

EVOLUTION OF THE URBAN WASTE MANAGEMENT SYSTEM IN THE EMILIA-ROMAGNA REGION

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SUPPLEMENTARY MATERIALS

Methods: compare regional and national indicators

When comparing regional indicators with national ones, it should be considered that waste production data and separate collection rates are calculated at national level by ISPRA, which annually acquires data from the Regional and Provincial Environmental Protection Agencies (ARPA/APPA). For the calculation of the separate collection rates, ISPRA historically used its own methodology, which partially differs from those adopted by the single Italian Regions. In 2016, the Italian Ministry of the Environment and Protection of Land and Sea issued its own Decree aimed at standardizing the calculation methodology of separate collection rate in all the Italian regions. ISPRA and the Emilia-Romagna Region have therefore applied an almost identical calculation methodology, since 2016 and since 2017 respectively. For this reason, where considered significant, the analysis included the national average values, while reporting for the Emilia-Romagna region the values calculated with both the regional methodology and the ISPRA one (Figures S2, S9).

A similar problem in different data source comparison concerns economic data. The economic data published by ISPRA derive from the Single Environmental Declaration Models (MUDs), which contain forecast information for some territories and final or pre-accounting information for other territories. Moreover, the sample size analysed by ISPRA on a regional scale is often partial. For these reasons, where a comparison between national and regional data is made, as well as in the comparison with other regions, the ISPRA data are used and they do not coincide with the data analysed on a regional scale.

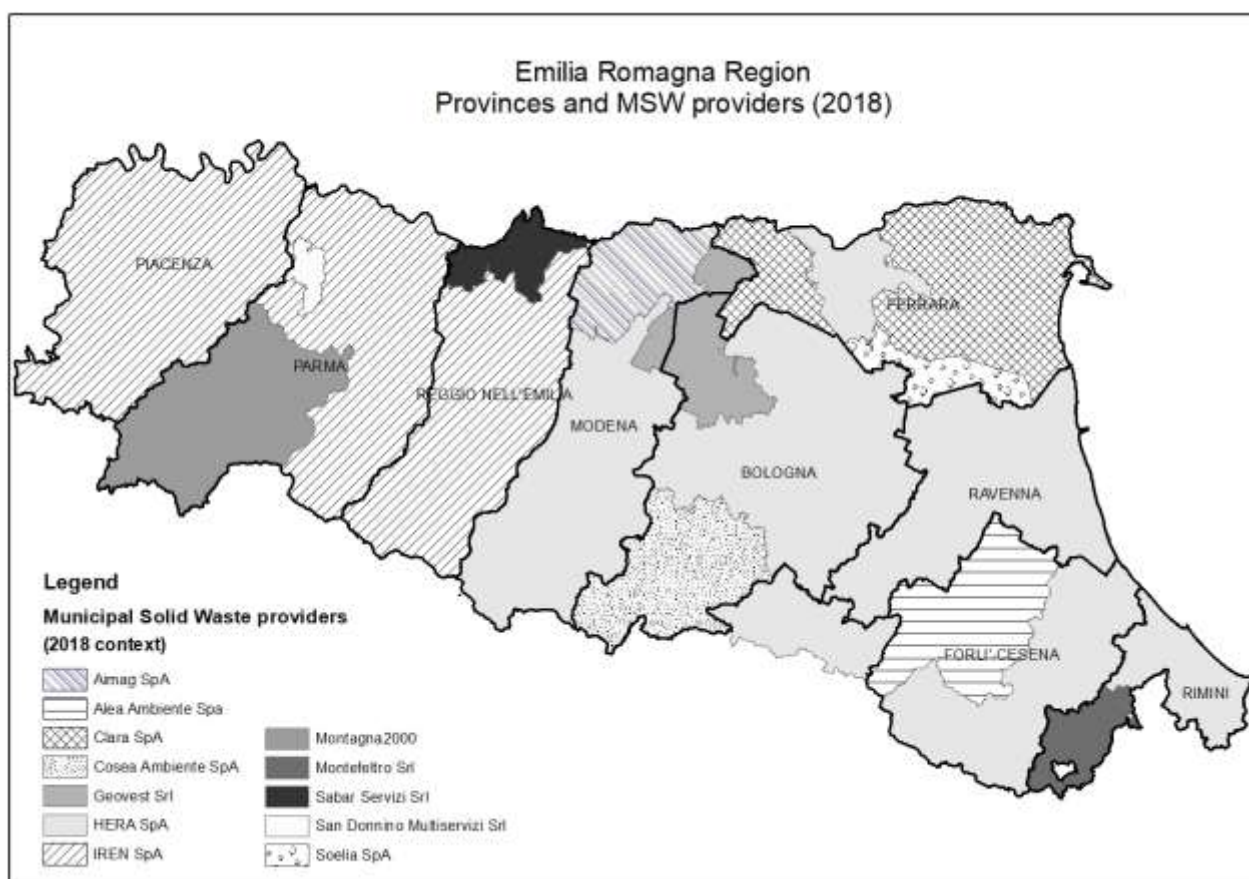


Figure S1- Map of Emilia-Romagna region, its Provinces and MSW providers' situation in 2018.

Table S1 Number of ATOs, SOTAs, service providers, and presence of regulatory agencies of OTA in the selected Italian Regions. Source: Invitalia, 2019

Italian region	Population (2014)	Number of ATOs	Number of SOTAs	Service providers	Regulatory agency operating
Emilia-Romagna	4.450.508	1	26	14	Operating
Lombardia	10.002.615	-	146	67	-
Veneto	4.881.756	12	17	18	Operating
Toscana	1.230.943	3	12	10	operating
Umbria	886.239	1	7	9	Operating
Friuli-Venezia Giulia	1.221.860	1	9	8	Operating
Liguria	1.565.127	1	37	21	Operating
Marche	309.031	5	52	21	4 out of 5 operating
Province of Trento	117.285	1	13	9	Operating

Table S2 Number and percentage of Municipalities analysed for the economic assessment, and number and percentage of Municipalities whose data do not come from financial-economic plans. Source: authors' elaboration.

