D4.6 – Pan-European scenarios of food waste levels

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FW	Food Waste
FSC	Food Supply Chain
GDP	Gross Domestic Product
NUTS 2	Nomenclature of territorial units for statistics 2
PPP	Purchasing Power Parity

Executive summary

REFRESH is an EU research project dedicated to contributing to the achievement of the Target 3 of Sustainable Development Goal 12, which aims to halve per capita food waste at the retail and consumer level as well as to reduce food losses along the food chain by 2030. Partners across Europe are collecting data on methods to decrease or repurpose food waste.

In developed countries an estimated 30 to 40% of food is wasted. About half of this waste stems from consumers, while the remaining part is lost through the other phases of the Food Supply Chain (FSC): farm practices, transport and processing, and the retail sector (Godfray et al. 2010; Gustavsson et al. 2011). To meet target 12.3 of the Sustainable Development Goals, a better understanding of food waste drivers is needed, both at the consumer and at the retail level. More importantly, the effectiveness of interventions designed to reduce food waste at every level of the FSC needs to be assessed.

Research on food waste faces several issues. On one side, large number of factors influences the behaviour of the actors in the Food Supply Chain, on the other side, food waste research often lacks reliable data on the amounts of food wasted along FSC. These limitations can be overcome using a simulation approach to predict household food waste levels.

Pan-European scenarios of food waste levels

This work is part of a collection of reports on household food waste prediction for EU28, Member Countries and European Regions. The collection consists of a methodological report, *REFRESH D4.8 - A roadmap to reduce food waste in Europe*, which represents the theoretical base for two additional reports, *REFRESH D4.6 Pan-European scenarios of food waste levels* and *REFRESH D4.7 A pan-European simulation of selected interventions*, where food waste scenarios for EU28 and for each European Country are presented.

In particular, this work collects 29 single food waste scenarios (28 Country scenarios and a prediction scenario related to the whole EU-28). Scenarios, describing kilograms of food wasted every year by an average household, are based on predictions of food waste levels conducted considering the current values of different socioeconomic and demographic factors: GDP (euros at purchasing power parity), the national tertiary education rates, national employment rate, average household size and house ownership status. No external intervention aimed at reducing the quantity of food waste is considered.

Method and limitations

Methodologies and results presented in this work are based on *REFRESH D4.8 - A roadmap to reduce food waste in Europe.* These simulations represent a first attempt to develop food waste predictions in the European Union and its Member States. The roadmap, published on line[1], includes a web-based user-friendly tool rooted on a Bayesian hierarchical mixed-effects modelling approach, derived from previous REFRESH works (*REFRESH D4.3 Model integration - Integrated socio-economic model on food waste* and *REFRESH D4.4 Behavioural Economics: Linking Bayesian and agent-based models to assess consumer food waste)*.

To overcome the data availability constraint and to gather data in a suitable format for the development of the model, UK data derived from WRAP (2013) relative to household food waste in UK in 2012 has been utilized. After a number of simulations this dataset proved to be the most reliable to address the needs of the hierarchical mixed-effects modelling approach.

The underlying assumption of this choice implies a general similarity between European countries. However, considering the complexity of factors driving households' behaviour and decisions concerning food consumption and management, trends in UK data may not accurately reflect household food waste variations elsewhere. Food waste behaviours are affected by several determinants concerning economic, cultural and social factors, which are in turn influenced by the community where consumers belong. Therefore, utilization of the UK dataset as a proxy to extend food waste data to other EU countries also represents a potential source of bias. In order to address this issue, a pan-European, standardized study design, – as also advocated by Reynolds et al., (2019)- may improve generality, facilitate interpretation, and provide more robust predictions of household food waste capturing underlying socio-economic characteristics at national and regional scales.

So, further research should focus on collecting reliable and validated data on food waste in different Regions and Countries, with the aim to better understand the local peculiarities of food waste habits, both at consumers and retail levels.

However, despite this limitation, the model provides a set of new and interesting information regarding the influence of socio-economic determinants on food waste generation, potentially suggesting some of the targets that policy interventions might consider to prioritize.

[1] https://refresh-determinants-of-consumers-food-waste.shinyapps.io/predicted_food_waste/

1 Introduction

Food waste (FW) is a widespread and complex problem, which relates to the functioning of the food supply chain (FSC) as a whole. Estimates suggest that, in the EU-28, annual FW amounts to 88 million tonnes, i.e. 173 kilograms per person (Stenmarck et al., 2016). Food waste has become a major global concern because of its diversified and interconnected implications on the different FSCs (Canali et al., 2016; Parfitt et al., 2010; Piras et al., 2016).

The generation of food waste stems from a complex set of interacting behaviours of both food consumers and suppliers. Therefore, systemic approaches might have the potential to capture this complexity in a more comprehensive and reliable manner (Grainger et al., 2018).

A combination of approaches based on Bayesian Networks (BN) and Agent Based Models (ABM) can represent an effective way to understand the drivers that underpin the FW phenomenon

While being powerful tools for the analysis of complex systems, these modelling approaches require reliable data to be able to produce robust predictions.

Following these approaches, integrated models of household food waste as an emergent property of a complex system were generated. Machine learnt Bayesian Networks and Agent Based Models were utilized to develop systems maps of the consumer food waste nexus. Through those models, different linkages were emphasised both in the retail environment and in the home predicted food waste. Therefore, modelling of consumer behaviour should not be restricted to a single environment and the key element for each of them should be identified.

Finally, an integrated whole-of-system modelling approach was built to allow the creation of a decision-relevant and dynamic support tool as base for the development of a road map to the reduction of European FW by 50% by 2030.

A first version of the integrated model was developed in Grainger et al. (2018)**.** As stated above, the use of a simulation approach is crucial for assessing food waste since empirical data are still limited in scale or have a high potential for bias (such as self-reported consumer food waste). This leads to high levels of uncertainty in the available data, additional to the complexity associated with understanding the socio-economic drivers of food waste.

Bayesian Networks (BNs) can incorporate uncertainty and complexity in the model structure, but they are less effective at incorporating behavioural factors (i.e. specific biases of single actors, and interactions among actors) and temporal dynamics (interactions among variables or actors across time). For these types of information, Agent-Based Models (ABMs) are much better suited. To represent food system complexity more accurately whilst incorporating interactions among and within actors (businesses, consumers, etc.), a BNs-ABMs dynamic interaction proved to be a suitable method (Grainger et al., 2018).

These modelling developments represented the basis for the structure of the REFRESH Roadmap, presented in *REFRESH D4.8 - A roadmap to reduce food waste in Europe,* which is focused on food waste generation at the household level and

allows simulations - based on a Bayesian hierarchical mixed-effects modelling approach - that quantify the relationships between socioeconomic and demographic indicators and household food waste.

Starting from this roadmap, a web-based, user-friendly tool simulating household food waste generation at the Regional, National and European level has been developed. This web-based tool allows to simulate a number of different scenarios, based on a set of socioeconomic variables, such as income per capita, tertiary education rate and national employment rate.

Methodological background

This work is part of a collection of reports on household food waste prediction for EU28, Member Countries and European Regions. The collection consists of a methodological report, *REFRESH D4.8 - A roadmap to reduce food waste in Europe*, which represents the theoretical base for two additional reports, *REFRESH D4.6 Pan-European scenarios of food waste levels* and *REFRESH D4.7 A pan-European simulation of selected interventions*, where food waste scenarios both for EU28 and for each single European Country are presented.

Moreover, methodologies and results presented in *REFRESH D4.8 - A roadmap to reduce food waste in Europe* are built on the results presented in *REFRESH D4.3 Model integration - Integrated socio-economic model on food waste* and in *REFRESH D4.4 Behavioural Economics: Linking Bayesian and agent-based models to assess consumer food waste.*

Limitations and future developments of the hierarchical mixed-effects modelling approach

The hierarchical mixed-effects modelling approach utilized to develop these estimations represents a first attempt to predict food waste at the EU level using a simulation model and it had to face, among others, important limitations in terms of data availability on food waste amounts.

To overcome the data availability constraint in a format suitable for the development of the model, UK data derived from WRAP (2013) *Household food and drink waste in the UK 2012* has been used. This choice is due to the statistical characteristics of WRAP dataset: while being UK specific, this data has the principal advantage of providing a validated measure of household food waste. Such a feature makes this dataset reliable for the simulation approach adopted in the roadmap, despite its limited territorial coverage.

The underlying assumption of this choice implies a general similarity between European countries. However, considering the complexity of factors driving households' behaviour and decisions concerning food consumption and management, trends in UK data may not accurately reflect household food waste variations elsewhere. Food waste behaviours are affected by several determinants concerning economic, cultural and social factors, which are often in turn influenced by the community where consumers belong. Therefore, utilization of the UK dataset as a proxy to extend food waste data to other EU countries represents also a potential source of bias. In order to address this likely source of bias, a pan-European, standardized study design, – as also advocated by Reynolds et al. (2019) - may improve generality, facilitate interpretation, and provide more robust

predictions of household food waste that capture underlying socio-economic characteristics at national and regional scales.

However, despite this limitation, the model provides a set of new information regarding the influence of socio-economic determinants on food waste generation. Furthermore, the model can suggest some of the targets that policy interventions might consider to prioritize.

To increase the reliability of the results obtained through the roadmap, future research should focus on obtaining more consistent national data on food waste and on the impact of food waste reduction interventions. Research on the impact of interventions is particularly urgent since there is a scarcity of reliable and solid quantitative data able to improve the predictive capacity of the model.

2 European Union

According to 2017 Eurostat data, the EU population amounts to **511,373,278**. The Gross Domestic Product (GDP) per capita on purchasing power parity is **29,500** euro at the European level, with consistent regional differences, ranging from **14,500** euro per capita in Bulgaria to **74,500** euro per capita in Luxemburg.
There are **221,430,500** households, with an average size of **2.3** persons.
The average employment rate is **61.1%**, while the level of tertiary education is **32.3%.** Table 2-1 summarizes the baseline values disclosed on Eurostat data.

