Greenhouse Gas Emissions from Municipal Waste Management : The Situation in Greece

D. Tsourdalaki, C. Papadaskalopoulou, M. Loizidou

School of Chemical Engineering, NTUA

Climate change framework

1992: United Nations Framework Convention on Climate Change (UNFCCC)

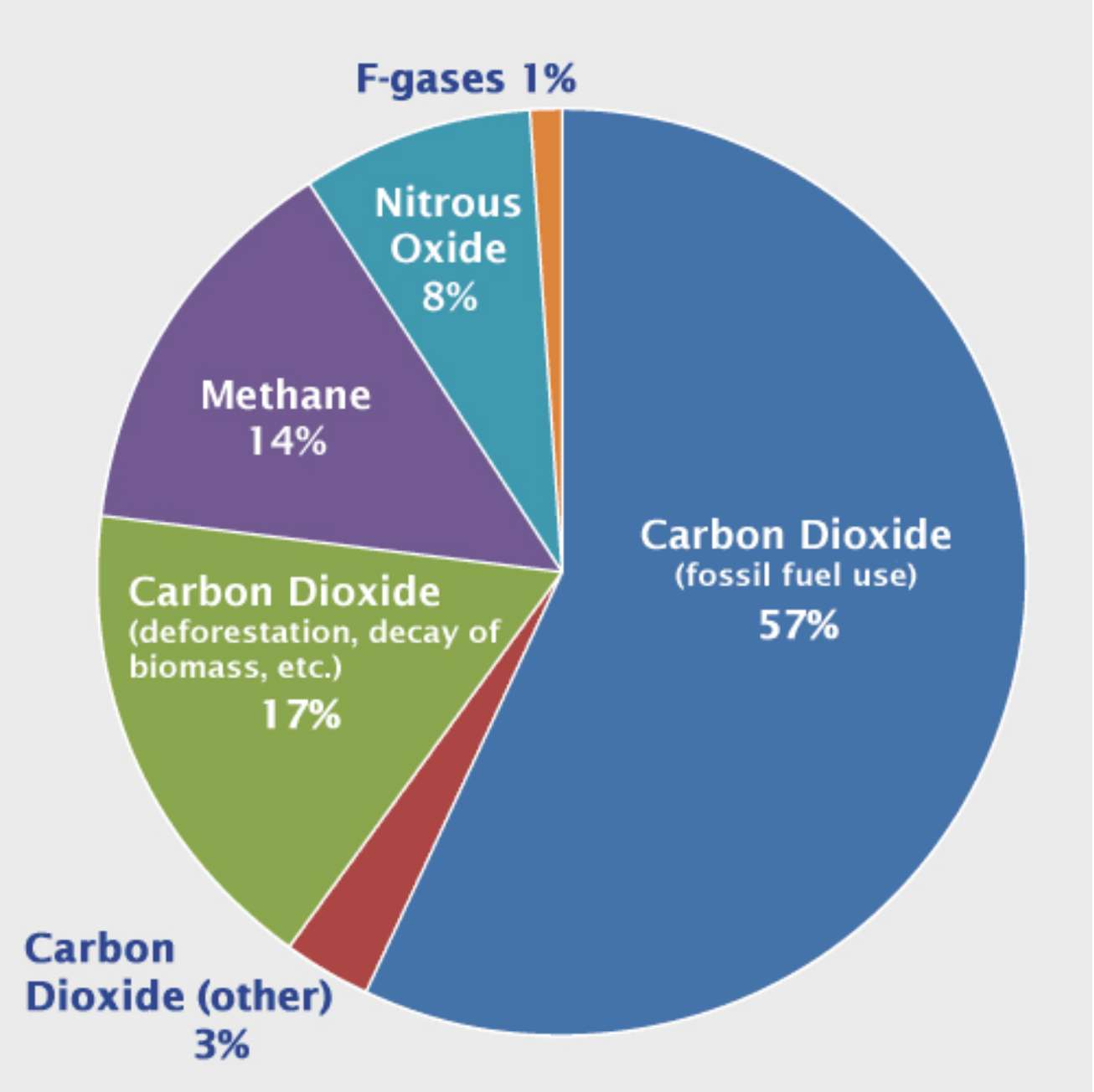
Aim: Hold global warming below 2°C

1997: Kyoto Protocol

Year	**GHG reduction targets compared to 1990 levels**	
	UNFCCC Parties	EU countries
2008-2012	5%	8%
2013-2020	18%	20%
2030	-	40%
2050	-	80-95%