YEAR	Number of Municipalities considered for total cost, and percentage out of total Municipalities in the region		Number of Municipalities considered for cost of treatment and disposal of unsorted waste (CTS) and percentage out of total Municipalities in the region		Number of Municipalities whose data come from regional database, for total cost, and percentage out of total Municipalities considered		Number of Municipalities whose data come from regional database, for CTS, and percentage out of total Municipalities considered	
2008	341	100%	295	86,51%	154	45,16%	169	57,29%
2009	339	99,41%	289	84,75%	165	48,67%	167	57,79%
2010	346	99,43%	309	88,79%	173	50,00%	233	75,40%
2011	344	98,85%	308	88,51%	153	44,48%	257	83,44%
2012	348	100%	313	89,94%	226	64,94%	244	77,96%
2013	348	100%	348	100%	0	0	0	0
2014	340	100%	340	100%	0	0	0	0
2015	340	100%	340	100%	0	0	0	0
2016	334	100%	334	100%	0	0	0	0
2017	333	100%	333	100%	0	0	0	0
2018	331	100%	331	100%	0	0	0	0

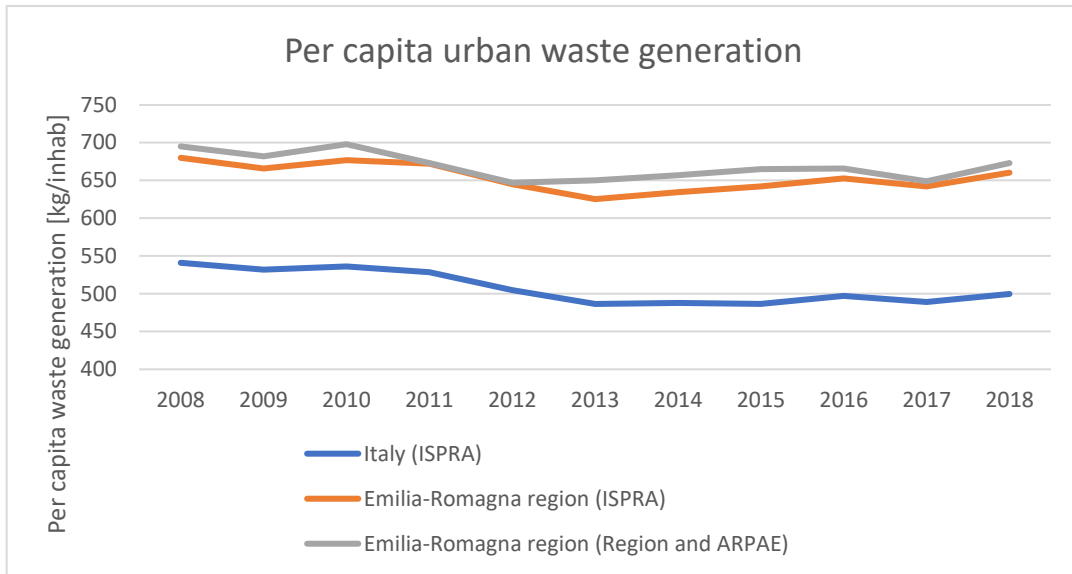


Figure S2- Comparison between Italy and Emilia-Romagna region, considering per capita urban waste generation. Source: authors' elaboration based on Emilia-Romagna Region and ISPRA data (ISPRA, 2020a).

Table S3 - Average touristic presence, grouped by Province, in 2018. Source: Emilia-Romagna region, 2019.

Province	Average daily value of guests in hotels and complementary structures
Piacenza	1.476
Parma	4.515
Reggio Emilia	2.317
Modena	4.434
Bologna	12.957
Ferrara	7.987
Ravenna	18.298
Forli-Cesena	15.047
Rimini	44.332

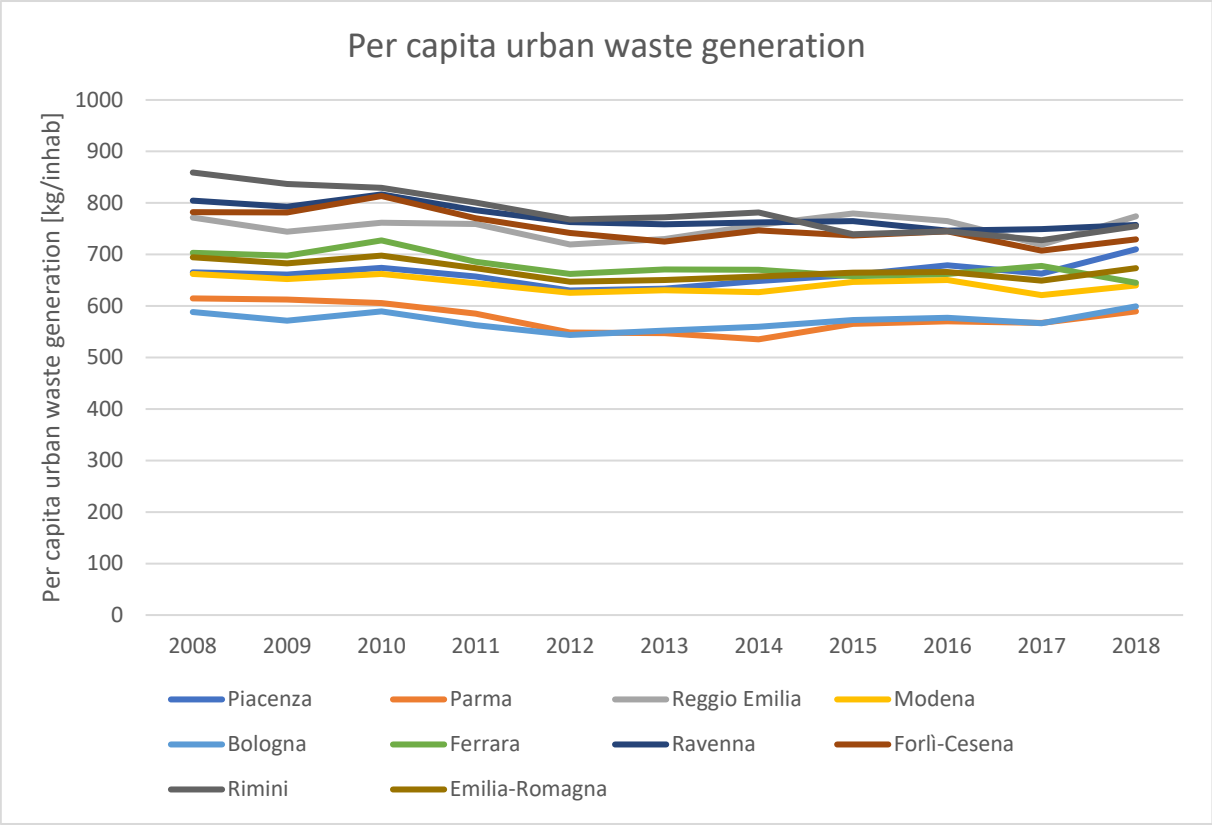


Figure S3- Trend of per capita waste generation in Emilia-Romagna and in the Provinces. Source: authors' elaboration based on Emilia-Romagna Region data.