Table 2-1: EU28 – parameters for FW estimation at European level

Country	GDP PPP (Eur)	Tertiary education level	Median age	Population	N° of households
Austria	37,400	32.7%	43.0	8,772,865	3,915,500
Belgium	34,300	40.6%	41.5	11,351,727	4,761,700
Bulgaria	14,500	28.2%	43.9	7,101,859	2,905,400
Cyprus	25,000	44.1%	37.4	854,802	321,200
Czech Republic	26,400	24.3%	41.9	10,578,820	4,699,000
Germany	36,400	29.1%	45.9	82,521,653	40,722,600
Denmark	37,700	39.7%	41.6	5,748,769	2,395,900
Estonia	23,200	41.2%	41.8	1,315,635	584,000
Greece	19,800	31.7%	44.2	10,768,193	4,393,900
Finland	32,100	44.5%	42.5	5,503,297	18,512,500
France	30,600	36.9%	41.4	66,804,121	2,655,500
Croatia	18,200	25.4%	43.4	4,154,213	29,375,800
Hungary	20,000	25.1%	42.3	9,797,561	1,471,600
Ireland	53,300	46.9%	36.9	4,784,383	4,131,400
Italy	28,400	19.3%	45.9	60,589,445	1,795,000
Lithuania	23,000	41.7%	43.4	2,847,904	25,864,700
Luxembourg	74,500	44.1%	39.4	590,667	1,357,000
Latvia	19,600	33.9%	43.1	1,950,116	242,400

Malta	28,700	26.3%	40.6	460,297	850,100
The Netherlands	37,700	38.3%	42.5	17,081,507	183,400
Poland	20,500	30.9%	40.3	37,972,964	3,100,052
Portugal	22,600	25.0%	44.4	10,309,573	14,465,800
Romania	18,400	17.8%	41.8	19,644,350	4,102,700
Spain	27,100	37.3%	43.2	46,528,024	7,482,400
Sweden	35,600	43.3%	40.8	9,995,153	4,862,700
Slovenia	25,100	32.5%	43.5	2,065,895	881,100
Slovakia	22,400	24.6%	39.8	5,435,343	1,874,500
United Kingdom	31,100	43.2%	40.0	65,844,142	28,830,100
EU 28 and Norway	**29,500**	**32.3%**	**42.8**	**511,373,278**	**221,430,500**

Source: author's elaboration on Eurostat data

Figure 1 and Table 2-2 summarize the food waste estimations for the European Union, both at the national and EU level, as developed on the basis of simulations run with the REFRESH Road Map (Stewart et al. 2019).

Figure 1: estimated FW per household per week in the EU

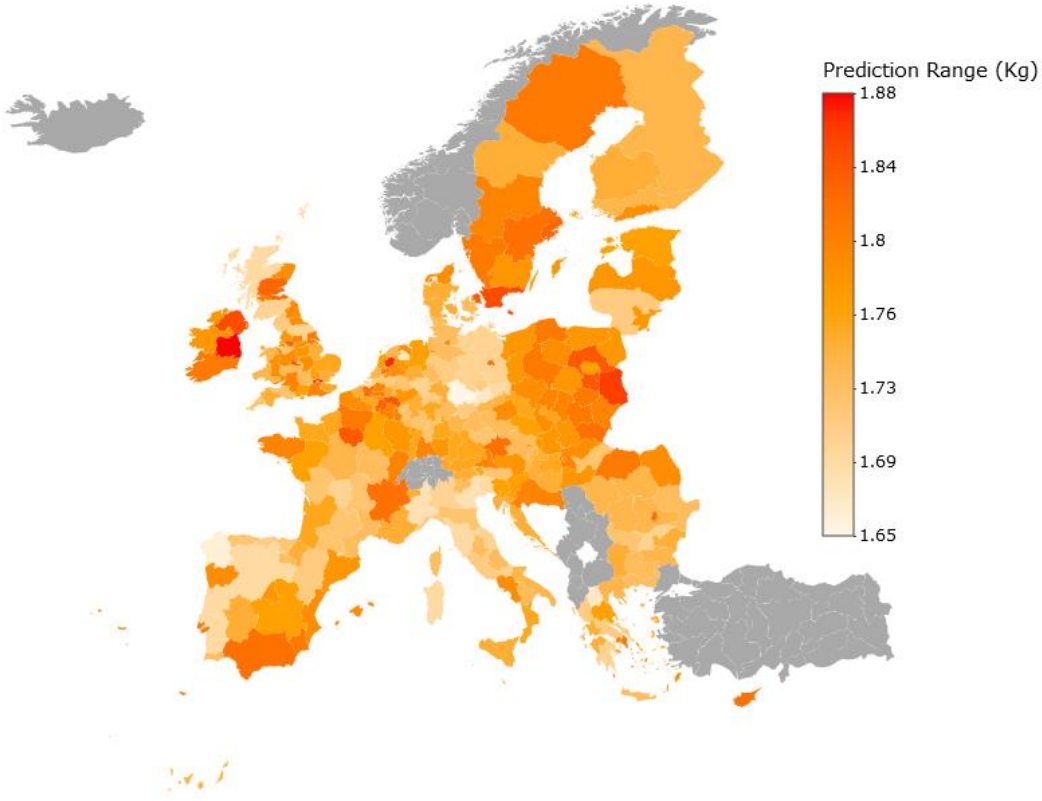

Table 2-2: EU28 –FW estimation at European level

Country	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/ year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Ireland	131.04	78.52	144.82	235,217	140,943	259,952
Cyprus	131.04	117.52	145.08	42,090	37,747	46,600
Malta	129.48	77.31	143.52	23,747	14,178	26,322
Poland	129.48	77.31	143.00	1,873,032	1,118,303	2,068,609
Slovakia	128.96	77.31	142.74	241,736	144,911	267,566
Croatia	127.40	76.27	141.18	187,482	112,234	207,760
Portugal	125.84	75.05	139.36	516,284	307,921	571,752
Romania	122.20	76.44	141.70	914,349	571,955	1,060,256
Spain	122.20	76.27	141.44	2,262,228	1,411,887	2,618,408
Belgium	98.54	56.85	112.32	469,218	270,719	534,834

Latvia	98.28	56.85	111.80	83,548	48,331	95,041
Norway	98.02	56.51	111.54	303,867	175,174	345,780
France	97.76	56.33	111.80	2,871,778	1,654,837	3,284,214
Lithuania	97.76	56.33	111.28	132,660	76,444	151,007
Slovenia	97.76	56.33	111.28	86,136	49,635	98,049
United Kingdom	97.76	56.16	111.28	2,818,431	1,619,098	3,208,214
Sweden	97.50	56.16	111.28	474,113	273,089	541,121
Hungary	97.24	56.16	111.02	401,737	232,019	458,668
Denmark	96.98	55.81	110.76	232,354	133,723	265,370
Estonia	96.72	55.47	110.76	56,484	32,393	64,684
The Netherlands	96.72	55.64	110.24	756,254	435,049	861,967
Finland	96.46	55.47	110.24	256,150	147,292	292,742
Greece	96.46	55.47	110.24	423,836	243,715	484,384
Austria	95.94	55.12	109.72	375,653	215,822	429,609
Bulgaria	95.16	54.43	108.68	276,478	158,131	315,759
Italy	94.64	54.08	108.16	2,447,835	1,398,763	2,797,526
Deutschland	94.12	53.73	107.64	3,832,811	2,188,161	4,383,381
Luxembourg	93.08	39.78	107.12	22,563	9,643	25,966
Czech Republic	91.00	55.64	110.24	427,609	261,452	518,018
EU 28	**98.02**	**56.46**	**111.71**	**21,705,610**	**12,502,226**	**24,735,250**

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for the EU 28, considering the current national values for GDP per capita and higher education level amounts to about **21,851,353** tons per year.
At the national level, Czech Republic has the lowest estimated values of household food waste, with an average value of **91** kg per year, while Ireland and Cyprus shows the highest value of **131.04** kg per year.

3 Austria

Austria is divided in 9 regions (NUTS 2): Burgenland, Lower Austria, Vienna, Carinthia, Styria, Upper Austria, Salzburg, Tyrol, and Vorarlberg.
According to 2017 Eurostat data, the population amounts to **8,772,865** The Gross Domestic Product (GDP) per capita on purchasing power parity is **37,400** euro at the regional level, with consistent regional differences, ranging from **26,600** euro per capita in Burgenland to **44,500** euro per capita of the Salzburg region.
There are **3,915,5002** households, with an average size of**.2.3** persons, and the number of households is, according to Eurostat data.
The average employment rate is **73%**, while the level of tertiary education is **32.7%**. Table 3-1 summarizes the baseline values disclosed on Eurostat data.

Table 3-1: Austria - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Burgenland	26,600	28.4%	46.7	291,942	124,700
Lower Austria	30,500	31.9%	44.9	1,665,753	722,300
Carinthia	32,000	30.6%	46.3	561,077	252,300
Styria	33,900	28.7%	44.5	1,237,298	544,200
Upper Austria	38,300	29.0%	43.0	1,465,045	631,900
Salzburg	44,500	32.3%	42.8	549,263	239,200
Tyrol	40,100	29.9%	42.0	746,153	325,000
Vorarlberg	39,900	27.6%	41.4	388,752	166,800
Vienna	44,400	42.3%	39.6	1,867,582	909,200
Austria	37,400	32.7%	43.0	8,772,865	3,915,500

Source: author's elaboration on Eurostat data

Figure 2 and Table 3-2 summarize the food waste estimations for the country, both at the regional and national level, as developed on the basis of simulations run with the REFRESH Road Map (Stewart et al. 2019).

Figure 2: estimated FW per household in Austrian regions

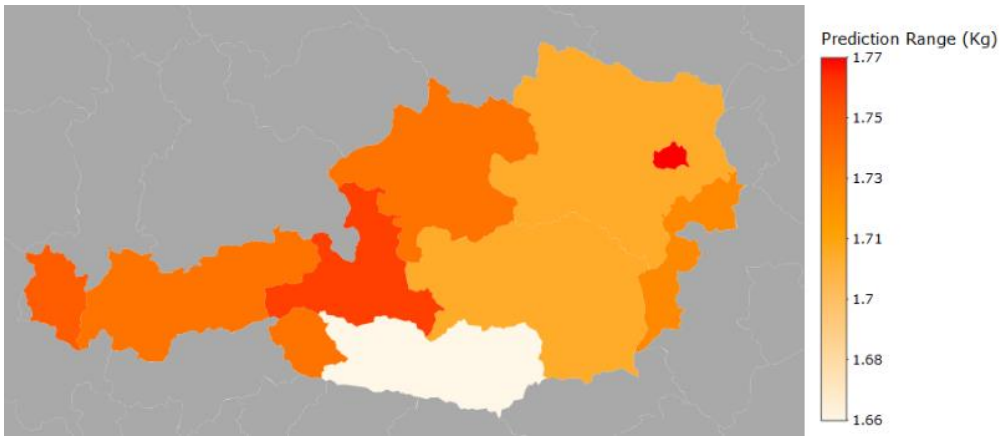

Table 3-2: Austria – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Vienna	99.84	57.72	113.36	90,538	52,321	103,067
Upper Austria	98.28	56.68	111.8	62,103	35,926	70,646
Salzburg	97.76	56.68	111.28	23,384	13,516	26,618
Vorarlberg	97.76	56.68	111.28	16,306	9,454	18,562
Carinthia	96.72	55.64	109.72	24,337	14,082	27,682
Lower Austria	96.20	55.64	109.72	69,485	40,064	79,251
Tyrol	96.20	55.64	109.72	31,265	18,027	35,659
Burgenland	96.20	55.64	109.72	11,996	6,917	13,682
Styria	94.64	54.08	108.16	51,503	29,525	58,861
Austria	95.94	55.12	109.72	306,197	175,918	350,177

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Austria, considering the actual regional values for GDP per capita and higher education level amounts to **95.94** kg per household and an overall total of almost **382,577** tons per year.
At the regional level the lowest estimated values of food waste are registered in the Styria, with an average household FW of **94.64** kg per year, while the highest are recorded in the Vienna region, with a value of **99.84** kg per year.