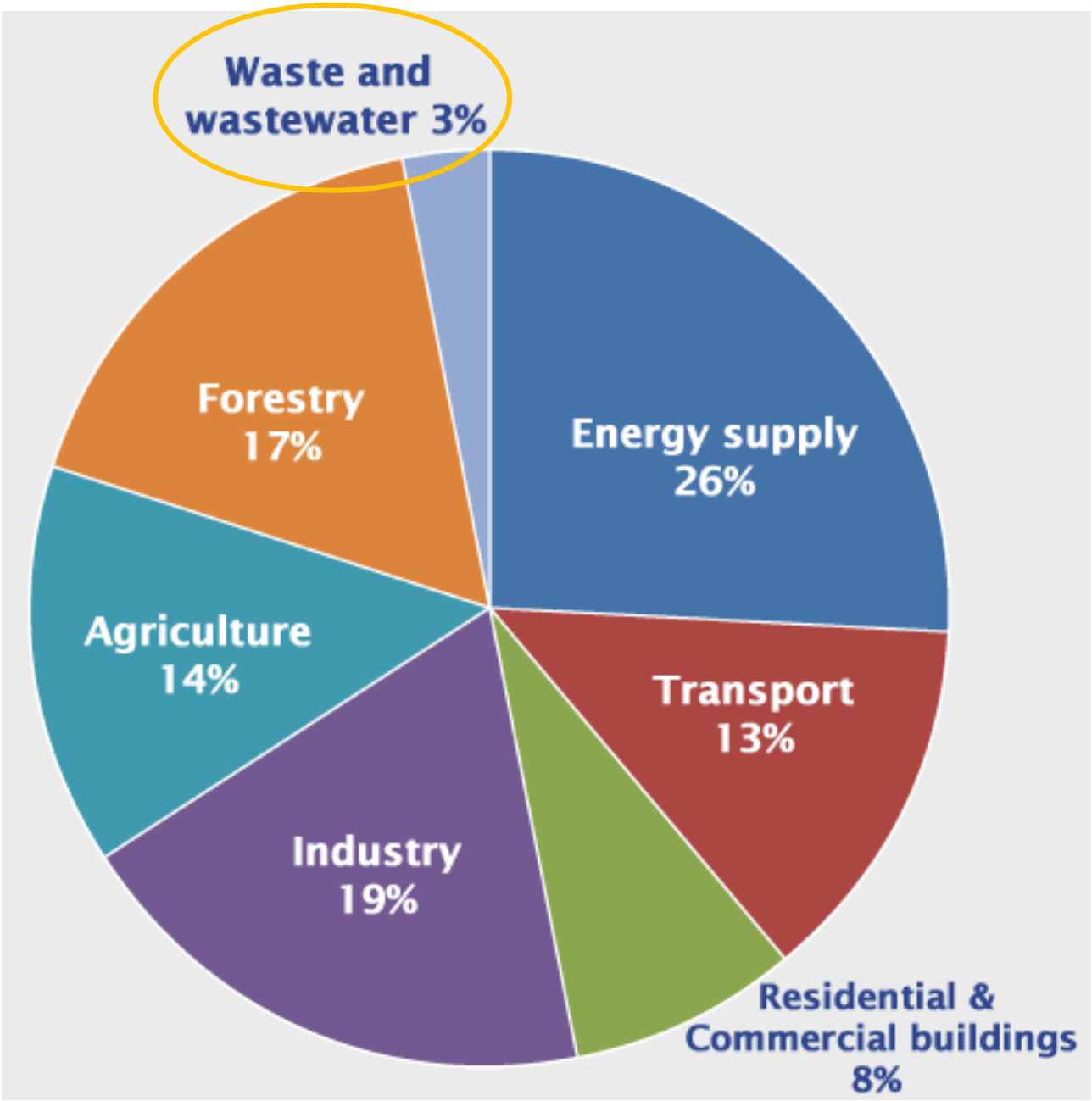
Global Greenhouse Gas Emissions by Gas

Source: IPCC (2007) based on global emissions from 2004

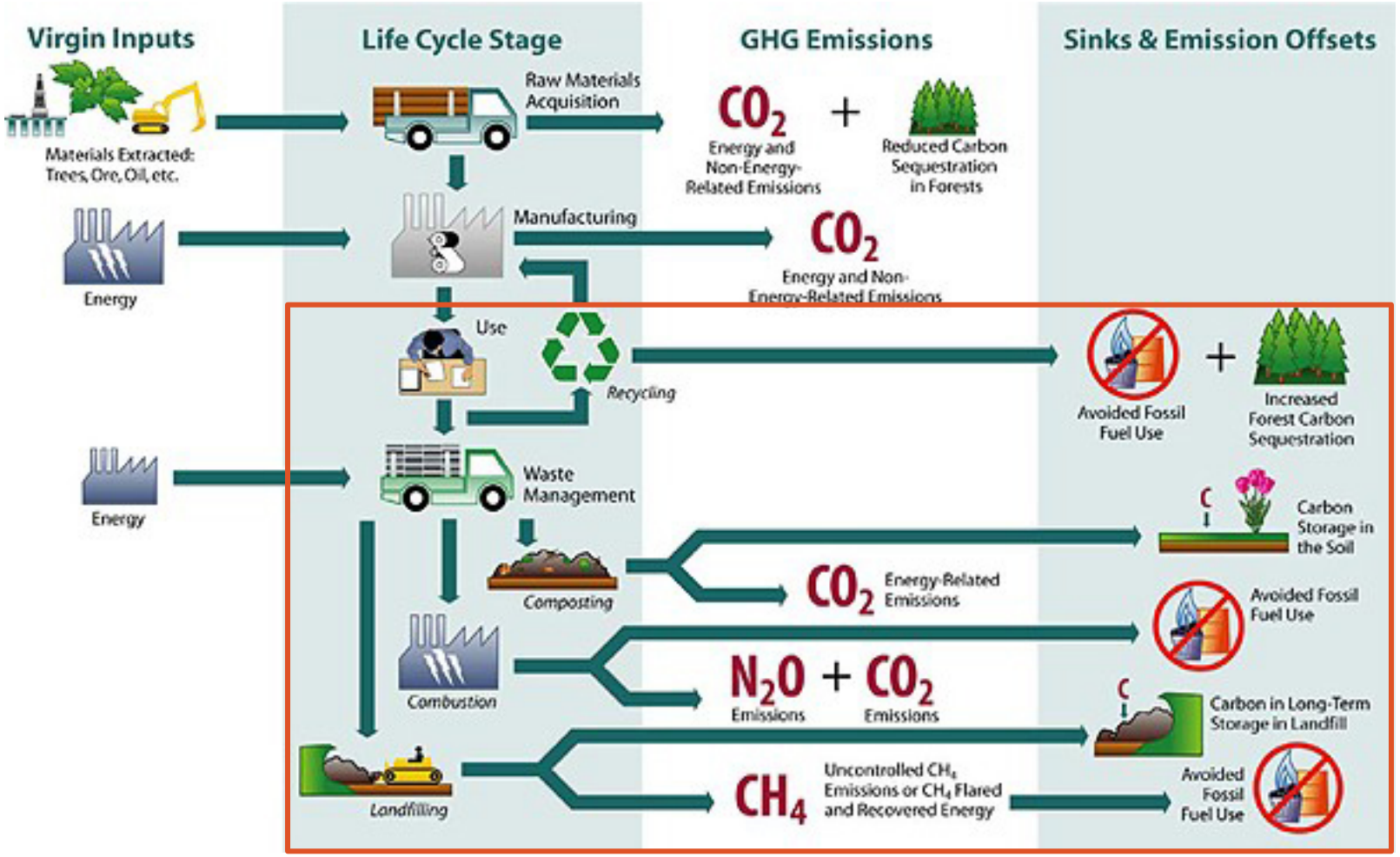


Global Greenhouse Gas Emissions by Source

IPCC (2007); based on global emissions from 2004



7.Gases-generation and contribution

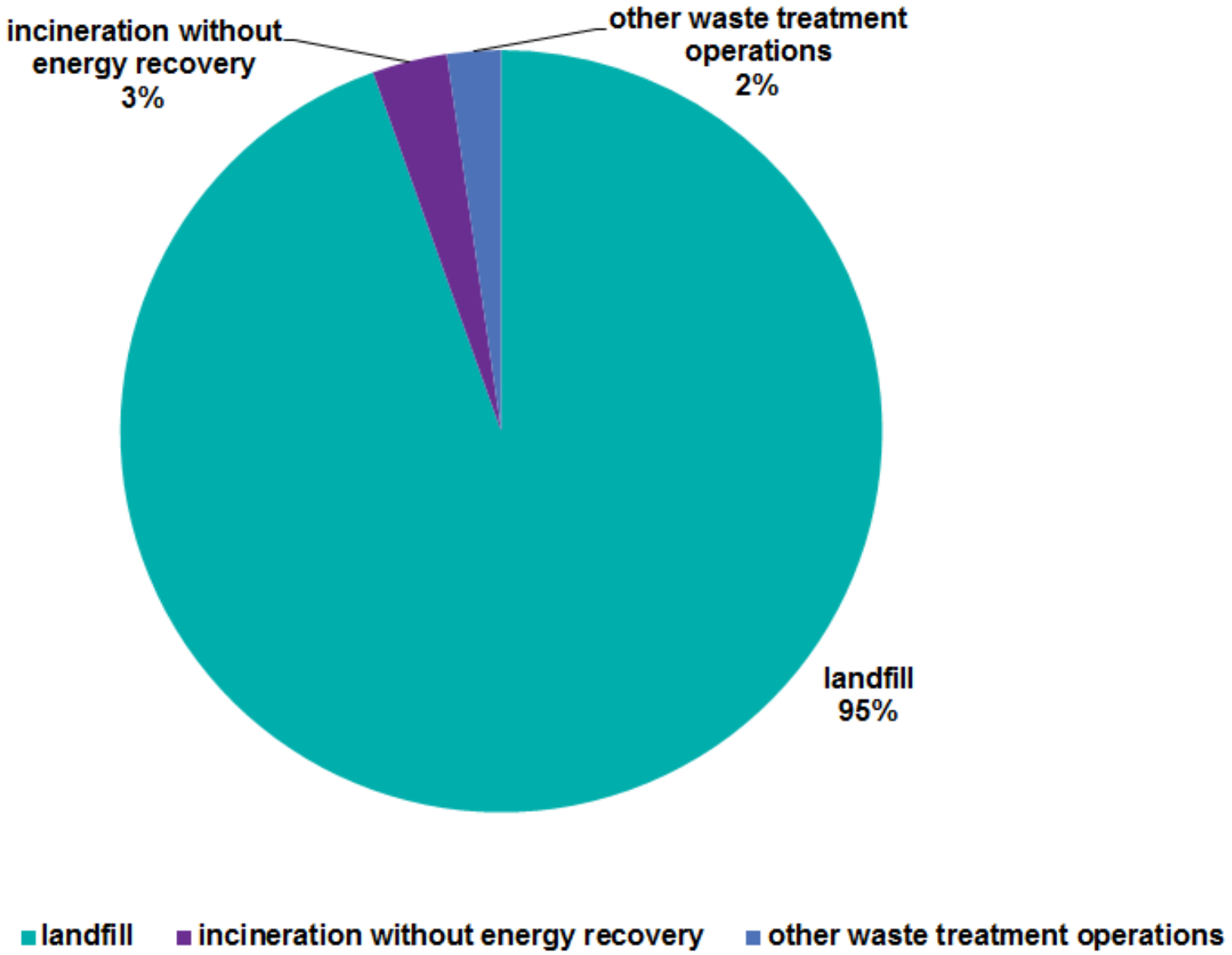


Anthropogenic emissions of the main GHG in the EU, 1994

Direct GHG	Emissions (Mt)	GWP [2] (over 100 years)	Global Warming Equivalence of all emissions Mt equiv CO_2 (% from solid waste disposal)	Global warming equivalence emissions from waste disposal Mt equiv CO_2 (% of total waste management component for each gas)
CO_2 fossil	3,215	1	3,215 (<0.5 %)	15 (9 %)
CH_4	22	21	460 (33 %)	152 (89 %)
N_2O	1.05	310	325 (1 %)	3 (2 %)

Estimated share of the three waste disposal operations in GHG emissions (2011)

