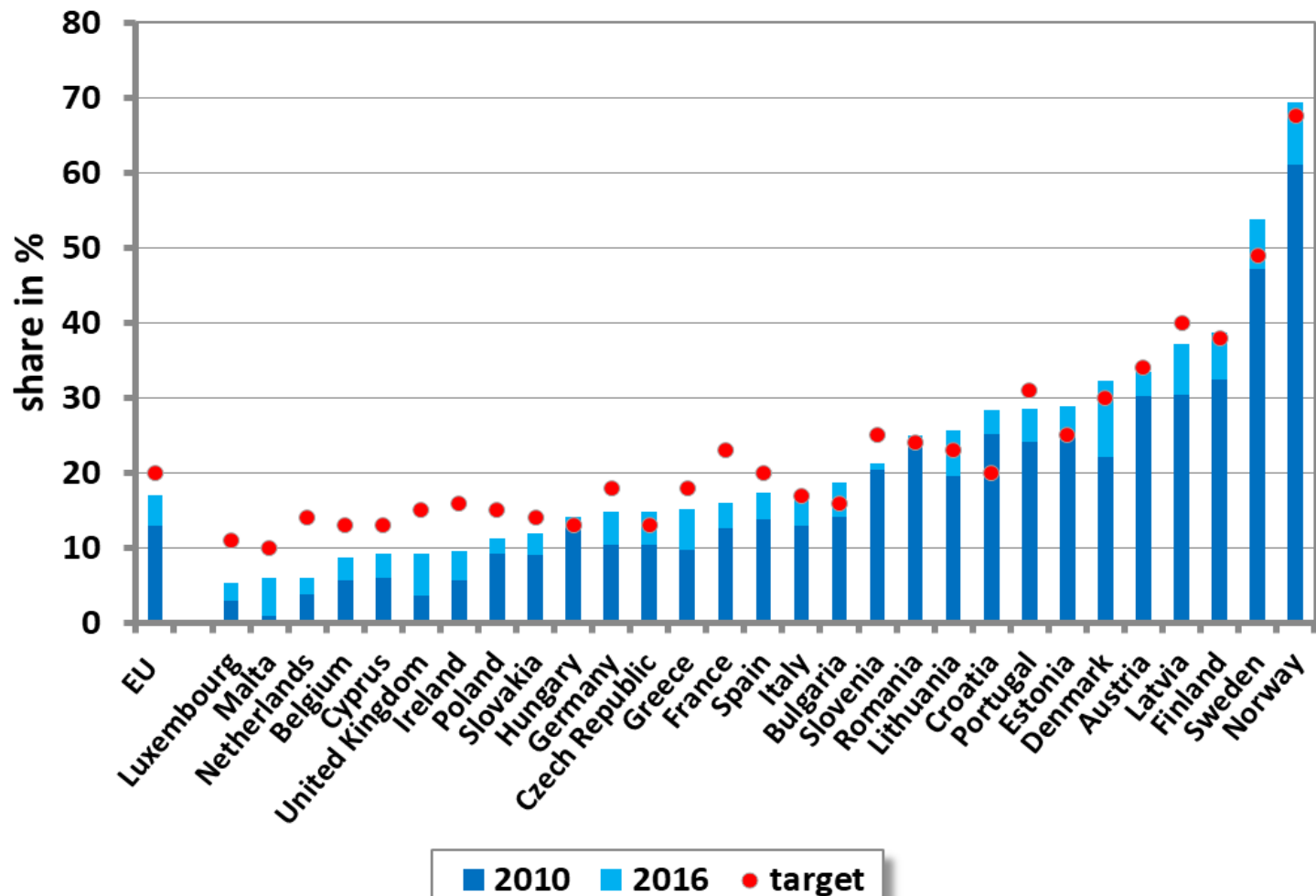
Energy Efficiency Directive (2012)

- **improving energy efficiency of buildings**
- **improving energy performance of products**
- **informing consumers (energy labelling)**
- **smart financing for smart buildings**