4 Belgium

Belgium is divided in 9 regions (NUTS 2): Brussels, Antwerp, Limburg, East Flanders, Flemish Brabant, West Flanders, Walloon Brabant, Hainaut, Liège, Luxembourg, and Namur.
According to 2017 Eurostat data, the population amounts to **11,351,727**. The Gross Domestic Product (GDP) per capita on purchasing power parity is **34,300** euro at the regional level, with consistent regional differences, ranging from **21,600** euro per capita in Luxembourg area to **57,700** euro per capita of the Brussels region.
There are **4,761,700** households, with an average size of **2.3** persons.
The average employment rate is **61.1%**, while the level of tertiary education is **40.6%**. Table 4-1 summarizes the baseline values disclosed on Eurostat data.

Table 4-1: Belgium - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Brussels	57,700	40.6%	41.5	1,199,095	533,700
Antwerp	41,300	47.5%	35.7	1,838,863	760,000
Limburg	28,400	40.0%	42.0	869,664	349,500
East Flanders	31,800	35.8%	43.9	1,498,483	632,600
Flemish Brabant	36,800	42.8%	42.5	1,130,644	451,200
West Flanders	33,800	48.7%	42.5	1,188,407	501,600
Walloon Brabant	38,800	37.3%	45.6	399,735	155,300
Hainaut	22,000	58.4%	41.8	1,342,053	571,300
Liège	24,800	31.4%	41.5	1,106,039	476,300
Luxembourg	21,600	35.9%	41.2	284,617	113,200
Namur	23,400	38.8%	39.5	494,127	217,100
Belgium	34,300	40.6%	41.5	11,351,727	4,761,700

Source: author's elaboration on Eurostat data

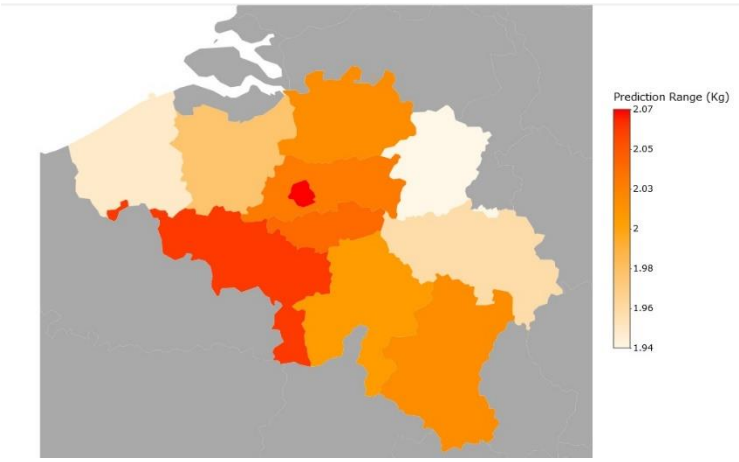

Figure 3 and

Table 4-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 3: estimated FW per household in Belgian regions

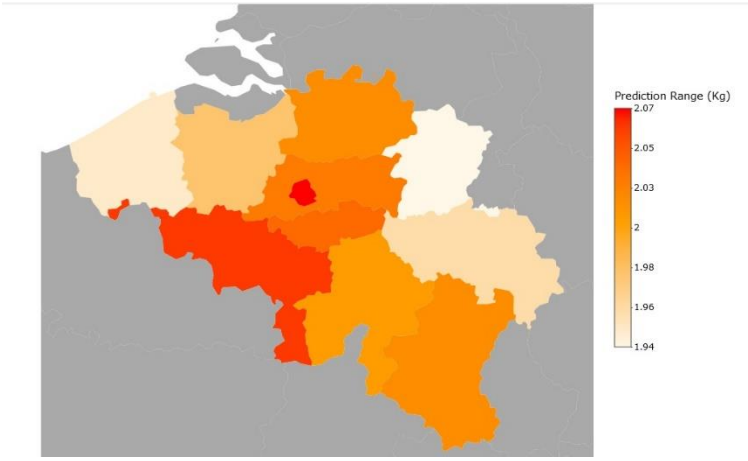

Table 4-2: Belgium – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Brussels	103.48	59.97	117.52	55,227	32,008	62,720
Walloon Brabant	101.66	59.28	114.92	15,788	9,206	17,847
Luxembourg	101.40	58.59	115.44	11,478	6,632	13,068
Liège	99.32	57.55	112.84	47,306	27,409	53,746
Namur	99.32	57.55	112.84	21,562	12,493	24,498

Hainaut	98.80	57.03	112.32	56,444	32,579	64,168
Antwerp	98.28	57.03	111.8	74,693	43,340	84,968
Limburg	98.28	56.68	111.8	34,349	19,810	39,074
Flemish Brabant	97.76	56.51	110.76	44,109	25,496	49,975
East Flanders	96.46	55.81	109.72	61,021	35,308	69,409
West Flanders	93.08	53.39	106.6	46,689	26,779	53,471
Belgium	98.54	56.85	112.32	469,218	270,719	534,834

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations,

Source: REFRESH Road Map

The predicted food waste for Belgium, considering the actual regional values for GDP per capita and higher education level amounts to **98.54** kg per household and an overall total of almost **469,218** tons per year,
At the regional level the lowest estimated values of food waste are registered in West Flanders, with an average household FW of **93.08** kg per year, while the highest are recorded in Brussels, with a value of **103.48** kg per year.

5 Bulgaria

Bulgaria is divided in 6 regions (NUTS 2): Severozapaden, Severen tsentralen, Severoiztochen, Yugoiztochen, Yugozapaden, and Yuzhen tsentralen.
According to 2017 Eurostat data, the population amounts to **7,101,859**. The Gross Domestic Product (GDP) per capita on purchasing power parity is **14,500** euro at the regional level, with consistent regional differences, ranging from **9,100** euro per capita of Severozapaden area to **23,300** euro per capita of the Yugozapaden region.
There are **2,905,400** households, with an average size of **2.3** persons.
The average employment rate is **66.9%**, while the level of tertiary education is **28.2%**. Table 5-1 summarizes the baseline values disclosed on Eurostat data.

Table 5-1: Bulgaria - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Severozapaden	57,700	40.6%	41.5	1,199,095	533,700
Severen tsentralen	41,300	47.5%	35.7	1,838,863	760,000
Severoiztochen	28,400	40.0%	42.0	869,664	349,500
Yugoiztochen	31,800	35.8%	43.9	1,498,483	632,600
Yugozapaden	36,800	42.8%	42.5	1,130,644	451,200
Yuzhen tsentralen	33,800	48.7%	42.5	1,188,407	501,600
Bulgaria	14,500	28.2%	43.9	7,101,859	2,905,400

Source: author's elaboration on Eurostat data

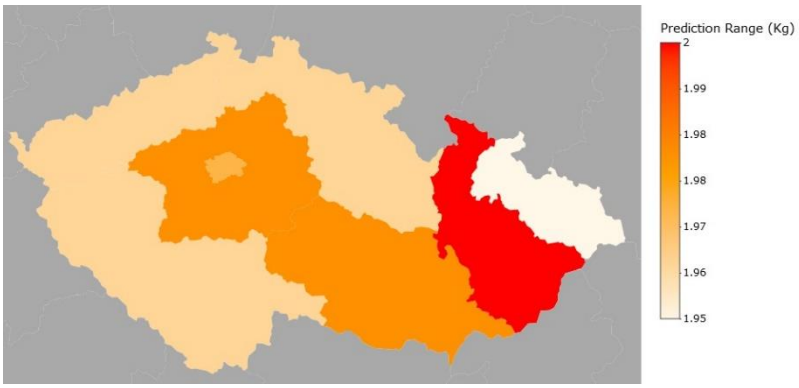

Figure 4 and Table 7-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 4: estimated FW per household in Bulgarian regions

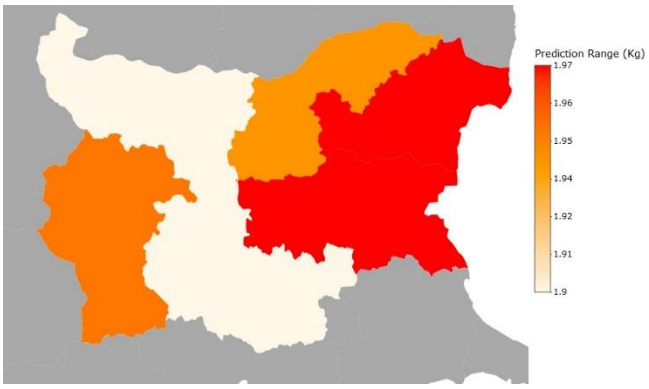

Table 5-2: Bulgaria – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Severoiztochen	96.72	55.47	109.98	36,995	21,216	42,067
Yugoiztochen	96.72	55.47	110.76	42,615	24,439	48,801
Yugozapaden	96.20	55.12	109.72	84,618	48,484	96,510
Severen Tsentralen	94.64	54.43	108.42	31,155	17,917	35,692
Yuzhen Tsentralen	92.82	53.04	106.6	51,738	29,564	59,419
Severozapaden	92.56	52.87	106.6	29,249	16,706	33,686
Bulgaria	95.16	54.43	108.68	276,478	158,131	315,759

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Bulgaria, considering the actual regional values for GDP per capita and higher education level amounts to **95.16** kg per household and an overall total of almost **276,478** tons per year.
At the regional level the lowest estimated values of food waste are registered in Severozapaden, with an average household FW of **92.56** kg per year, while the highest are recorded in Severoiztochen, with a value of **96.72** kg per year.

6 Croatia

Croatia is divided in 2 regions (NUTS 2): Jadranska Hrvatska, and Kontinentalna Hrvatska.
According to 2017 Eurostat data, the population amounts to **4,254,313.** The Gross Domestic Product (GDP) per capita on purchasing power parity is **18,200** euro, **17,500** euro per capita in Jadranska Hrvatska area and **18,200** euro per capita in the Kontinentalna Hrvatska region.
There are **2,655,500** households, with an average size of **2.8** persons.
The average employment rate is **58.9%**, while the level of tertiary education is **25.4%**. Table 6-1 summarizes the baseline values disclosed on Eurostat data.

Table 6-1: Croatia - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Jadranska Hrvatska	17,500	26.6%	44.4	1,387,363	502,200
Kontinentalna Hrvatska	18,600	24.8%	42.9	2,766,850	969,300
Croatia	18,200	25.4%	43.4	4,154,213	1,471,600

Source: author's elaboration on Eurostat data

Figure 5 and Table 6-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 5: estimated FW per household in Croatian regions

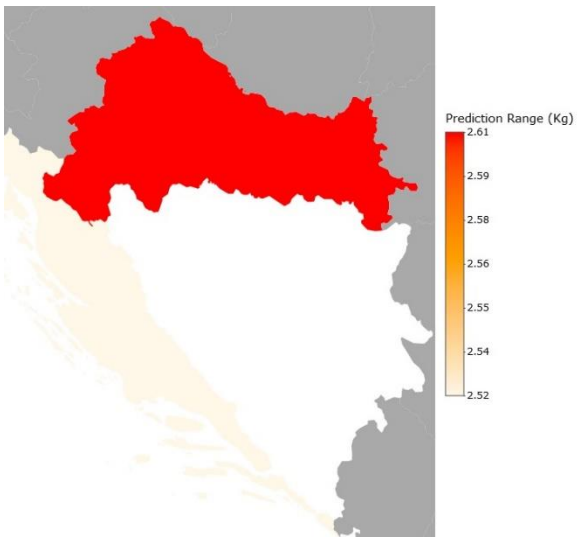

Table 6-2: Croatia – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Jadranska Hrvatska	132.08	79.04	145.6	66,331	39,694	73,120
Kontinentalna Hrvatska	127.40	76.27	141.18	123,489	73,925	136,846
Croatia	127.40	76.27	141.18	187,482	112,234	207,760

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Croatia. Considering the actual regional values for GDP per capita and higher education level amounts to **127.4** kg per household and an overall total of almost **187,482** tons per year.
At the regional level, the lowest estimated values of food waste are registered in Kontinentalna Hrvatska with an average household FW of **127.4** kg per year, while the highest are recorded in Jadranska Hrvatska with a value of **132.8** kg per year.