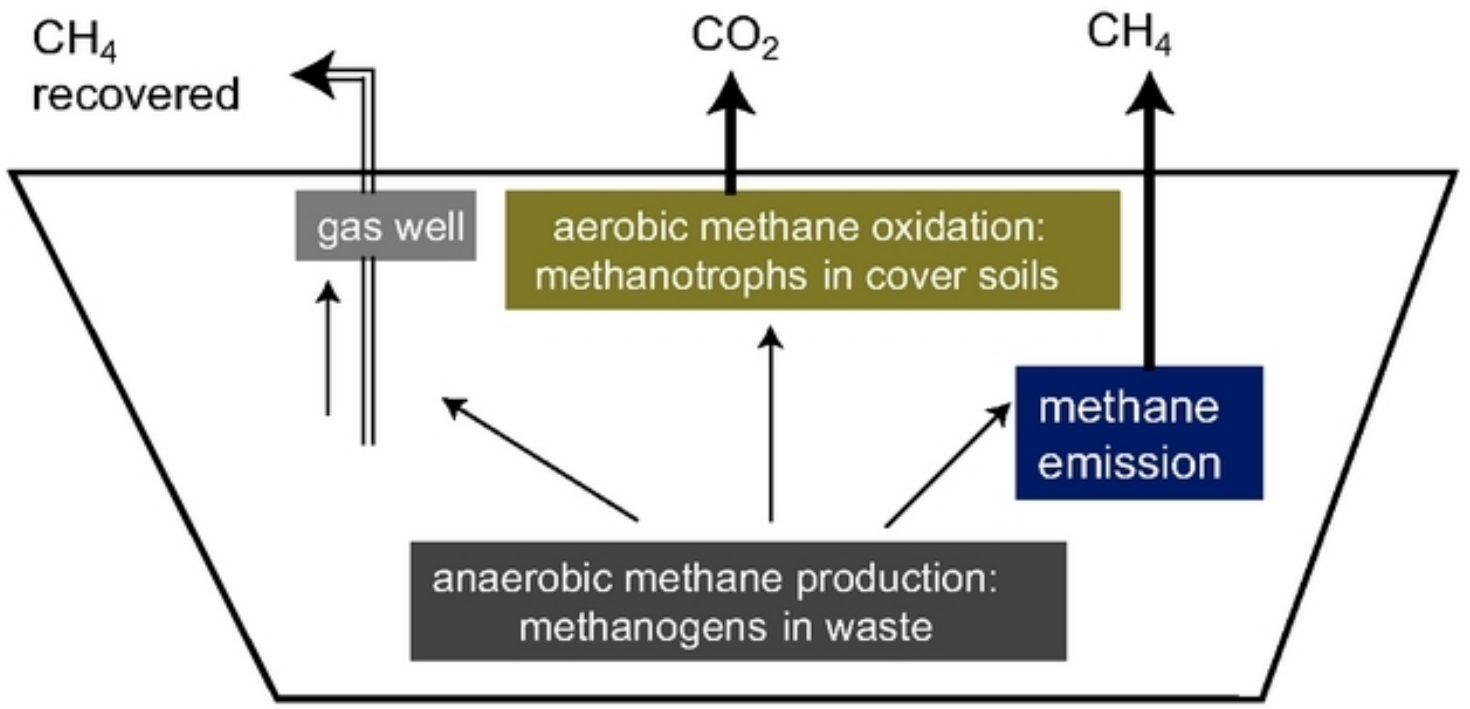
Source: EEA Greenhouse gas data viewer, March 2014



GWP values and lifetimes for a time horizon of 100yrs (IPCC)

GHG	Lifetimes (years)	2001	2007	2013
CO_2	-	1	1	1
CH_4	12,4	23	25	34
N_2O	121	296	298	298

GHG emissions from landfills



Simplified Landfill Methane Mass Balance

Methane (CH_4) produced (mass/time) = Σ(CH_4 recovered + CH_4 emitted + CH_4 oxidized)

Solid waste landfilling technologies

- **Dump**

The dump refers to a landfill where many different kinds of waste are disposed of with little or no benefit of an engineering plant. The waste is not compacted, no measures exist to prevent gas and leachate emissions to the environment, and the waste is not covered.

- **Conventional landfill**

A conventional landfill, as typically defined, is a landfill that implements technical measures to collect and manage the leachate and gas generated (as also foreseen in the Landfill Directive).