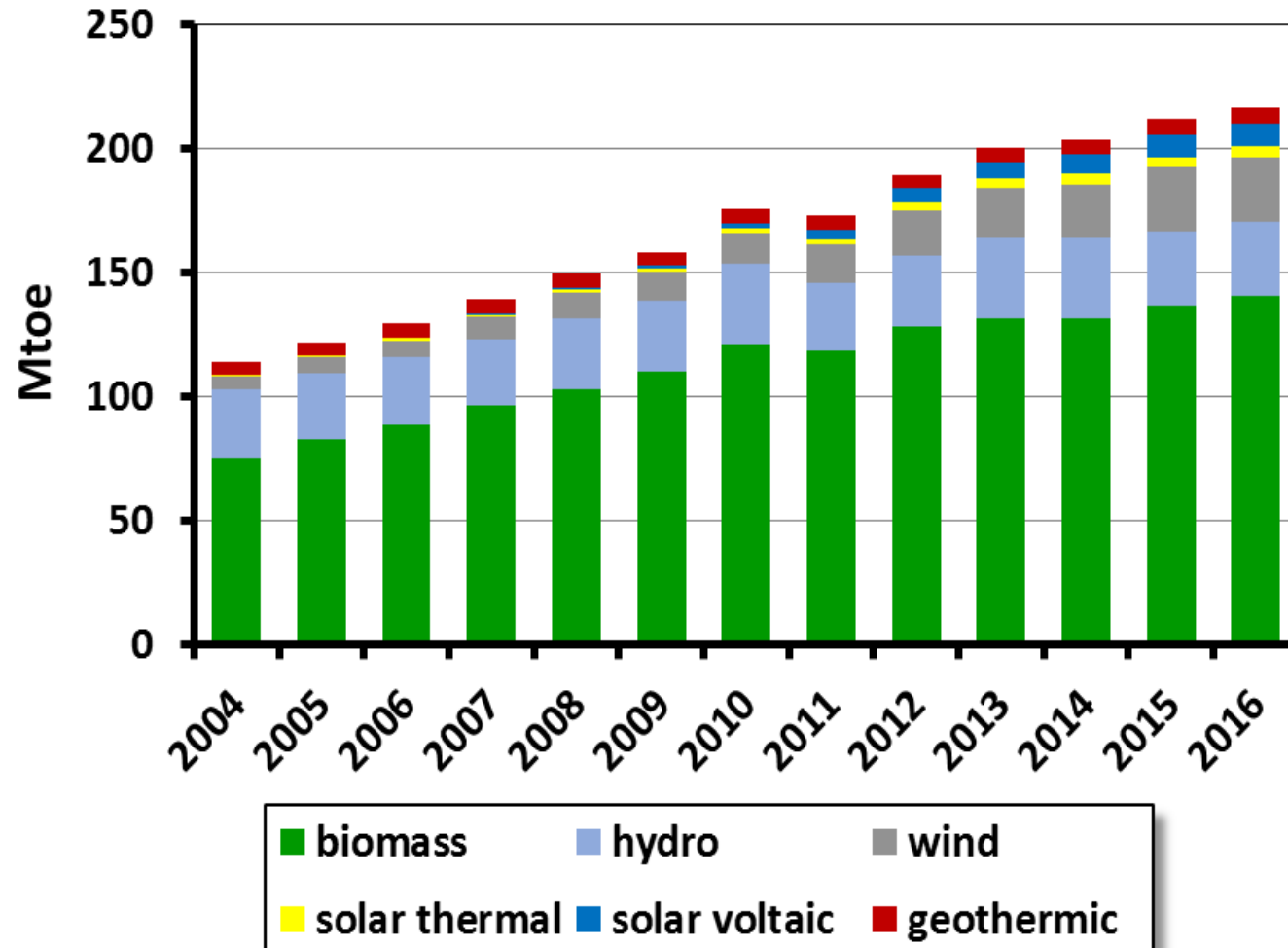
source: EUROSTAT

EU primary, final, and renewable energy consumption