7 Czech Republic

Czech Republic is divided in 8 regions (NUTS 2): Prague, Střední Čechy, Jihozápad, Severozápad, Severovýchod, Jihovýchod, Střední Morava, andMoravskoslezsko.
According to 2017 Eurostat data, the population amounts to **10,578,820**, The Gross Domestic Product (GDP) per capita on purchasing power parity is **26,400** euro, with some regional differences ranging from **18,700** euro per capita of Severozápad area to the **55,200** euro per capita of the Prague region.
There are **4,699,000** households, with an average size of **2.3** persons.
The average employment rate is **73.6%**, while the level of tertiary education is **24.3%**. Table 7-1 summarizes the baseline values disclosed on Eurostat data.

Table 7-1: Czech Republic - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Prague	55,200	46.4%	41.1	1,280,508	652,900
Střední Čechy	24,700	23.6%	41.1	1,338,982	583,600
Jihozápad	22,800	20.1%	42.4	1,217,411	526,100
Severozápad	18,700	13.9%	42.1	1,118,126	526,800
Severovýchod	22,200	20.6%	42.2	1,508,527	641,600
Jihovýchod	23,900	25.8%	42.0	1,687,764	684,200
Střední Morava	21,600	19.5%	42.5	1,217,623	532,600
Moravskoslezsko	21,700	21.1%	42.4	1,209,879	551,200
Czech Republic	26,400	24.3%	41.9	10,578,820	4,699,000

Source: author's elaboration on Eurostat data

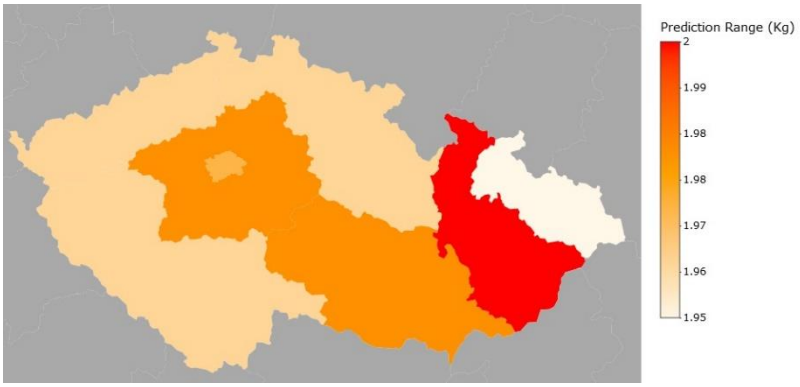

Figure 6 and Table 7-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 6: estimated FW per household in Czech regions

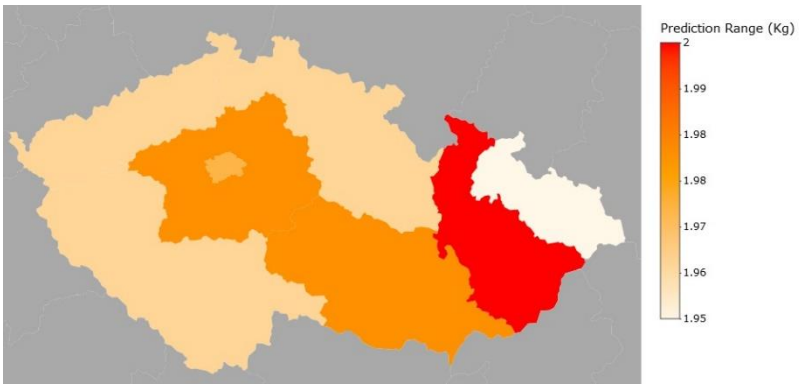

Table 7-2: Czech Republic – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Střední Morava	92.56	56.68	112.32	49,297	30,188	59,822
Střední Čechy	91.52	55.99	111.02	53,411	32,674	64,791
Prague	91.52	56.16	111.02	59,753	36,667	72,485
Jihovýchod	91.52	55.81	111.02	62,618	38,187	75,960
Jihozápad	90.48	55.29	109.72	47,602	29,090	57,724
Severovýchod	90.48	55.29	109.72	58,052	35,476	70,396
Severozápad	89.96	54.77	109.2	47,391	28,855	57,527
Moravskoslezsko	89.96	55.12	109.2	49,586	30,382	60,191
Czech Republic	91.00	55.64	110.24	427,609	261,452	518,018

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Czech Republic, considering the actual regional values for GDP per capita and higher education level amounts to **91** kg per household and an overall total of almost **427,609** tons per year.
At the regional level, the lowest estimated values of food waste are registered in Moravskoslezsko, with an average household FW of **89.96** kg per year, while the highest are recorded in Střední Morava, with a value of **92.56** kg per year.

8 Cyprus

The whole Cyprus territory is considered as a unique NUTS 2 Region.
According to 2017 Eurostat data, the population amounts to **854,802**. The Gross Domestic Product (GDP) per capita on purchasing power parity is **25,000** euro.
There are **321,200** households with an average size of **2.3** persons.
The average employment rate is **65.6%**, while the level of tertiary education is **44.1%**. Table 8-1 summarizes the baseline values disclosed on Eurostat data.

Table 8-1: Cyprus - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Cyprus	25,000	44.1%	37.4	854,802	321,200

Source: author's elaboration on Eurostat data

Table 8-2 summarizes the food waste estimations for the country as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Table 8-2: Cyprus – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Cyprus	131.04	117.52	145.08	42,090	37,747	46,600

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Cyprus, considering the actual regional values for GDP per capita and higher education level amounts to **131.04** kg per household and an overall total of almost **42,090** tons per year.
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9 Denmark

Denmark is divided in 5 regions (NUTS 2): Hovedstaden, Sjælland, Southern Denmark, Midtjylland, and Nordjylland.
According to 2017 Eurostat data, the population amounts to **5,748,769.** The Gross Domestic Product (GDP) per capita on purchasing power parity is **37,700** euro, with some regional differences ranging from **25,800** euro per capita of Sjælland area to the **48,900** euro per capita of the Hovedstaden region.
There are **2,395,900** households, with an average size of **2** persons.
The average employment rate is **74.2%**, while the level of tertiary education is **39.7%**. Table 9-1 summarizes the baseline values disclosed on Eurostat data.

Table 9-1: Denmark - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Hovedstaden	48,900	51.5%	38.8	1,807,404	714,300
Sjælland	25,800	31.2%	45.4	832,553	332,900
Southern Denmark	33,600	32.7%	43.5	1,217,224	531,800
Midtjylland	33,800	37.8%	40.8	1,304,253	579,800
Nordjylland	32,200	32.2%	43.2	587,335	237,000
Denmark	37,700	39.7%	41.6	5,748,769	2,395,900

Source: author's elaboration on Eurostat data

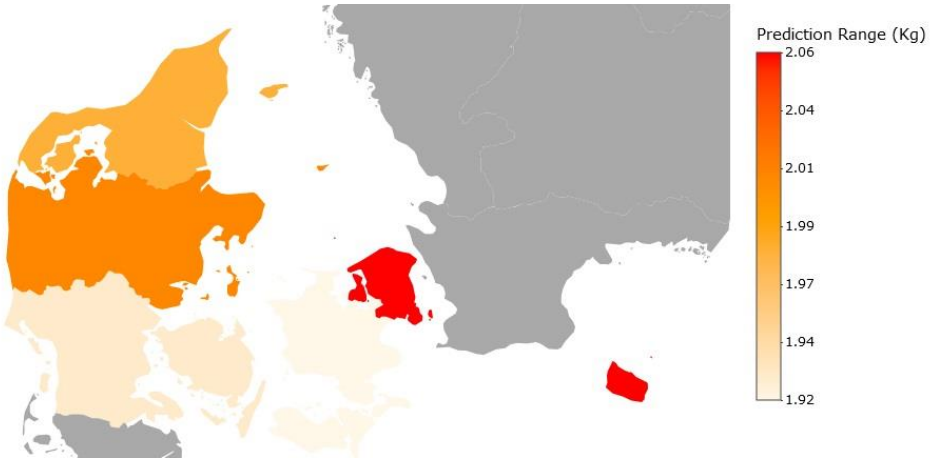

Figure 7 and Table 9-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 7: estimated FW per household in Danish regions

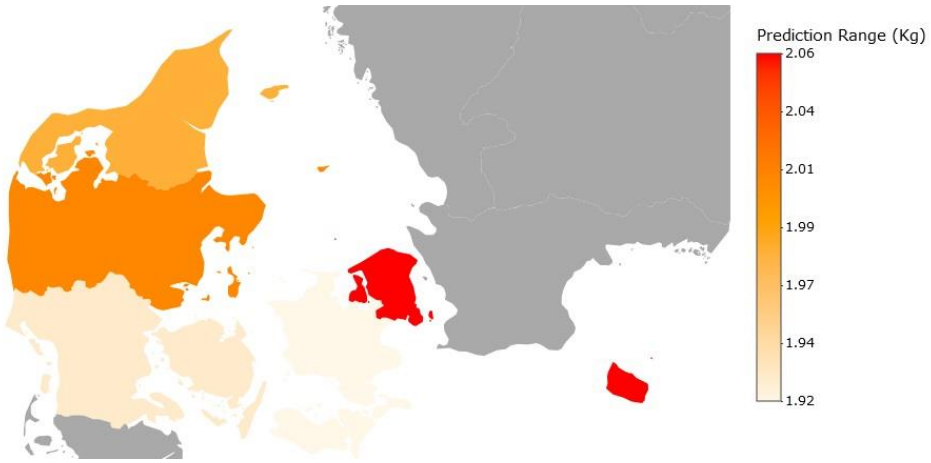

Table 9-2: Denmark – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Hovedstaden	101.92	58.93	115.44	72,801	42,096	82,459
Midtjylland	98.80	56.85	112.32	57,284	32,964	65,123
Nordjylland	96.72	55.47	110.24	22,923	13,146	26,127
Southern Denmark	94.12	53.91	107.64	50,053	28,668	57,243
Sjælland	93.60	53.39	107.64	31,159	17,772	35,833
Denmark	96.98	55.81	110.76	232,354	133,723	265,370

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Denmark, considering the actual regional values for GDP per capita and higher education level amounts to **96.98** kg per household and an overall total of almost **232,254** tons per year.
At the regional level the lowest estimated values of food waste are registered in Sjælland, with an average household FW of **93.60** kg per year, while the highest are recorded in Hovedstaden, with a value of **101.92** kg per year.