- **Engineered landfills with energy recovery**

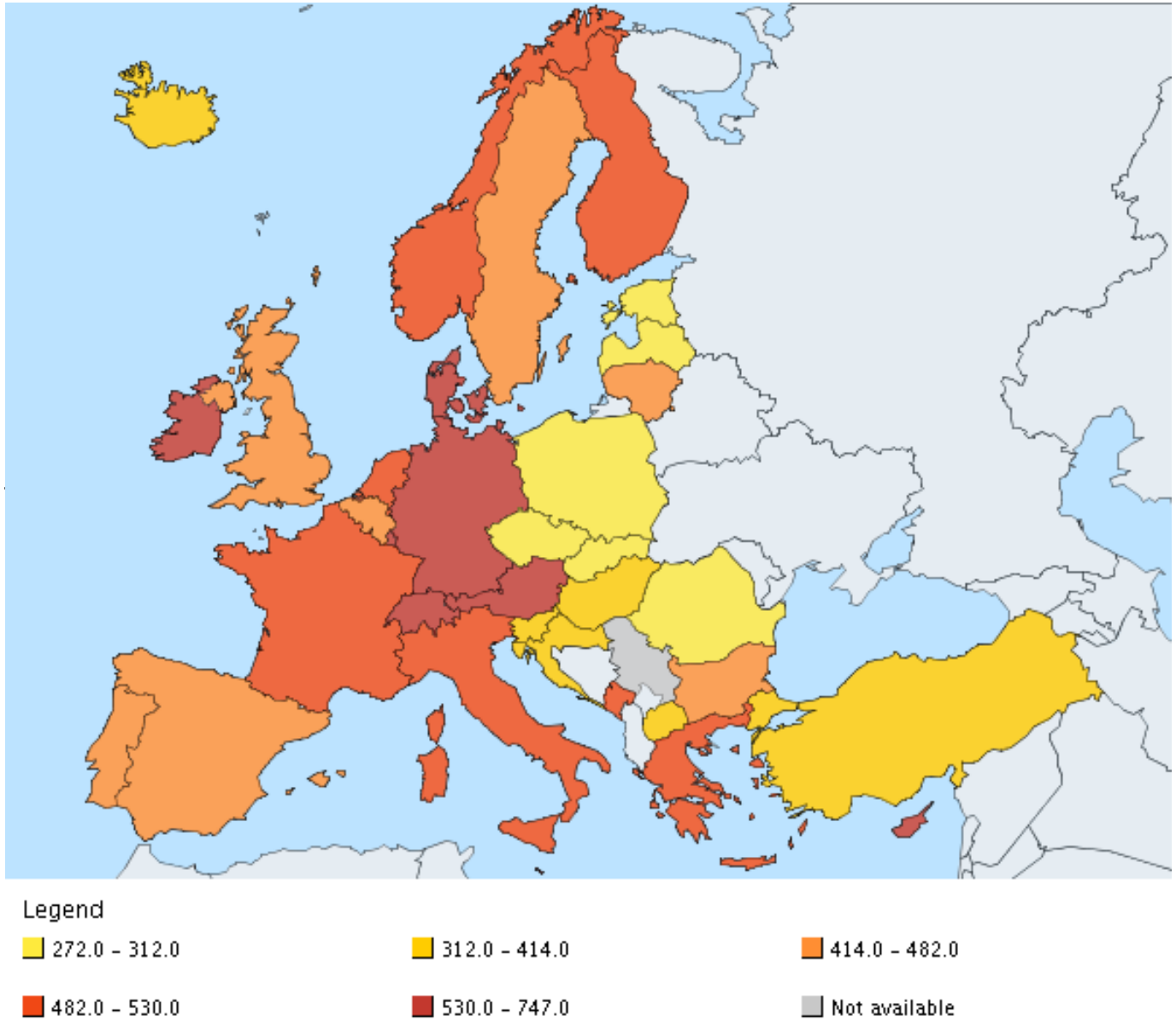
In addition to the technical measures implemented in conventional landfills, these technologies adopt active measures to enhance the waste degradation process, in order to make it faster and more efficient.

- **Engineered landfills for low organic waste**

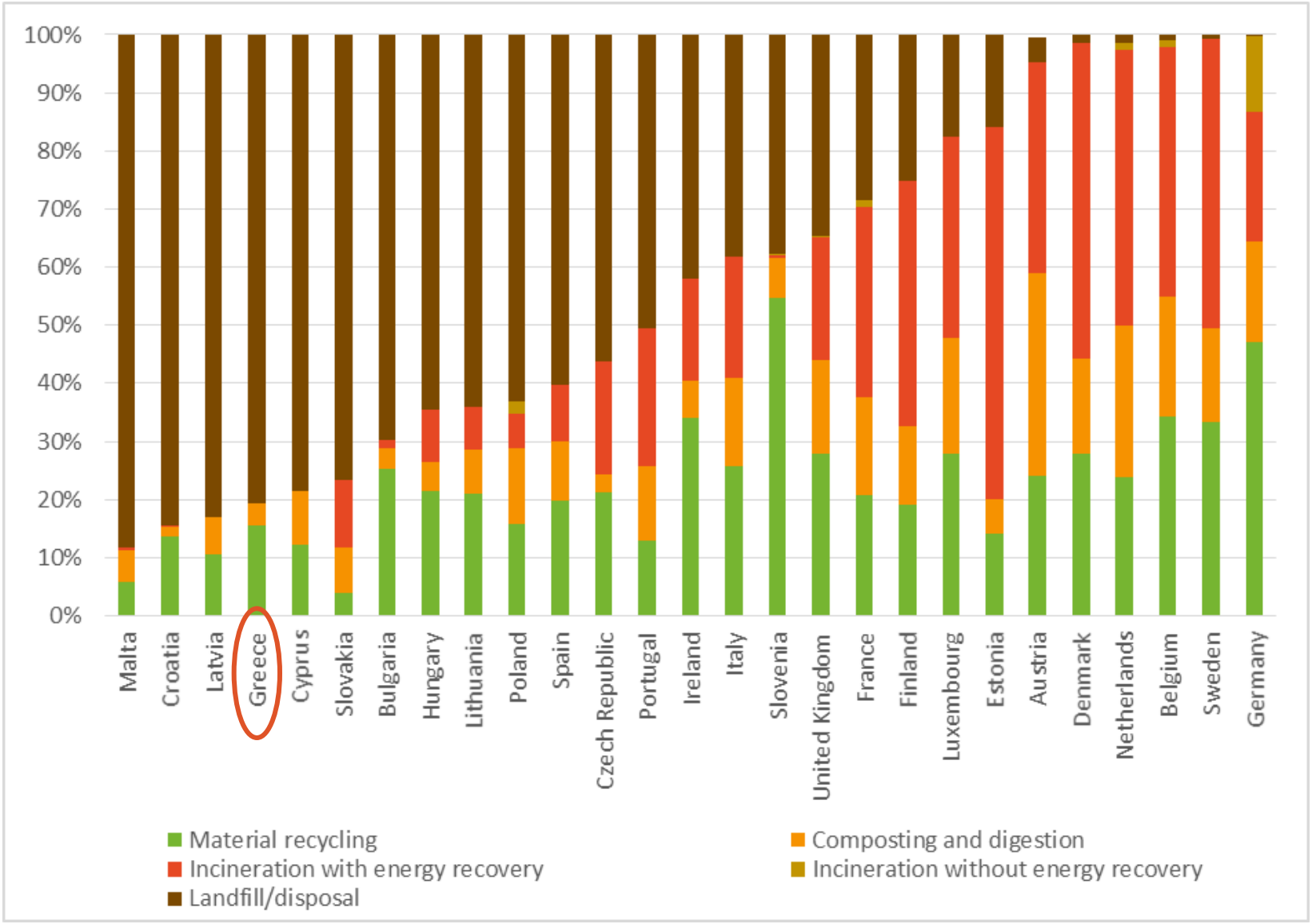
These landfills are destined for the disposal of residual waste. Similar to engineered landfills, these landfills adopt technical measures to collect and treat the generated leachate.