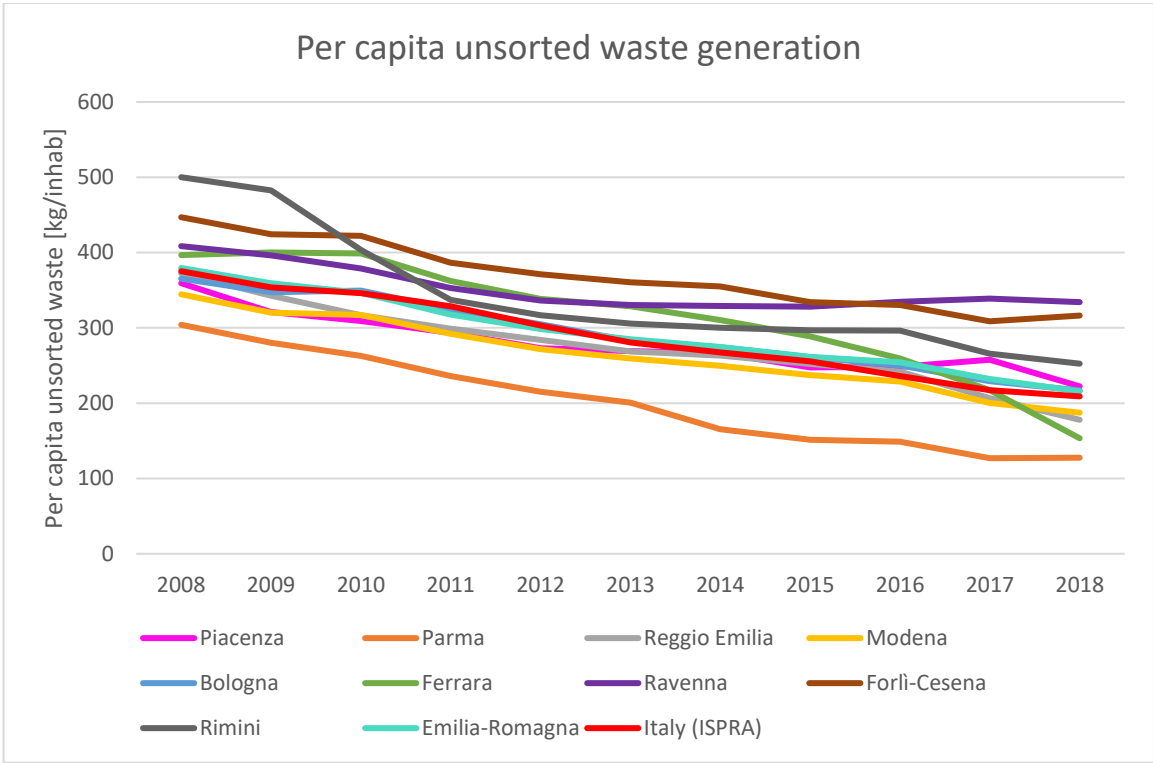


Figure S4- Trend of unsorted waste per capita generation, in the Emilia-Romagna region, in the provinces and in Italy 2008-2018. Source: authors' elaboration based on Emilia-Romagna Region and ISPRA data (ISPRA, 2020a).

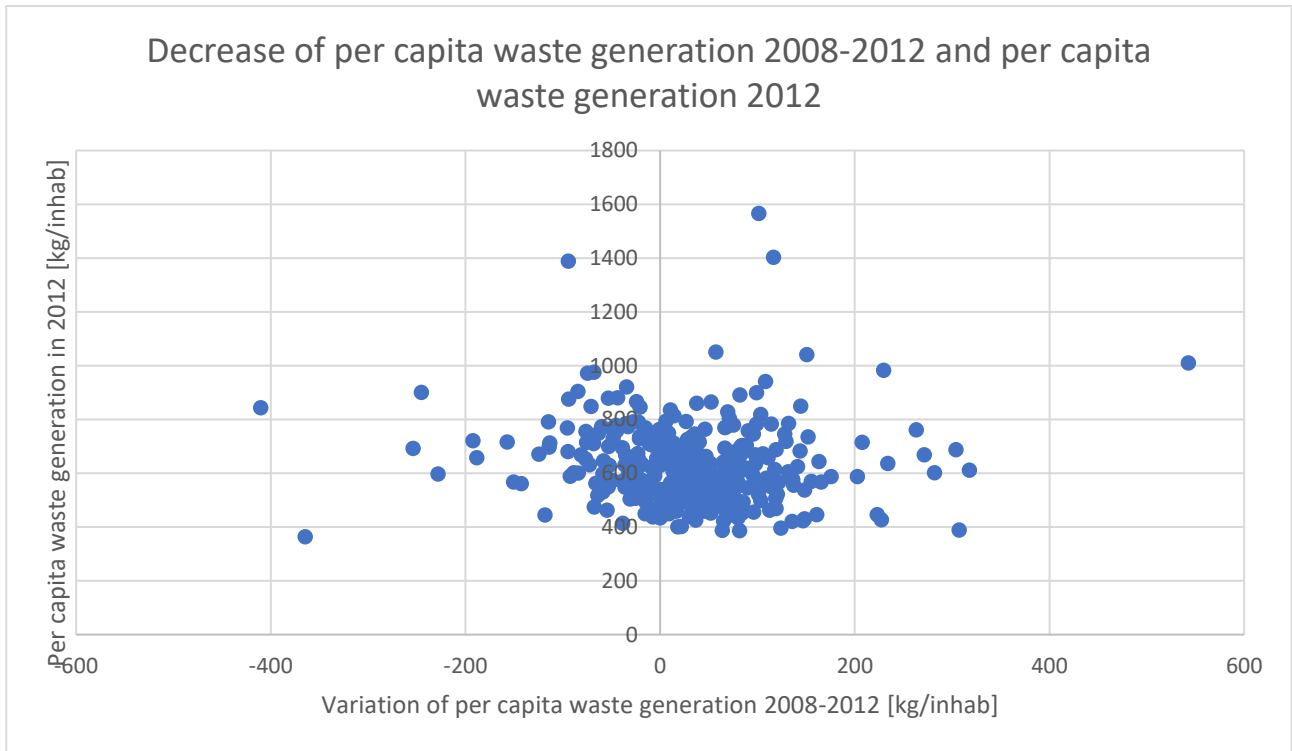


Figure S5 - Variation of per capita waste generation (2008-2012) and per capita waste generation (2012), for each Municipality in the Emilia-Romagna region (each dot represents a Municipality). Source: authors' elaboration based on Emilia-Romagna Region data.