10 Estonia

The whole Estonia territory is considered as a unique NUTS 2 Region.
According to 2017 Eurostat data, the population amounts to **1,315,635.** The Gross Domestic Product (GDP) per capita on purchasing power parity is **23,200** euro.
There are **584,000 households** with an average size of **2.1** persons.
The average employment rate is **66.9%**, while the level of tertiary education is **44.1%**. Table 10-1 summarizes the baseline values based on Eurostat data.

Table 10-1: Estonia - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Estonia	23,200	41.2%	41.8	1,315,635	584,000

Source: author's elaboration on Eurostat data

Table 10-2 summarize the food waste estimations for the country as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019)

Table 10-2: Estonia – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Estonia	96.72	55.47	110.76	56,484	32,393	64,684

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations,

Source: REFRESH Road Map

The predicted food waste for Estonia, considering the actual regional values for GDP per capita and higher education level amounts to **96.72** kg per household and an overall total of almost **56,484** tons per year.
.

11 Finland

Finland is divided in 5 regions (NUTS 2): West Finland, Helsinki-Uusimaa, South Finland, North & East Finland, and Åland.
According to 2017 Eurostat data, the population amounts to **5,503,297** The Gross Domestic Product (GDP) per capita on purchasing power parity is **32,100** euro, with relevant regional differences ranging from **26,700** euro per capita of North & East Finland area to **41,600** euro per capita of the Helsinki-Uusimaa region.
There are **2,655,500** households, with an average size of **2.1** persons.
The average employment rate is **70%**, while the level of tertiary education is **44.5%**. Table 11-1 summarizes the baseline values based on Eurostat data.

Table 11-1: Finland - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
West Finland	28,500	42.2%	43.0	1,380,593	666,800
Helsinki-Uusimaa	41,600	52.0%	39.4	1,638,293	766,600
South Finland	28,800	40.9%	45.8	1,159,174	582,900
North & East Finland	26,700	39.5%	44.4	1,296,023	625,600
Åland	37,200	36.4%	44.2	29,214	13,600
Finland	32,100	37.3%	44.5	5,503,297	2,655,500

Source: author's elaboration on Eurostat data

Figure 8 and Table 11-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 8: estimated FW per household in Finnish regions

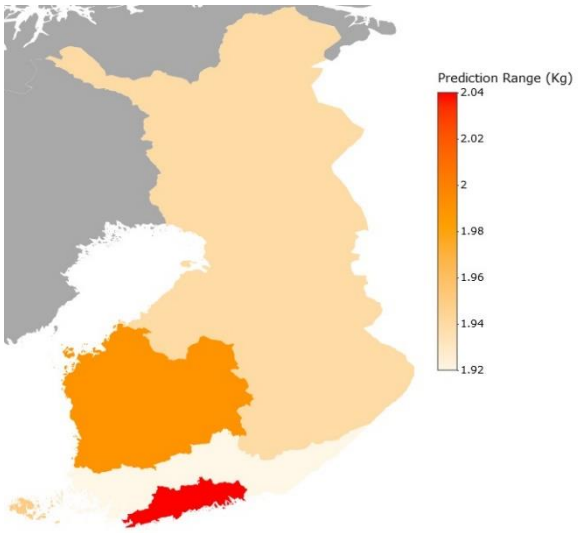

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Table 11-2: Finland – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Helsinki-Uusimaa	99.06	57.03	112.58	75,939	43,717	86,304
West Finland	97.50	56.16	111.28	65,013	37,447	74,202
Åland	95.16	54.60	108.94	1,294	743	1,482
North & East Finland	94.90	54.43	108.68	59,369	34,049	67,990
South Finland	93.86	53.73	107.64	54,711	31,321	62,743
Finland	96.46	55.47	110.24	256,150	147,292	292,742

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Finland. considering the actual regional values for GDP per capita and higher education level amounts to **96.46** kg per household and an overall total of almost **256,150** tons per year.
At the regional level the lowest estimated values of food waste are registered in South Finland. with an average household FW of **93.86** kg per year. while the highest are recorded in Helsinki-Uusimaa with a value of **99.06** kg per year.

12 France

France is divided in 27 regions (NUTS 2): Île de France, Centre-Val de Loire, Bourgogne, Franche-Comté, Lower Normandy, Upper Normandy, Nord-Pas-de-Calais, Picardy, Alsace, Champagne-Ardenne, Lorraine, Pays de la Loire, Brittany, Aquitaine, Limousin, Poitou-Charentes, Languedoc-Roussillon, Midi-Pyrénées, Auvergne, Rhône-Alpes, Provence-Alpes-Côte d'Azur, Corsica, Guadaloupe, Martinique, French Guyana, La Réunion, and Mayotte.
According to 2017 Eurostat data, the population amounts to **66,804,121** The Gross Domestic Product (GDP) per capita on purchasing power parity is **36.600** euro, with relevant regional differences ranging from **10,100** euro per capita of Mayotte overseas area to **52,100** euro per capita of the Île de France region.
There are **2,655,500** households, with an average size of **2.1** persons.
The average employment rate is **64.7%**, while the level of tertiary education is **36.9%**. Table 12-1 summarizes the baseline values based on Eurostat data.

Table 12-1: France - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Île de France	52,100	49.4%	37.2	12,152,461	5,121,900
Centre-Val de Loire	24,800	31.8%	43.9	2,575,917	1,125,000
Bourgogne	24,400	30.1%	45.5	1,633,186	773,400
Franche-Comté	23,100	30.4%	42.6	1,179,419	509,900
Lower Normandy	23,900	28.3%	44.8	1,473,939	670,000
Upper Normandy	26,000	27.0%	41.3	1,858,680	802,500
Nord-Pas-de-Calais	24,500	31.9%	38.8	4,071,241	1,731,800
Picardy	22,100	28.0%	40.8	1,930,305	822,200
Alsace	28,300	32.8%	41.8	1,886,550	821,400
Champagne-Ardenne	25,000	28.0%	42.7	1,328,826	594,800
Lorraine	22,200	29.0%	42.9	2,331,204	1,040,100
Pays de la Loire	27,600	34.5%	41.7	3,756,053	1,672,600
Brittany	26,000	37.5%	43.6	3,315,901	1,599,000

Aquitaine	26,900	35.3%	44.2	3,414,116	1,547,500
Limousin	23,600	32.0%	47.5	734,296	367,200
Poitou-Charentes	24,400	30.8%	46.0	1,808,700	814,000
Languedoc-Roussillon	22,500	33.3%	44.3	2,809,609	1,298,500
Midi-Pyrénées	28,000	44.1%	43.3	3,030,683	1,390,600
Auvergne	23,500	29.5%	45.7	1,363,035	606,300
Rhône-Alpes	30,700	40.7%	40.2	6,594,307	2,863,600
Provence-Alpes-Côte d'Azur	28,000	38.0%	44.1	5,036,446	2,279,600
Corsica	24,600	30.2%	45.3	333,542	99,800
Guadaloupe	21,500	21.2%	43.2	426,449	190,800
Martinique	22,300	25.5%	46.0	372,666	178,100
French Guyana	14,500	21.1%	26.1	278,165	68,300
La Réunion	20,500	21.9%	35.6	857,816	325,300
Mayotte	10,100	10.0%	17.7	250,609	61,400
France	30,600	36.9%	41.4	66,804,121	29,375,800

Source: author's elaboration on Eurostat data

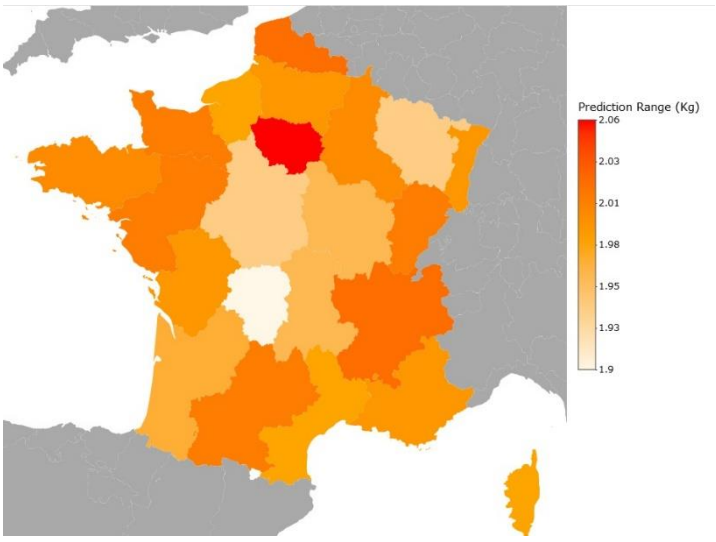

Figure 9 and Table 12-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 9: estimated FW per household in French regions

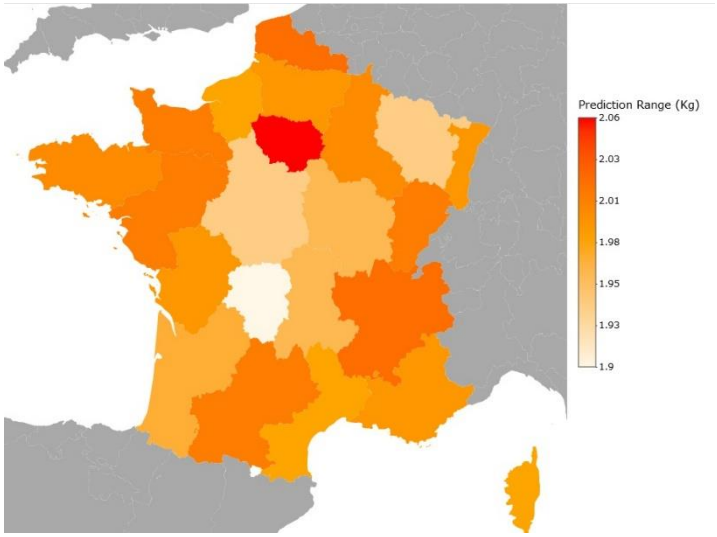

Table 12-2: France – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Mayotte	120.38	69.68	136.5	7,391	4,278	8,381
French Guyana	113.88	66.21	128.96	7,778	4,522	8,808
La Réunion	104.00	59.63	119.08	33,831	19,397	38,737
Île de France	101.66	58.93	115.44	520,692	301,851	591,272
Nord-Pas-de-Calais	99.32	57.20	113.1	172,002	99,059	195,867
Midi-Pyrénées	99.32	57.20	113.1	138,114	79,542	157,277
Rhône-Alpes	99.32	57.55	113.1	284,413	164,791	323,873
Franche-Comté	98.54	56.85	112.06	50,246	28,990	57,139
Pays de la Loire	98.54	56.85	112.06	164,818	95,093	187,432
Lower Normandy	98.28	56.51	111.8	65,848	37,859	74,906
Brittany	98.28	56.51	111.8	157,150	90,354	178,768

Alsace	97.76	56.16	111.28	80,300	46,130	91,405
Champagne-Ardenne	97.76	56.16	111.28	58,148	33,404	66,189
Provence-Alpes-Côte d'Azur	97.76	56.16	111.28	222,854	128,022	253,674
Poitou-Charentes	97.50	56.16	111.28	79,365	45,714	90,582
Picardy	97.24	55.99	111.02	79,951	46,032	91,281
Languedoc-Roussillon	97.24	55.81	110.76	126,266	72,474	143,822
Corsica	97.24	55.81	110.76	9,705	5,570	11,054
Upper Normandy	96.72	55.64	110.24	77,618	44,651	88,468
Aquitaine	96.72	55.81	110.24	149,674	86,371	170,596
Guadaloupe	96.46	55.47	109.98	18,405	10,583	20,984
Bourgogne	96.20	55.12	110.24	74,401	42,630	85,260
Auvergne	95.94	55.12	109.46	58,168	33,419	66,366
Lorraine	95.16	54.43	108.68	98,976	56,609	113,038
Centre-Val de Loire	94.64	54.43	108.16	106,470	61,230	121,680
Limousin	92.56	52.69	106.6	33,988	19,349	39,144
Martinique	92.56	53.04	106.08	16,485	9,446	18,893
France	97.76	56.33	111.8	2.871.778	1.654.837	3.284.214

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for France. considering the actual regional values for GDP per capita and higher education level amounts to **97.76** kg per household and an overall total of almost **2,871,778** tons per year.
At the regional level the lowest estimated values of food waste are registered in Martinique. with an average household FW of **92.56** kg per year. while the highest are recorded in Mayotte with a value of **120.38** kg per year.