MSW generation in the EU (2013)

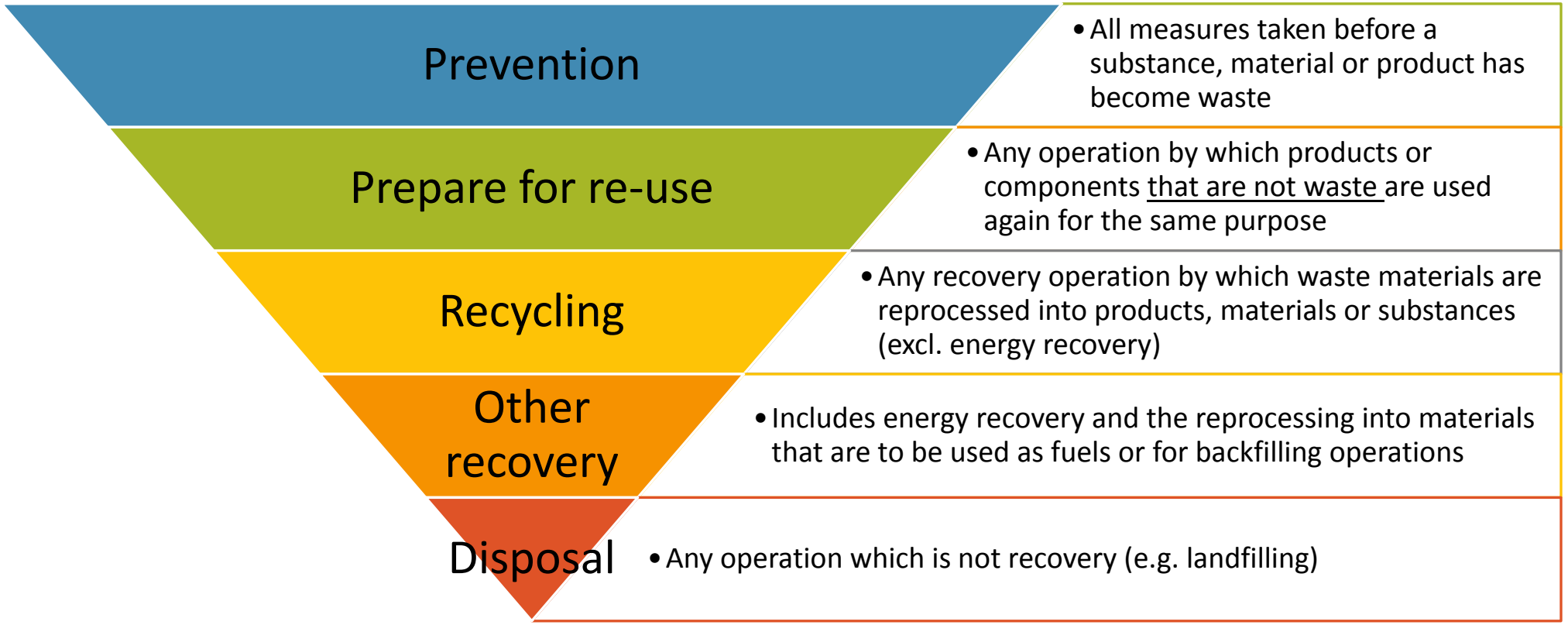
in kg per capita



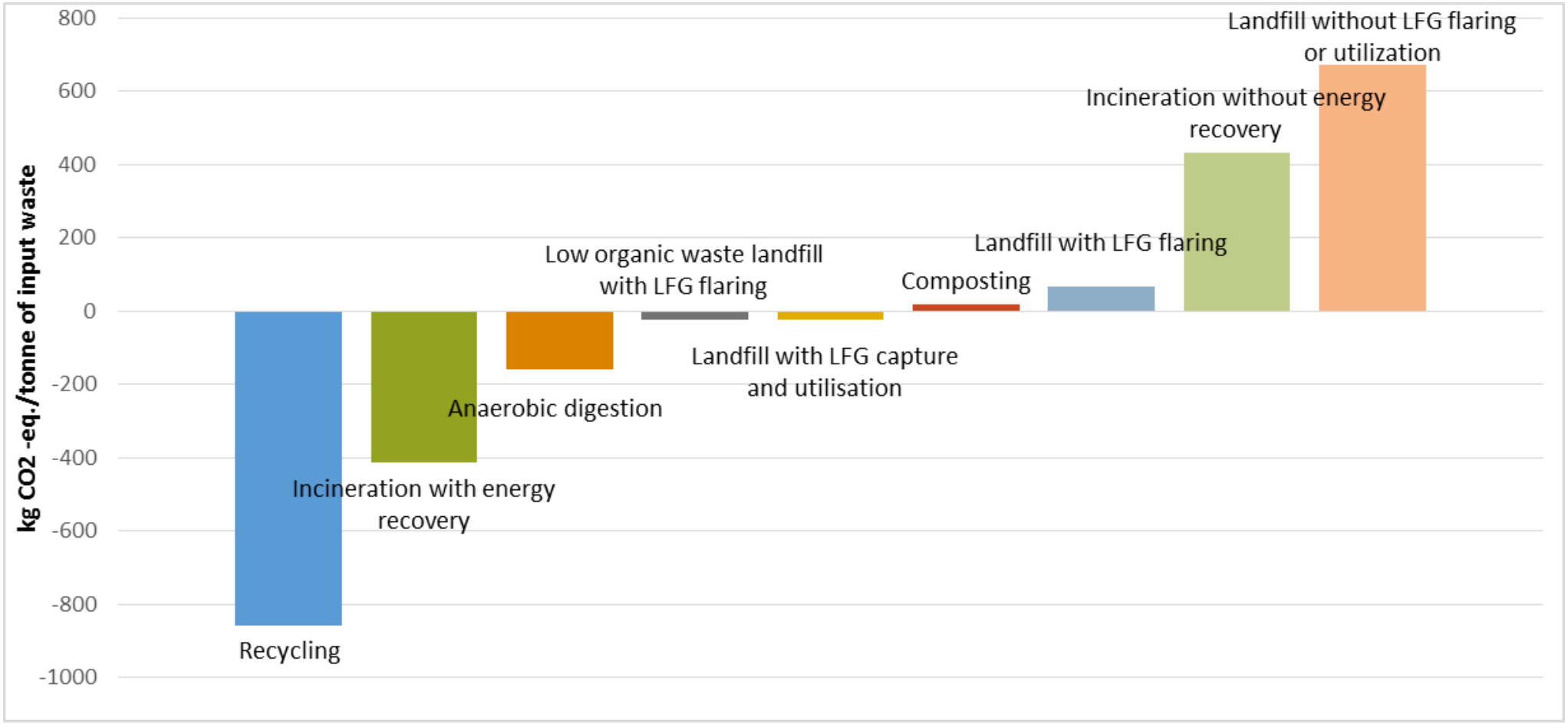
Waste management in the EU-28 (2013)



The EU legislation: Waste Framework Directive 2008/98/EC

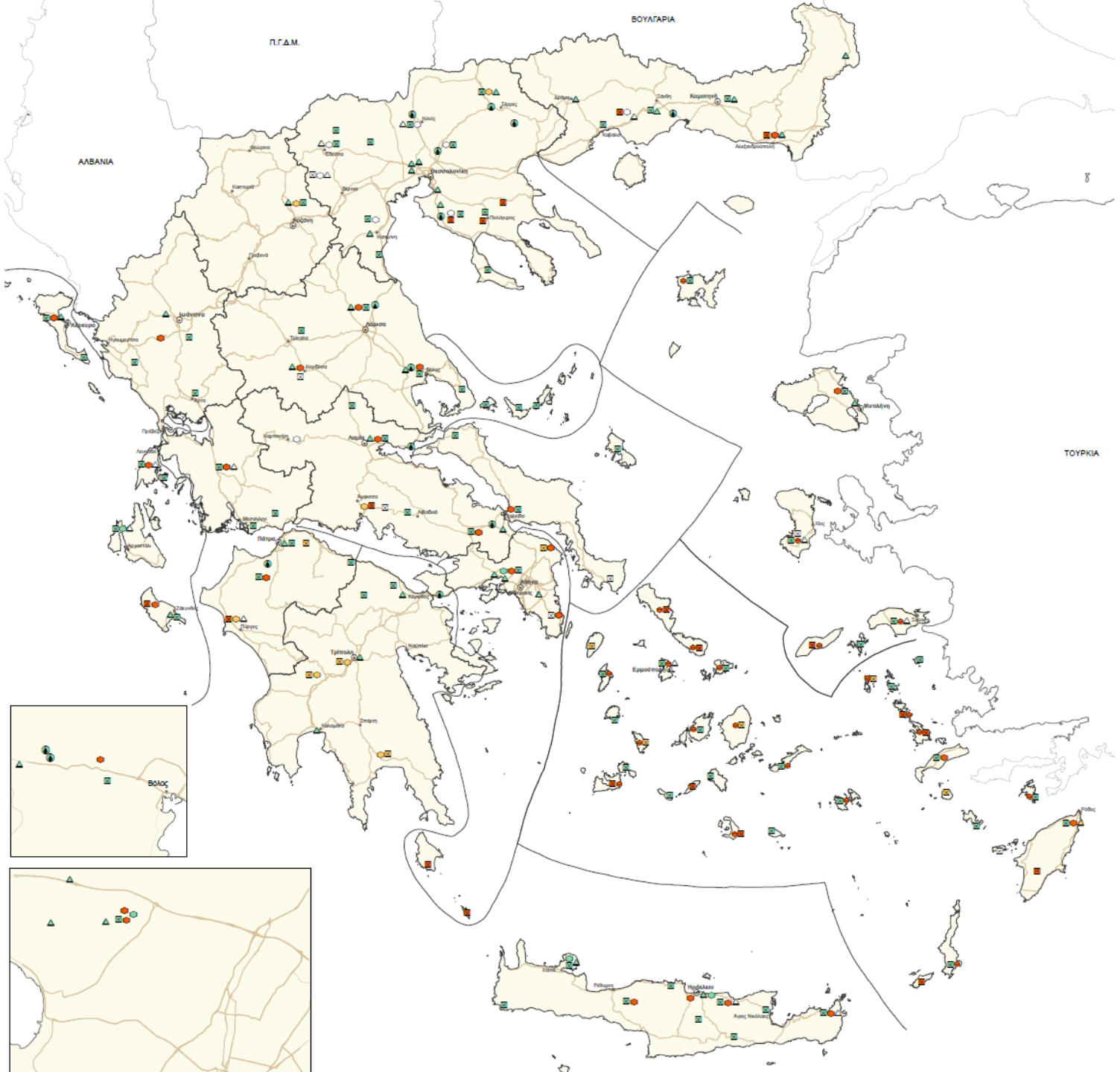


Average net GHG emissions from different types of waste management methods



MSW management facilities in Greece

- 29 Material Recovery Facilities
- 4 Mechanical Biological Treatment Plants
- 79 Sanitary landfills (75 in operation)
- 39 Dumps in operation