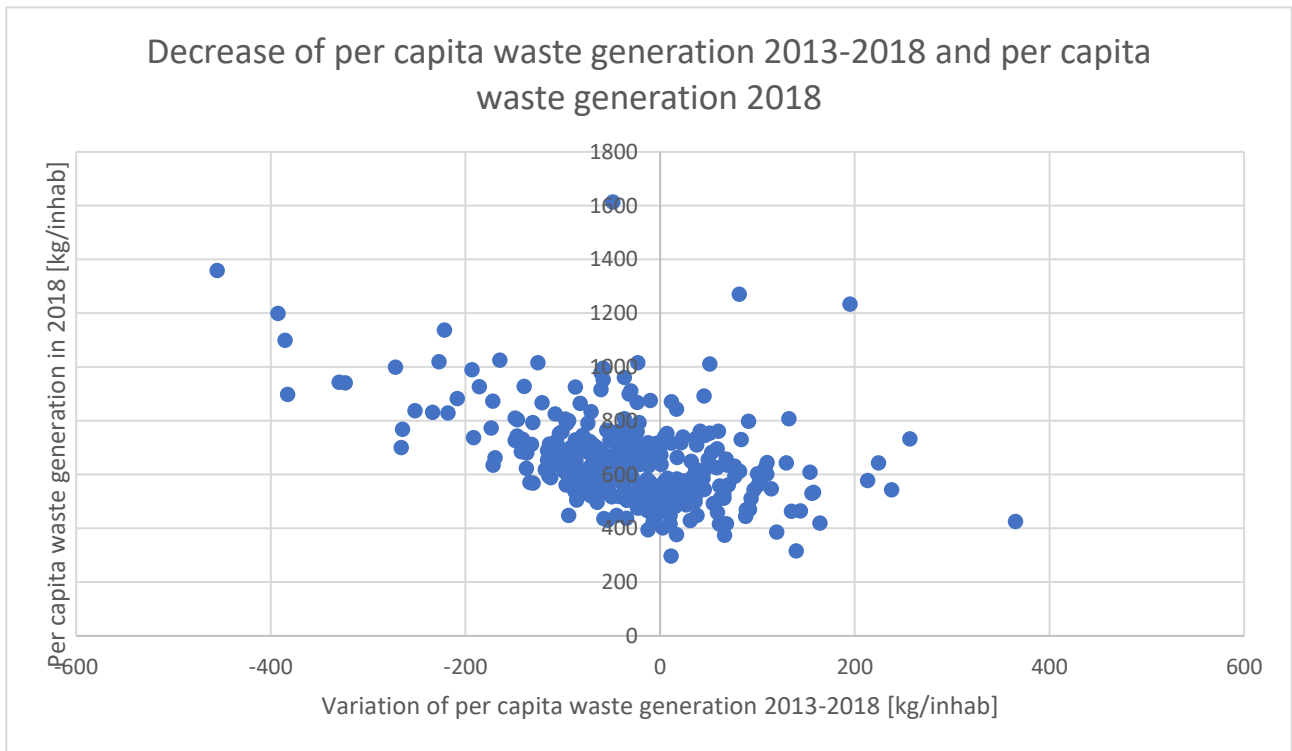


Figure S6 - Variation of per capita waste generation (2013-2018) and per capita waste generation (2018), for each Municipality in the Emilia-Romagna region (each dot represents a Municipality). Source: authors' elaboration based on Emilia-Romagna Region data.

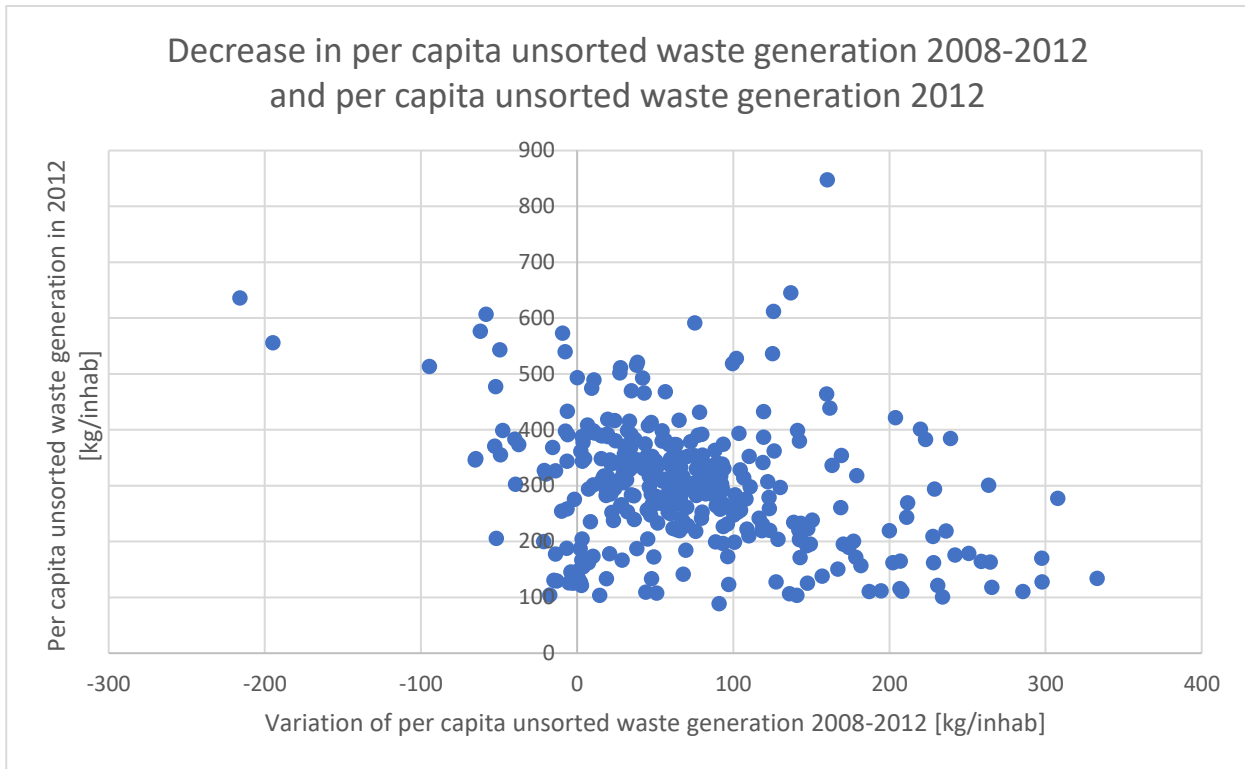


Figure S7 - Variation of per capita unsorted waste generation (2008-2012) and per capita unsorted waste generation (2012), for each Municipality in the Emilia-Romagna region (each dot represents a Municipality). Source: authors' elaboration based on Emilia-Romagna Region data.