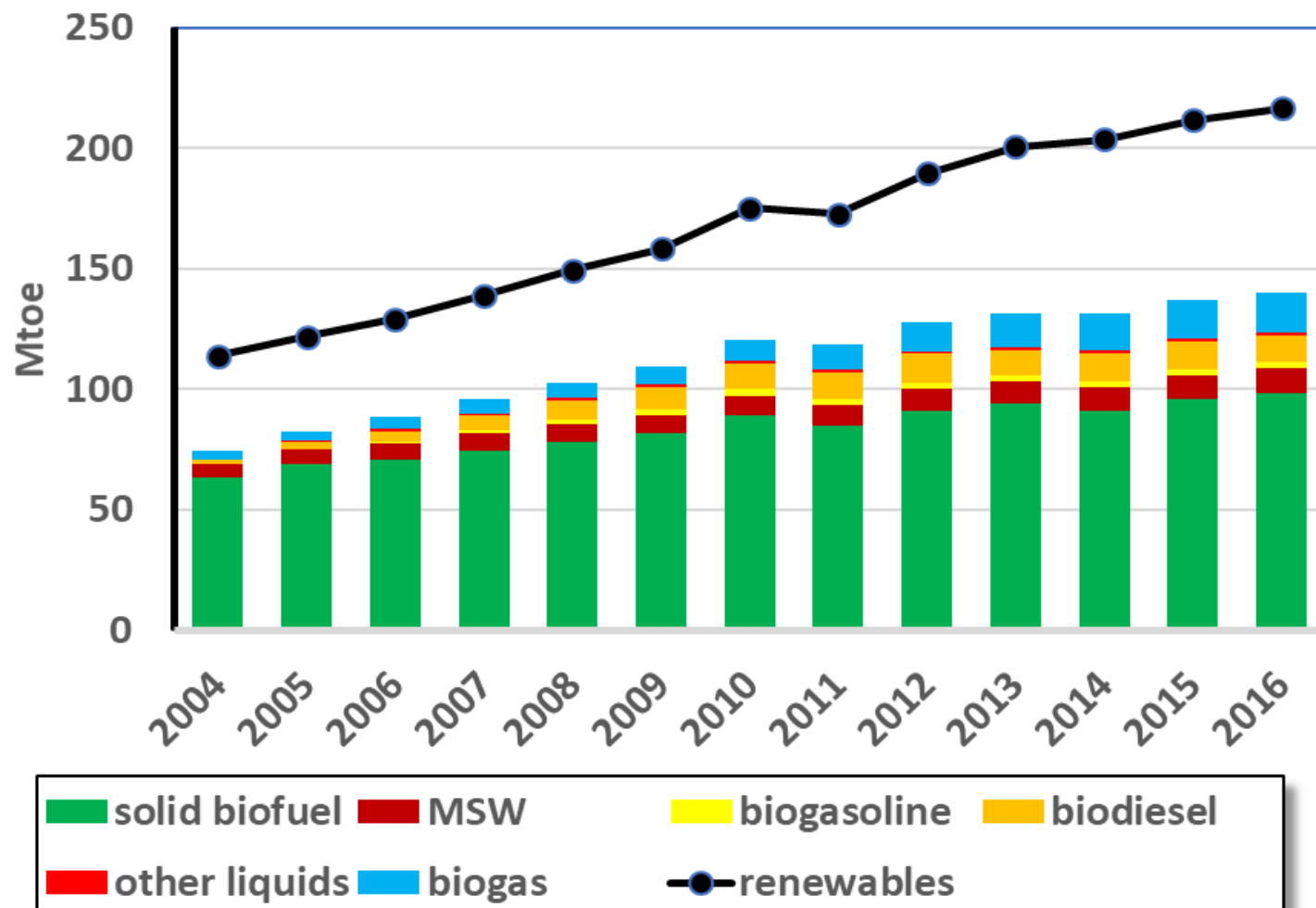
source: EUROSTAT

renewables in final energy consumption (2016)