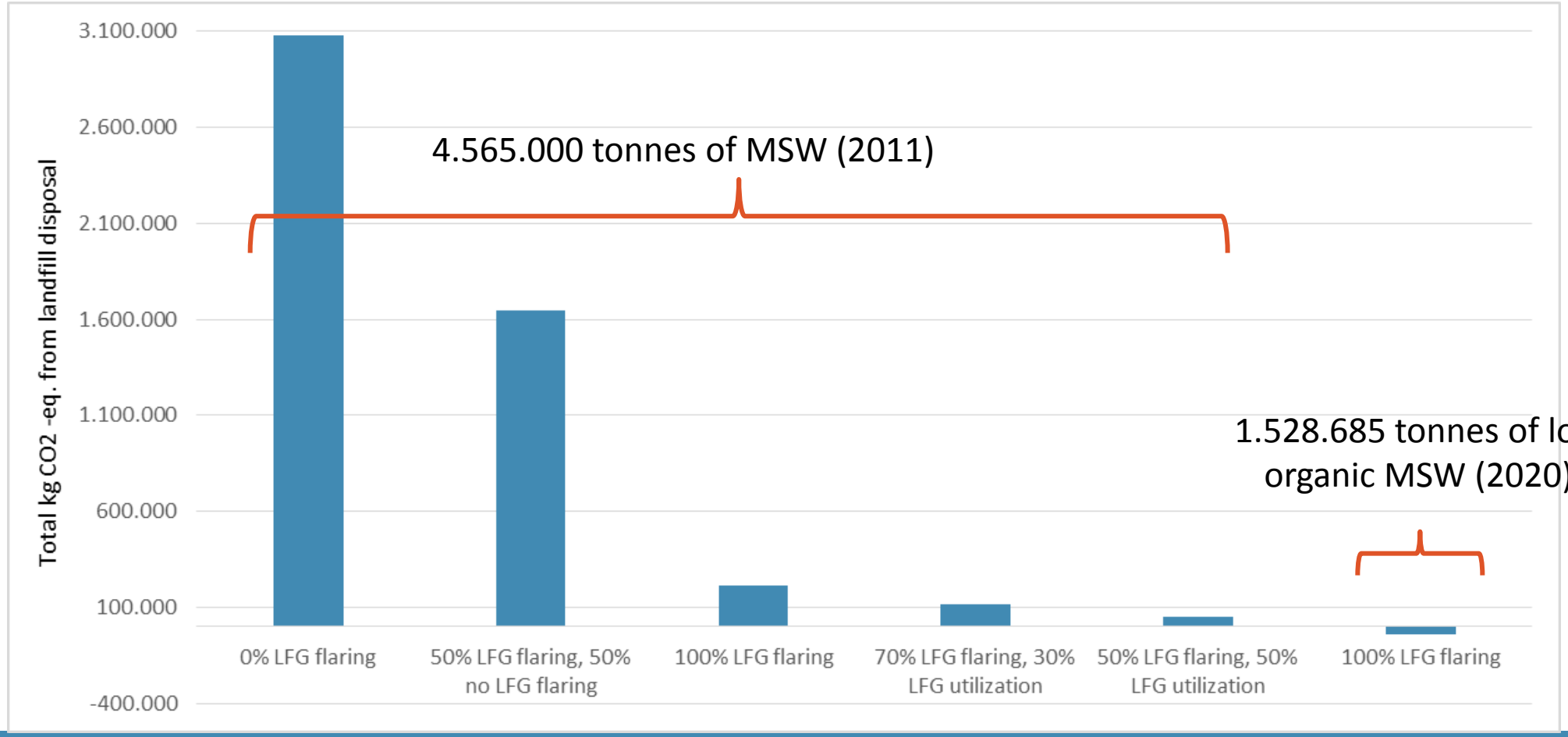


National Waste Management Plan in Greece

The National Waste Management Plan (NWMP) sets a number of ambitious targets for waste management by 2020:

- Preparing for re-use and recycling with separate collection of recyclable and biowaste of at least 50% w/w of MSW
- Reduction of BMW going to landfills to 35% w/w (compared to 1997 levels)
- Reduction of total waste disposal of MSW to <30% w/w
- Separate collection of 40% w/w of BMW
- Preparing for re-use and recycling of 65% w/w of at least paper, glass, metal and plastic
- Recovery of 60% and recycling 55-80% w/w of packaging waste

GHG emissions for different landfill scenarios



Concluding remarks

- Although landfill disposal of MSW is considered the least preferred option, there is great potential for reducing its carbon footprint
- Landfilling is unavoidable, as with any other waste management option, there will always be an amount of residual waste that will need to be disposed of
- Waste, even when disposed of in landfills, holds a significant value that may still be exploited
- The amount of biodegradable waste disposed of in landfills must be reduced to avoid methane generation in landfills
- In all cases, standards must be followed for reducing landfill methane emissions by capture and combustion of landfill gas with or - if this is not possible - without energy recovery
- Achieving the targets set in the National Waste Management Plan for 2020, is expected to substantially reduce landfill emissions in Greece

Thank you for your time and your attention!!