13 Germany

Germany is divided in 38 regions (NUTS 2): Stuttgart, Karlsrue, Freiburg, Tübingen, Oberbayern, Niederbayern, Oberpfalz, Oberfranken, Mittelfranken, Unterfranken, Schwaben, Berlin, Brandenburg, Bremen, Hamburg, Darmstadt, Giessen, Kassel, Mecklenburg-Vorpommern, Braunshweig, Hannover, Lüneburg, Weser-Ems, Düsseldorf, Köln, Münster, Detmold, Arnsberg, Koblenz, Trier, Rheinhessen-Pfalz, Saarland, Chemnitz, Dresden, Leipzig, Saxony-Anhalt, Schleswig-Holstein, and Thüringen.
According to 2017 Eurostat data, the population amounts to **82,521,653** The Gross Domestic Product (GDP) per capita on purchasing power parity is **36,400** euro, with consistent regional differences ranging from **24,500** euro per capita of Mecklenburg-Vorpommern area to **59,500** euro per capita of the Hamburg region. There are **40,722,600** households, with an average size of **2** persons, and the number of households is, according to Eurostat data.
The average employment rate is **75.2%**, while the level of tertiary education is **29.1%**. Table 13-1 summarizes the baseline values based on Eurostat data.

Table 13-1: Germany - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Stuttgart	46,900	32.7%	44.0	4,098,278	1,916,400
Karlsruhe	40,100	31.2%	44.6	2,779,314	1,347,100
Freiburg	34,900	29.5%	44.9	2,239,734	1,067,800
Tübingen	39,700	30.6%	44.2	1,834,567	839,300
Oberbayern	52,000	40.6%	43.2	4,633,323	2,266,900
Niederbayern	35,800	21.5%	45.6	1,219,397	551,600
Oberpfalz	38,000	24.9%	45.4	1,098,378	539,900
Oberfranken	34,000	24.7%	47.4	1,062,394	523,300
Mittelfranken	39,900	30.7%	44.9	1,750,059	882,500
Unterfranken	36,900	27.4%	46.6	1,309,209	634,400
Schwaben	36,200	26.7%	45.0	1,857,991	890,900
Berlin	34,800	42.1%	41.7	3,574,830	1,982,000
Brandenburg	25,600	28.2%	49.9	2,494,648	1,239,900
Bremen	45,700	28.4%	44.0	678,753	360,600

Hamburg	59,500	36.9%	41.1	1,810,438	980,300
Darmstadt	46,400	33.9%	44.3	3,951,234	1,926,200
Giessen	30,700	27.5%	45.4	1,043,643	498,000
Kassel	33,900	25.4%	47.2	1,218,211	588,400
Mecklenburg-Vorpommern	24,500	25.5%	49.8	1,610,674	817,300
Braunschweig	41,500	28.5%	46.9	1,595,609	829,100
Hannover	34,900	27.4%	46.6	2,139,976	1,082,800
Lüneburg	25,800	23.5%	47.3	1,703,945	816,900
Weser-Ems	32,600	21.5%	45.2	2,506,155	1,182,900
Düsseldorf	37,900	25.9%	46.1	5,190,790	2,582,400
Köln	39,000	30.5%	44.5	4,439,416	2,191,000
Münster	30,700	24.4%	45.4	2,619,376	1,230,000
Detmold	35,000	23.5%	45.2	2,054,205	964,000
Arnsberg	31,900	22.7%	46.4	3,586,313	1,745,800
Koblenz	31,500	25.5%	47.6	1,492,187	698,100
Trier	28,800	28.4%	45.9	528,728	257,100
Rheinhessen-Pfalz	34,800	28.5%	46.2	2,045,138	980,000
Saarland	32,700	24.5%	48.7	996,651	491,000
Chemnitz	27,900	32.2%	48.3	1,600,155	820,100
Dresden	26,000	24.7%	51.3	1,454,144	757,400
Leipzig	29,000	32.9%	45.6	1,027,484	544,900
Saxony-Anhalt	25,200	21.5%	50.4	2,236,252	1,165,300
Schleswig-Holstein	29,800	24.4%	47.2	2,881,926	1,440,100
Thüringen	26,500	28.3%	49.7	2,158,128	1,091,100
Germany	36,400	29.1%	45.9	82,521,653	40,722,600

Source: author's elaboration on Eurostat data

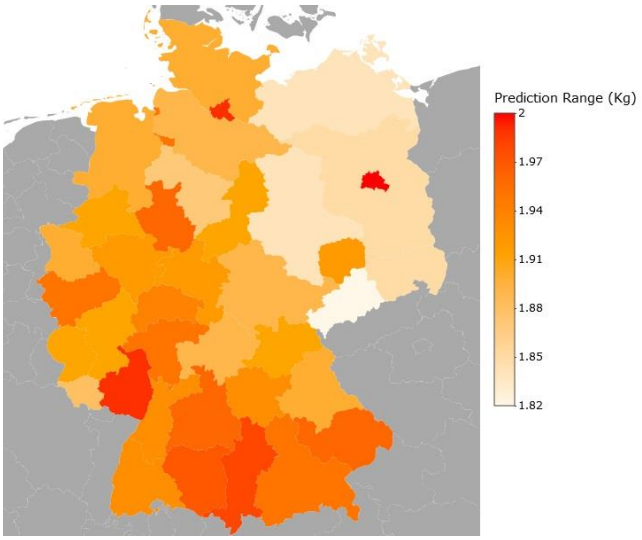

Figure 10 and Table 13-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 10: estimated FW per household in German regions

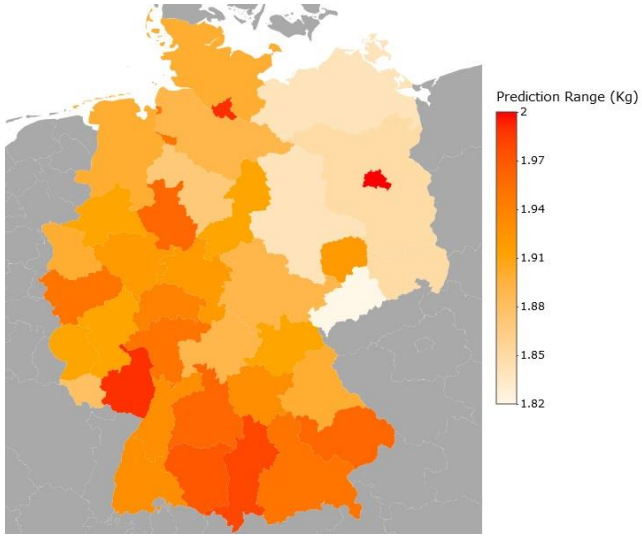

Table 13-2: Germany – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Berlin	99.06	57.20	112.84	196,337	113,370	223,649
Hamburg	97.50	55.99	111.28	95,579	54,884	109,088
Rheinhessen-Pfalz	97.76	56.16	111.8	95,805	55,037	109,564

Schwaben	96.98	55.81	110.24	86,399	49,724	98,213
Tübingen	96.72	55.47	110.76	81,177	46,553	92,961
Stuttgart	96.20	55.47	109.72	184,358	106,296	210,267
Oberbayern	95.68	55.12	109.2	216,897	124,952	247,545
Niederbayern	95.68	54.77	109.72	52,777	30,213	60,522
Bremen	95.68	54.95	109.2	34,502	19,814	39,378
Darmstadt	95.68	54.95	109.46	184,299	105,838	210,842
Köln	95.68	54.77	109.72	209,635	120,008	240,397
Detmold	95.68	55.12	109.2	92,236	53,136	105,269
Giessen	95.16	54.43	108.68	47,390	27,104	54,123
Karlsruhe	94.64	54.08	108.16	127,490	72,851	145,702
Freiburg	94.64	54.25	108.16	101,057	57,932	115,493
Mittelfranken	94.64	54.43	108.16	83,520	48,032	95,451
Kassel	94.12	54.08	107.64	55,380	31,821	63,335
Leipzig	94.12	54.08	107.9	51,286	29,468	58,795
Oberfranken	93.60	53.56	107.12	48,981	28,028	56,056
Braunschweig	93.60	53.73	107.12	77,604	44,550	88,813
Arnsberg	93.60	53.73	107.38	163,407	93,808	187,464
Koblenz	93.60	53.39	107.12	65,342	37,269	74,780
Trier	93.60	53.39	107.12	24,065	13,726	27,541
Düsseldorf	92.82	53.04	106.6	239,698	136,970	275,284
Münster	93.08	53.39	106.6	114,488	65,666	131,118
Schleswig-Holstein	93.08	53.04	106.6	134,045	76,383	153,515
Oberpfalz	92.56	53.04	106.08	49,973	28,636	57,273
Unterfranken	92.56	52.69	106.08	58,720	33,429	67,297
Lüneburg	92.56	53.04	106.34	75,612	43,328	86,869
Weser-Ems	92.56	52.87	106.08	109,489	62,536	125,482

Thüringen	92.56	53.04	106.08	100,992	57,872	115,744
Saarland	92.04	52.52	105.56	45,192	25,787	51,830
Hannover	91.52	52.35	105.04	99,098	56,681	113,737
Brandenburg	90.48	51.65	104.26	112,186	64,045	129,272
Mecklenburg-Vorpommern	90.22	51.31	103.74	73,737	41,933	84,787
Chemnitz	90.48	51.65	104	74,203	42,361	85,290
Saxony-Anhalt	89.96	51.31	103.22	104,830	59,788	120,282
Dresden	88.92	50.61	102.96	67,348	38,335	77,982
Germany	94.12	53.73	107.64	3,832,811	2,188,161	4,383,381

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Germany, considering the actual regional values for GDP per capita and higher education level amounts to **94.12** kg per household and an overall total of almost **3,832,811** tons per year.
At the regional level the lowest estimated values of food waste are registered in Dresden, with an average household FW of **88.92** kg per year, while the highest are recorded in Berlin, with a value of **99.06** kg per year.