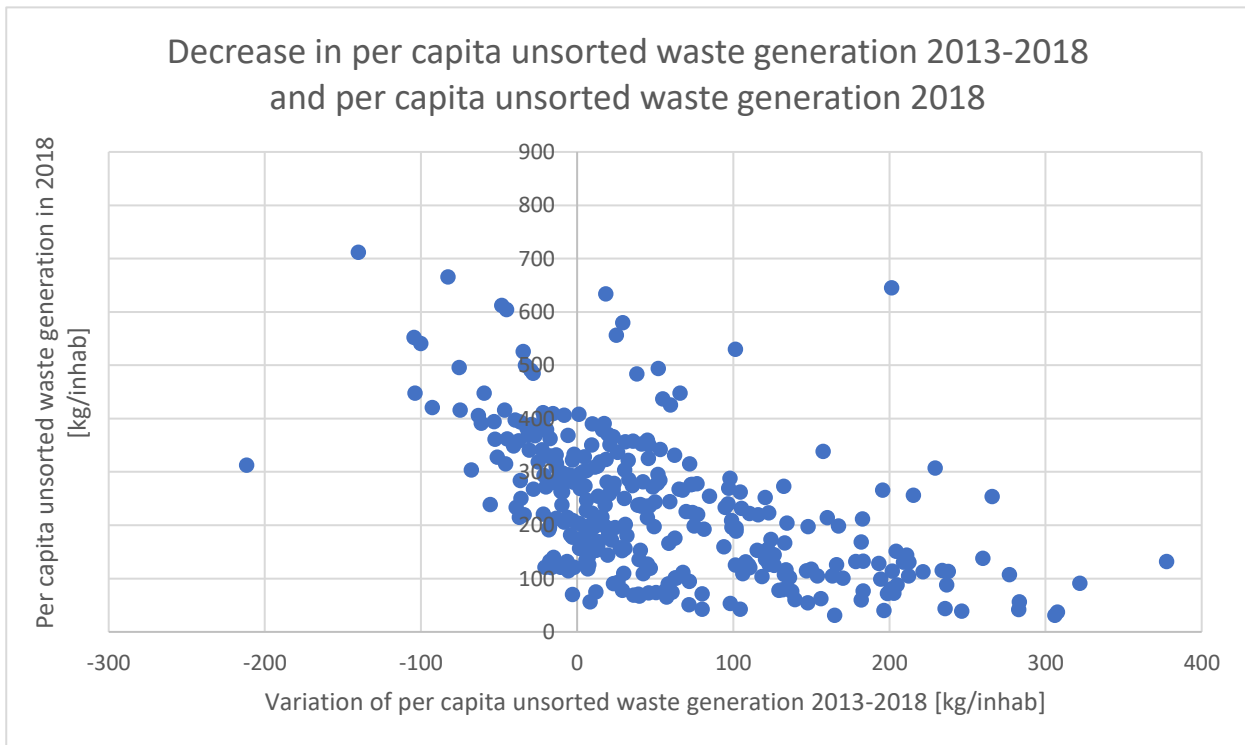


Figure S8 - Variation of per capita unsorted waste generation (2013-2018) and per capita unsorted waste generation (2018), for each Municipality in the Emilia-Romagna region (each dot represents a Municipality). Source: authors' elaboration based on Emilia-Romagna Region data.

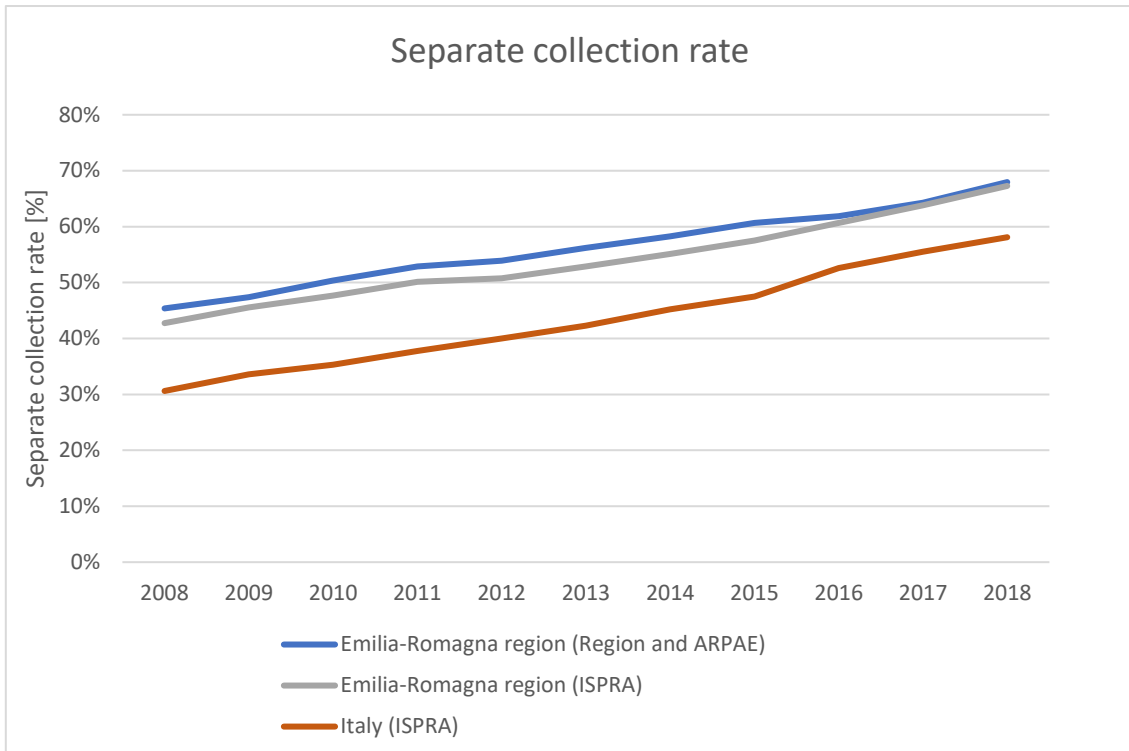


Figure S9- Comparison between Italy and Emilia-Romagna region, considering separate collection rate. Source: authors' elaboration based on Emilia-Romagna Region and ISPRA data (ISPRA, 2020a).

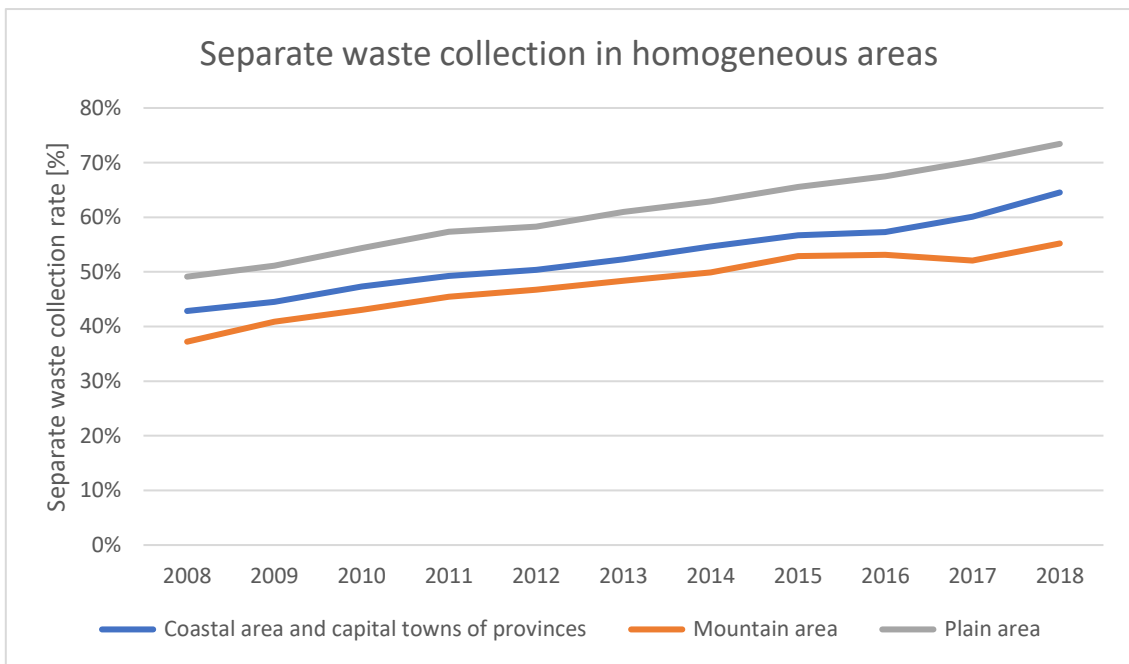


Figure S10- Trend of separate waste collection rate, in the “homogeneous areas” of Emilia-Romagna.