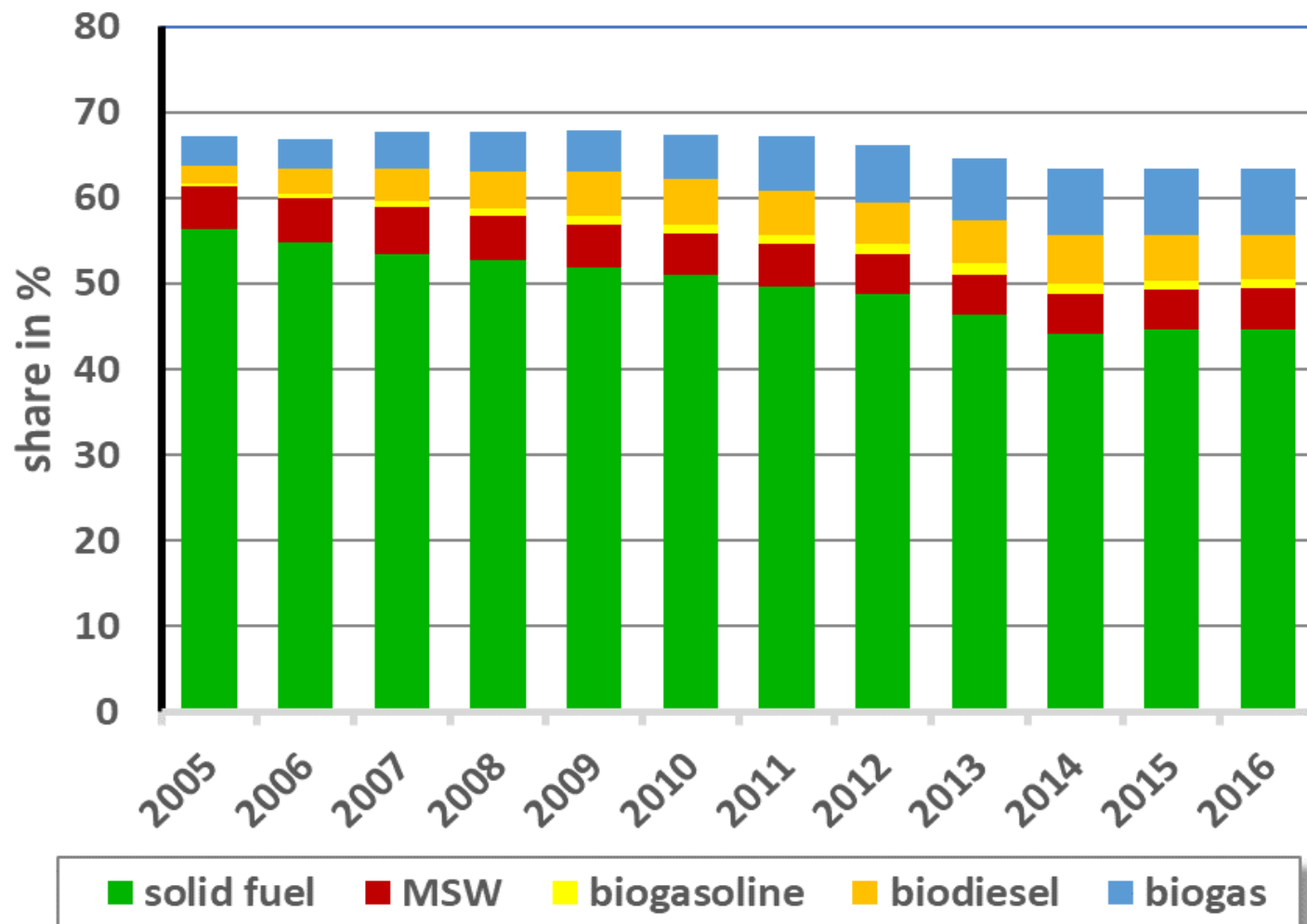
source: EUROSTAT

renewables in final energy consumption (2016)



source: EUROSTAT

biomass in gross inland renewable energy consumption



source: EUROSTAT

share of bioenergy sources in the EU

conclusions

- **the energy consumption in the EU is slowly declining**
- **the share of renewable energy sources will still increase**
- **especially bioenergy strategies are strongly promoted**
- **waste-to-energy is in many countries well established and will still grow**
 - **especially for biodegradable MSW separate collection is recommended**
 - **composting will widely be replaced by AD**
 - **waste incineration with CHP is the preferred treatment for residual MSW**