14 Greece

Greece is divided in 13 regions (NUTS 2): Attica, North Aegan, South Aegan, Crete, Eastern Macedonia and Thrace, Central Macedonia, Western Macedonia, Epirus, Thessaly, Ionian Island, Western Greece, Central Greece, and Peloponnese.
According to 2017 Eurostat data, the population amounts to **10,738,193** The Gross Domestic Product (GDP) per capita on purchasing power parity is **19,800** euro, with some regional differences ranging from **13,600** euro per capita of Eastern Macedonia and Thrace area to the **26,800** euro per capita of the Attica region.
There are **4,393,900** households, with an average size of **2.3** persons.
The average employment rate is **53.5%**, while the level of tertiary education is **31.7%**. Table 14-1 summarizes the baseline values based on Eurostat data.

Table 14-1: Greece - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Attica	26.800	39.3%	43.7	3,773,559	245,800
North Aegan	14.200	24.5%	43.1	203,700	761,100
South Aegan	21.300	20.8%	41.0	338,383	101,700
Crete	16.700	26.6%	41.4	632,674	148,700
Eastern Macedonia and Thrace	13.600	25.1%	44.2	602,799	273,700
Central Macedonia	15.700	31.7%	44.5	1,880,122	82,800
Western Macedonia	17.500	26.0%	46.5	271,488	267,400
Epirus	14.100	33.8%	47.3	335,250	219,000
Thessaly	15.400	32.1%	45.8	725,874	227,800
Ionian Island	18.200	22.8%	45.6	205,431	1,597,000
Western Greece	14.600	21.9%	44.0	663,970	82,500
Central Greece	18.200	23.6%	45.2	555,761	131,000
Peloponnese	16.700	23.8%	46.5	579,182	255,600
Greece	19.800	31.7%	44.2	10,768,193	4,393,900

Source: author's elaboration on Eurostat data

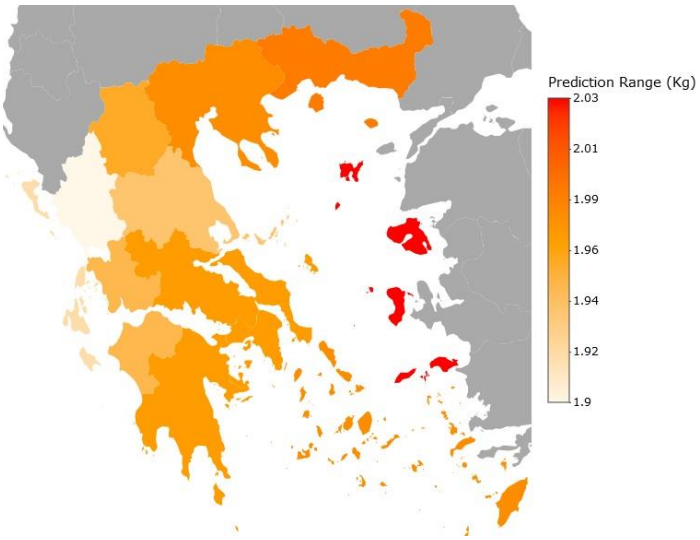

Figure 11 and
Table 14-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 11: estimated FW per household in Greek regions

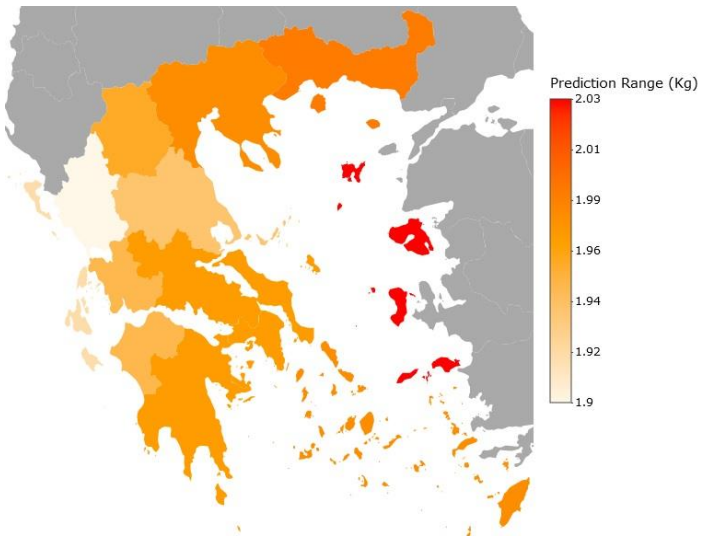

Table 14-2: Greece – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
North Aegan	99.32	57.55	112.84	75,592	43,799	85,883
Crete	98.28	56.51	111.8	14,614	8,403	16,625
Central Macedonia	97.50	55.99	111.28	8,073	4,636	9,214

Attica	96.98	55.81	110.76	23,838	13,719	27,225
Eastern Macedonia and Thrace	97.24	56.16	110.76	26,615	15,371	30,315
South Aegan	96.72	55.47	110.24	9,836	5,641	11,211
Western Macedonia	96.20	55.47	109.72	25,724	14,832	29,339
Central Greece	96.20	55.47	110.24	12,602	7,266	14,441
Peloponnese	96.20	55.47	109.72	24,589	14,177	28,044
Thessaly	95.16	54.60	108.68	21,677	12,438	24,757
Western Greece	95.16	54.77	108.68	7,851	4,519	8,966
Ionian Island	93.86	53.73	107.64	149,894	85,812	171,901
Epirus	93.34	53.56	106.86	20,441	11,730	23,402
Greece	96.46	55.47	110.24	423,836	243,715	484,384

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Greece, considering the actual regional values for GDP per capita and higher education level amounts to **96.46** kg per household and an overall total of almost **423,836** tons per year.
At the regional level the lowest estimated values of food waste are registered in Epirus, with an average household FW of **93.34** kg per year, while the highest are recorded in North Aegan, with a value of **99.32** kg per year.

15 Hungary

Hungary is divided in 8 regions (NUTS 2): Budapest, Pest, Central Transdanubia, Western Transdanubia, Southern Transdanubia, Northern Hungary, Northern Great Plain, and Southern Great Plain.
According to 2017 Eurostat data, the population amounts to **9,797,561** The Gross Domestic Product (GDP) per capita on purchasing power parity is **20,000** euro, with relevant regional differences ranging from **12,700** euro per capita of Northern Great Plain area to **41,100** euro per capita of the Budapest region.
There are **4,131,400** households, with an average size of **2.3** persons.
The average employment rate is **68.2%**, while the level of tertiary education reaches **25.1%**. Table 15-1 summarizes the baseline values based on Eurostat data.

Table 15-1: Hungary - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Budapest	41,100	46.5%	41.8	1,752,704	1,307,800
Pest	15,800	26.4%	41.0	1,247,372	503,100
Central Transdanubia	18,400	19.9%	42.6	1,056,097	438,700
Western Transdanubia	21,100	20.5%	42.9	983,251	404,600
Southern Transdanubia	13,200	18.1%	44.1	894,223	376,500
Northern Hungary	13,500	17.4%	42.5	1,143,902	465,000
Northern Great Plain	12,700	18.5%	41.4	1,468,088	581,100
Southern Great Plain	14,200	20.9%	43.5	1,251,924	557,700
Hungary	20,000	25.1%	42.3	9,797,561	4,131,400

Source: author's elaboration on Eurostat data

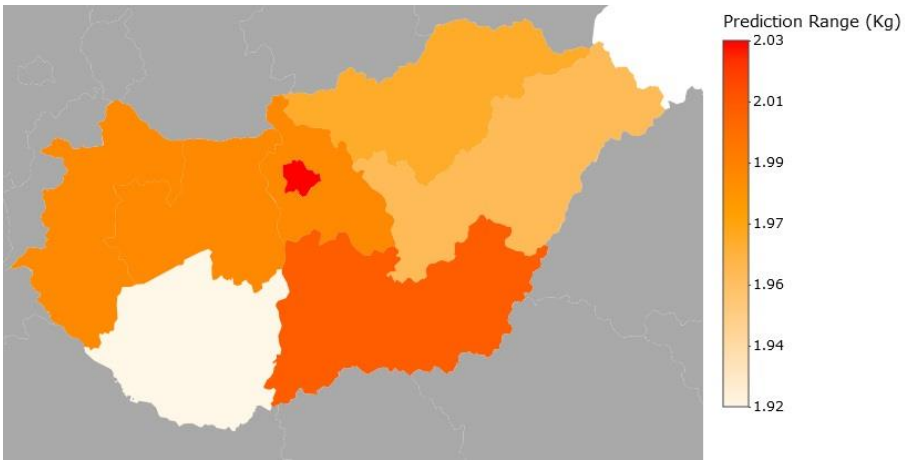

Figure 12 and Table 15-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 12: estimated FW per household in Hungarian regions

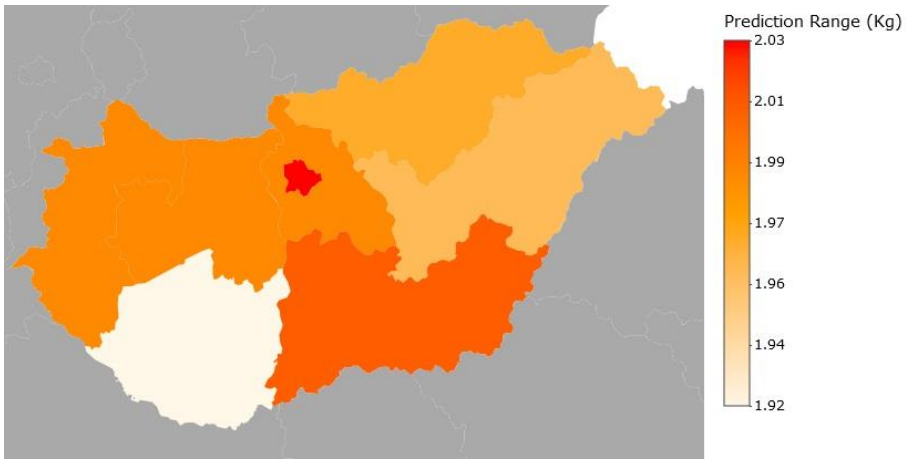

Table 15-2: Hungary – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Budapest	99.32	57.20	112.84	129,891	74,806	147,572
Southern Great Plain	98.28	56.68	112.06	54,811	31,610	62,496
Pest	97.76	56.51	111.28	49,183	28,429	55,985
Western Transdanubia	97.50	56.16	111.28	39,449	22,722	45,024
Hungary	97.24	56.16	111.02	401,737	232,019	458,668

Central Transdanubia	97.24	55.99	110.76	42,659	24,561	48,590
Northern Hungary	96.20	55.29	110.24	44,733	25,711	51,262
Northern Great Plain	95.94	55.12	109.46	55,751	32,030	63,607
Hungary	97.24	56.16	111.02	401,737	232,019	458,668

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Hungary, considering the actual regional values for GDP per capita and higher education level amounts to **97.24** kg per household and an overall total of almost **401,737** tons per year.
At the regional level the lowest estimated values of food waste are registered in Northern Great Plain, with an average household FW of **95.95** kg per year, while the highest are recorded in Budapest, with a value of **99.32** kg per year.