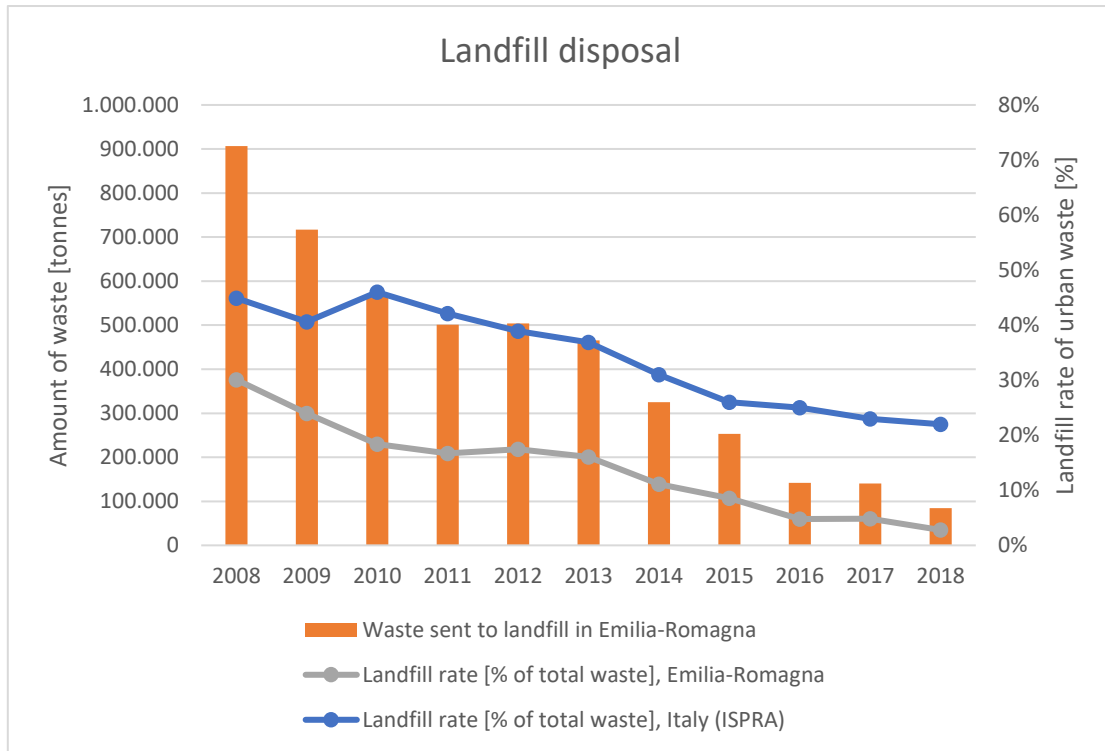


Figure S11- Trend of landfill disposal, in the Emilia-Romagna region and in Italy, 2008-2018. Source: authors' elaboration based on Emilia-Romagna Region and ISPRA data (ISPRA, 2020b).

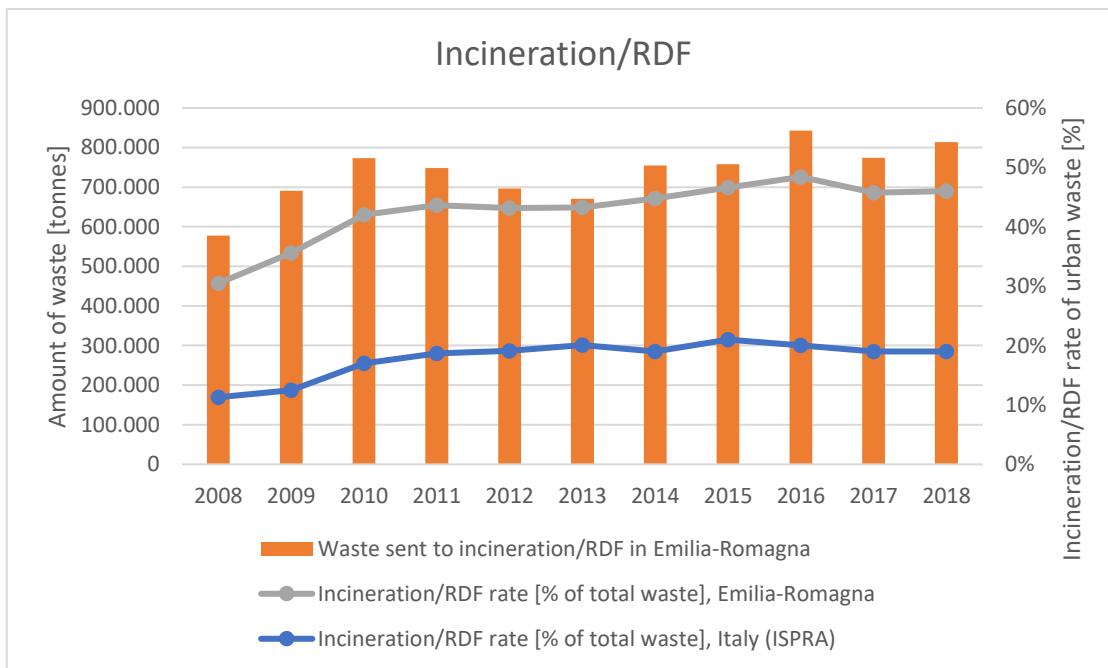


Figure S12- Trend of incineration/RDF, in the Emilia-Romagna region and in Italy, 2008-2018. Source: authors' elaboration based on Emilia-Romagna Region and ISPRA data (ISPRA, 2020b).

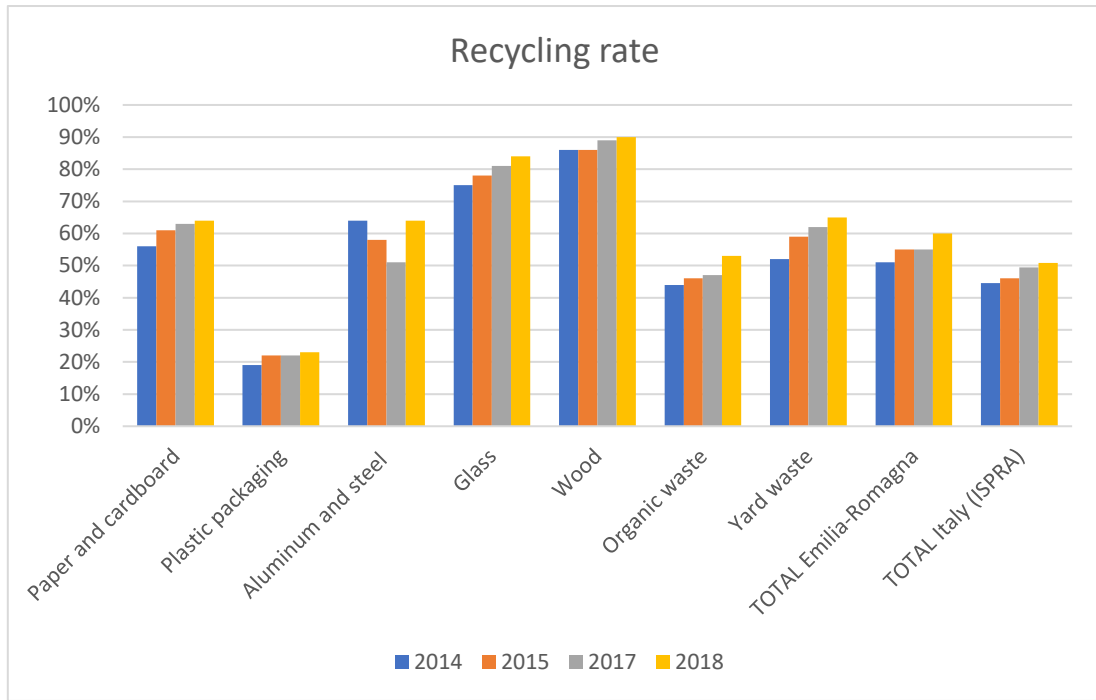


Figure S13- Trend of recycling rate for some waste flows, in the Emilia-Romagna region and in Italy, 2014-2018. Source: authors' elaboration based on Emilia-Romagna Region data and ISPRA data (ISPRA, 2020b).

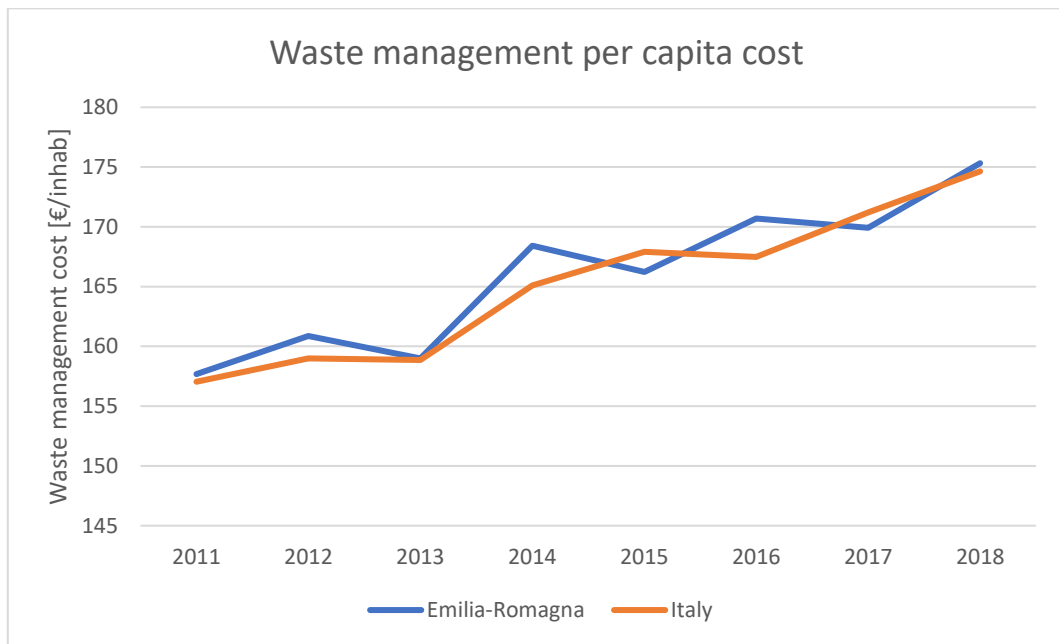


Figure S14- Comparison between Italy and Emilia-Romagna region, considering per capita waste management cost. Source: ISPRA, 2019.

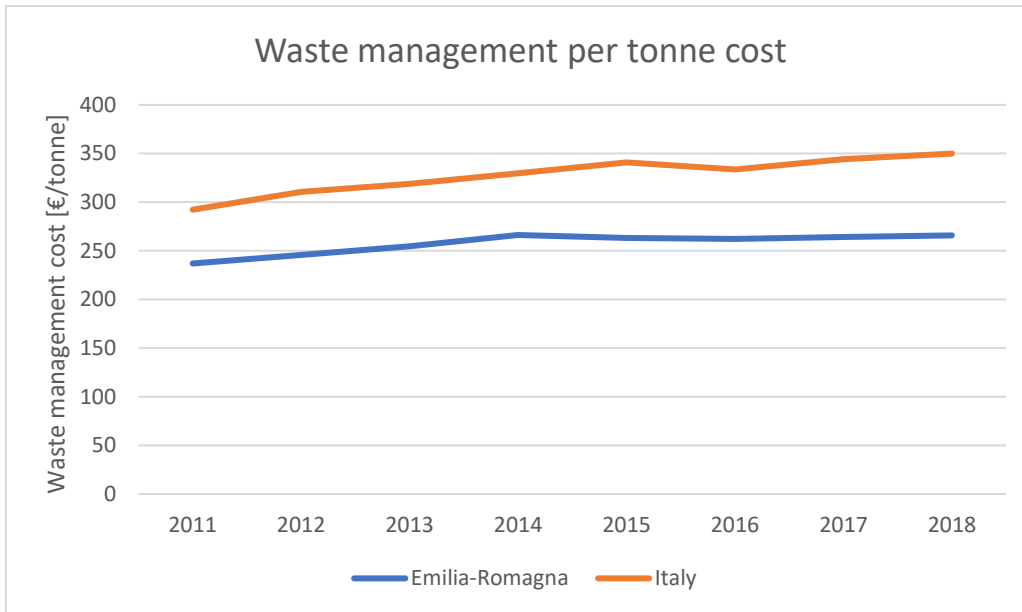


Figure S15- Comparison between Italy and Emilia-Romagna region, considering per tonne waste management cost. Source: ISPRA, 2019.

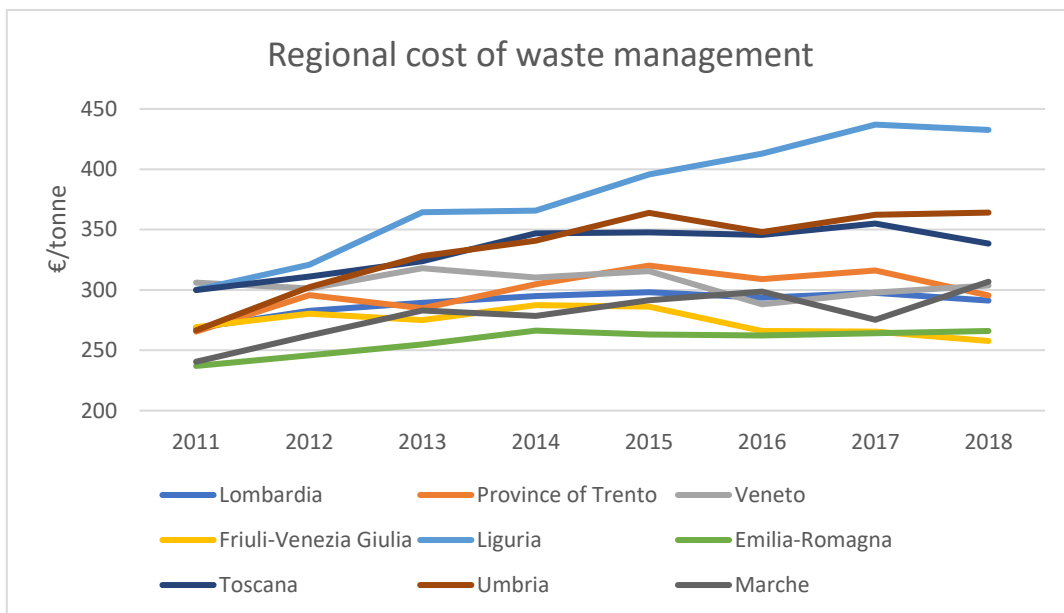


Figure S16- Average of per tonne cost of waste management for some Italian Regions, at municipal level. Source: authors' elaboration on ISPRA, 2019

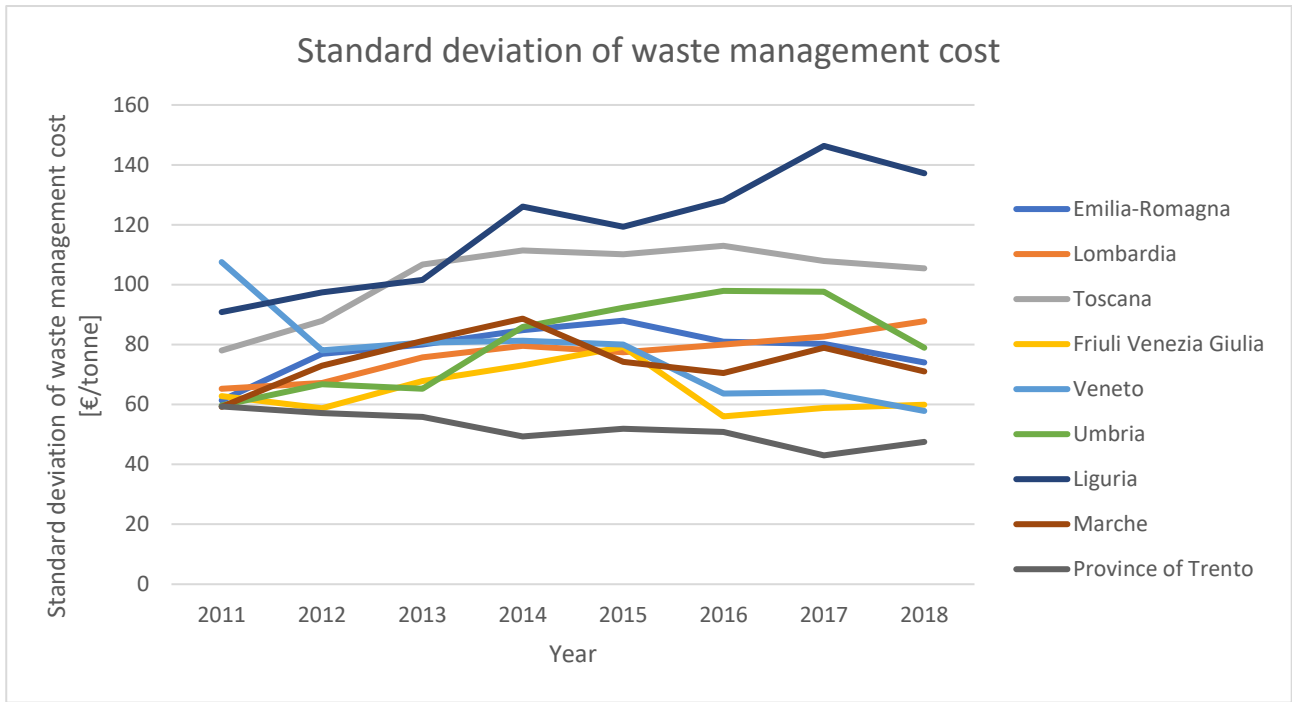


Figure S17- Standard deviation of per tonne cost of waste management for some Italian regions, at municipal level. Source: authors' elaboration on ISPRA, 2019

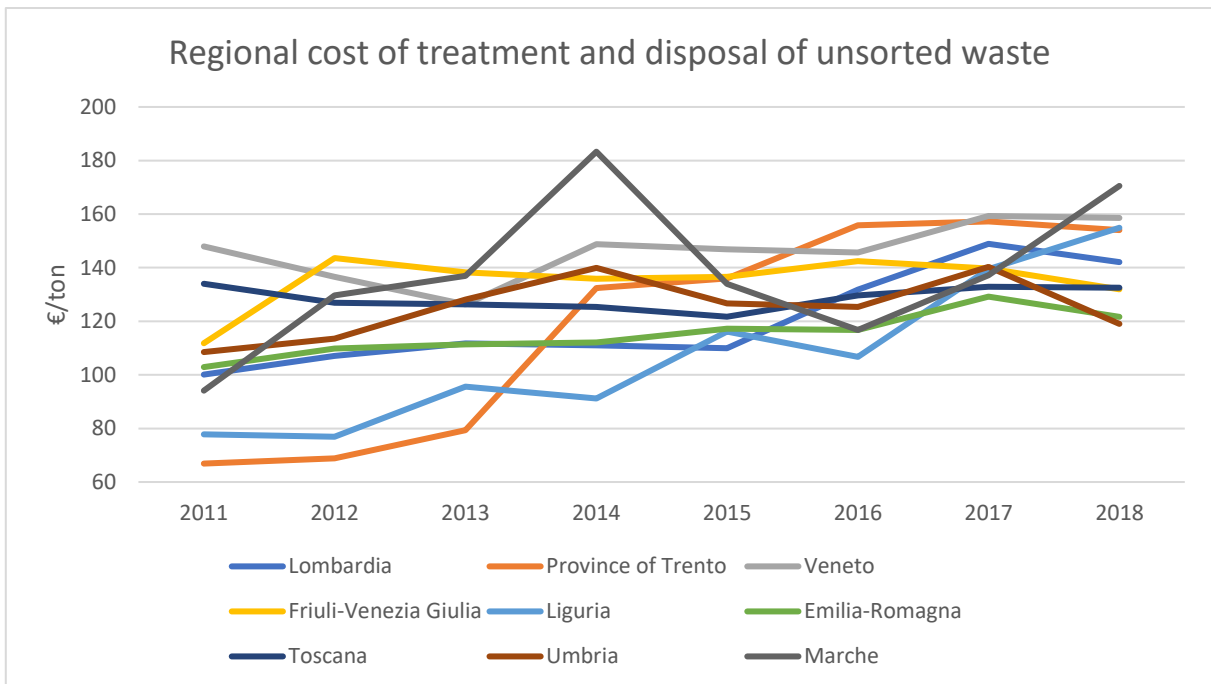


Figure S18- Average of per tonne cost of treatment and disposal of unsorted waste for some Italian Regions, at municipal level. Source: authors' elaboration on ISPRA, 2019

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