16 Ireland

Hungary is divided in 3 regions (NUTS 2): Northern and Western Ireland, Southern Ireland, and Eastern and Midland.
According to 2017 Eurostat data, the population amounts to **4,784,383** The Gross Domestic Product (GDP) per capita on purchasing power parity is **53,500** euro, with relevant regional differences ranging from **24,700** euro per capita of Northern and Western Ireland area to **65,000** euro per capita of the Southern Ireland region. There are **1,795,000** households, with an average size of **2.6** persons.
The average employment rate is **67.7%**, while the level of tertiary education is **46.9%**. Table 16-1 summarizes the baseline values based on Eurostat data.

Table 16-1: Ireland - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Northern and Western Ireland	24,700	41.2%	38.3	848,383	323,300
Southern Ireland	65,000	42.5%	38.0	1,591,718	600,000
Eastern and Midland	55,700	51.7%	35.9	2,344,282	871,800
Hungary	53,300	46.9%	36.9	4,784,383	1,795,000

Source: author's elaboration on Eurostat data

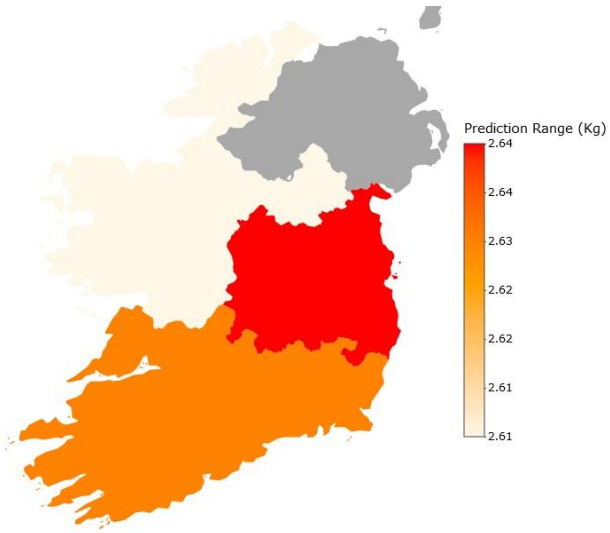

Figure 13 and
Table 16-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 13: estimated FW per household in Irish regions

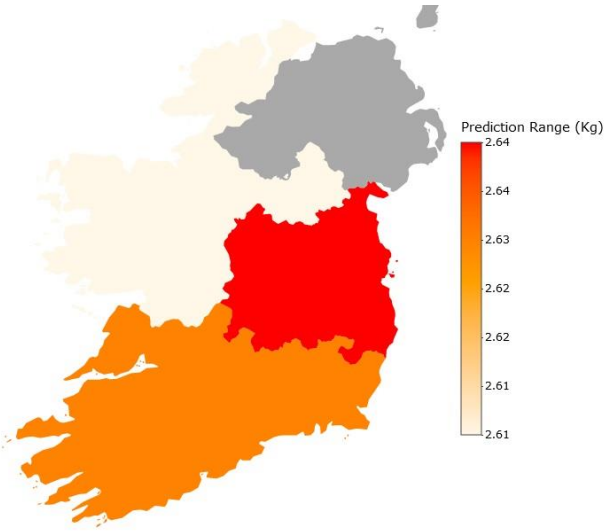

Table 16-2: Ireland – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Eastern and Midland	132.08	79.04	145.6	115,147	68,907	126,934
Southern Ireland	130.52	78.00	144.04	78,312	46,800	86,424
Northern and Western Ireland	130.00	78.00	144.04	42,029	25,217	46,568
Ireland	131.04	78.52	144.82	235,217	140,943	259,952

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Ireland, considering the actual regional values for GDP per capita and higher education level amounts to **131.04** kg per household and an overall total of almost **235,217** tons per year.
At the regional level the lowest estimated values of food waste are registered in Northern and Western Ireland, with an average household FW of **130** kg per year, while the highest are recorded in Eastern and Midland, with a value of **132.08** kg per year.

17 Italy

Italy is divided in 21 regions (NUTS 2): Piedmont, Valle d'Aosta, Liguria, Lombardy, Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicily, Sardinia, South Tyrol, Trento, Veneto, Friuli-Venezia Giulia, Emilia-Romagna, Tuscany, Umbria, Marche, and Lazio.
According to 2017 Eurostat data, the population amounts to **60,589,445**, The Gross Domestic Product (GDP) per capita on purchasing power parity is **28,400** euro, with relevant regional differences ranging from **17,100** euro per capita of Calabria area to **42,200** euro per capita of the South Tyrol region.
There are **25,864,500** households, with an average size of **2.3** persons.
The average employment rate is **58%**, while the level of tertiary education is **19.3%**. Table 17-1 summarizes the baseline values based on Eurostat data.

Table 17-1: Italy - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Piedmont	30,100	19.3%	47.9	4,392,526	2,006,400
Valle d'Aosta	35,000	18.8%	47.1	126,883	60,900
Liguria	31,400	22.0%	50.3	1,565,307	770,700
Lombardia	37,800	21.2%	45.9	10,019,166	4,430,800
Abruzzo	24,600	19.3%	46.6	1,322,247	554,500
Molise	19,700	19.7%	47.2	310,449	130,600
Campania	18,200	15.5%	42.5	5,839,084	2,162,600
Puglia	18,300	14.8%	44.7	4,063,888	1,588,400
Baslicata	21,000	15.9%	46.1	570,365	232,900
Calabria	17,100	15.1%	44.4	1,965,128	801,800
Sicily	17,400	14.0%	44.0	5,056,641	2,020,100
Sardinia	20,500	16.1%	47.2	1,653,135	720,900
South Tirol	42,200	17.8%	43.4	524,256	218,700
Trento	35,900	21.3%	45.4	538,604	233,500
Veneto	32,900	18.8%	46.4	4,907,529	2,063,200
Friuli-Venezia Giulia	30,800	21.1%	48.5	1,217,872	559,200

Emilia-Romagna	35,200	22.0%	46.9	4,448,841	1,995,000
Tuscany	30,300	21.4%	47.8	3,742,437	1,646,000
Umbria	24,400	20.7%	47.5	888,908	383,500
Marche	26,700	20.5%	47.1	1,538,055	643,800
Lazio	32,600	25.6%	45.5	5,898,124	2,641,200
Italy	28,400	19.3%	45.9	60,589,445	25,864,700

Source: author's elaboration on Eurostat data

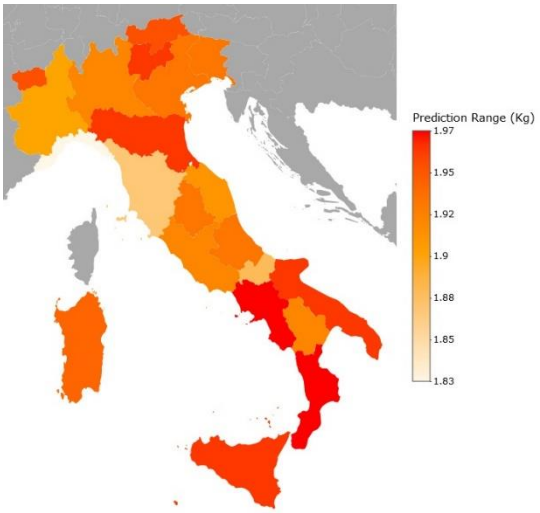

Figure 14 and
Table 17-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 14: estimated FW per household in Italian regions

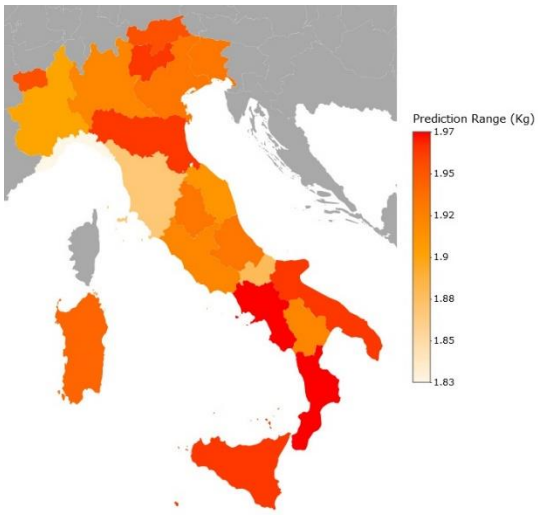

Table 17-2: Italy – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Campania	96.98	55.81	110.76	209,729	120,702	239,530
Calabria	96.72	55.47	110.24	77,550	44,473	88,390
Puglia	96.20	55.12	109.72	152,804	87,553	174,279
Sicily	96.20	55.12	109.98	194,334	111,348	222,171
Trento	9620	55.29	109.72	22,463	12,911	25,620
Emilia-Romagna	95.94	55.29	109.46	191,400	110,310	218,373
Valle d'Aosta	95.42	54.77	108.94	5,811	3,336	6,634
Sardinia	95.16	54.60	109.20	68,601	39,361	78,722
South Tirol	95.16	54.60	108.68	20,811	11,941	23,768
Abruzzo	94.64	54.25	108.16	52,478	30,083	59,975
Veneto	94.64	54.08	108.16	195,261	111,578	223,156
Friuli-Venezia Giulia	94.64	54.43	108.16	52,923	30,435	60,483
Umbria	94.64	54.43	108.16	36,294	20,873	41,479
Lazio	94.38	53.91	108.16	249,276	142,378	285,672

Lombardia	94.12	54.08	107.64	417,027	239,618	476,931
Baslicata	93.86	53.73	107.12	21,860	12,514	24,948
Marche	93.60	53.39	107.12	60,260	34,370	68,964
Piedmont	92.82	53.04	106.60	186,234	106,419	213,882
Molise	92.04	52.69	105.82	12,020	6,882	13,820
Tuscany	91.52	52.35	105.04	150,642	86,163	172,896
Liguria	89.44	50.96	102.96	68,931	39,275	79,351
Italy	94.64	54.08	108.16	2,447,835	1,398,763	2,797,526

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Italy. Considering the actual regional values for GDP per capita and higher education level amounts to **94.64** kg per household and an overall total of almost **2,477,835** tons per year.
At the regional level, the lowest estimated values of food waste are registered in Liguria. With an average household FW of **89.44** kg per year. While the highest are recorded in Campania with a value of **96.98** kg per year.

18 Lithuania

Lithuania is divided in 2 regions (NUTS 2): Sostinės regionas and Vidurio ir vakarų. According to 2017 Eurostat data, the population amounts to **2,847,904** The Gross Domestic Product (GDP) per capita on purchasing power parity is **23,000** euro, **33,000** euro per capita in Sostinės regionas area and **19,100** euro per capita in the Vidurio ir vakarų region.
There are **1,357,000** households, with an average size of **2.1** persons, and the number of households is, according to Eurostat data.
The average employment rate is **70.4%**, while the level of tertiary education is **41.7%**. Table 18-1 summarizes the baseline values based on Eurostat data.

Table 18-1: Lithuania - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Sostinės regionas	33,000	54.7%	39.8	805,173	384,500
Vidurio ir vakarų	19,100	36.0%	44.9	2,042,731	972,500
Lithuania	23,000	41.7%	43.4	2,847,904	1,357,000

Source: author's elaboration on Eurostat data

Figure 15 and

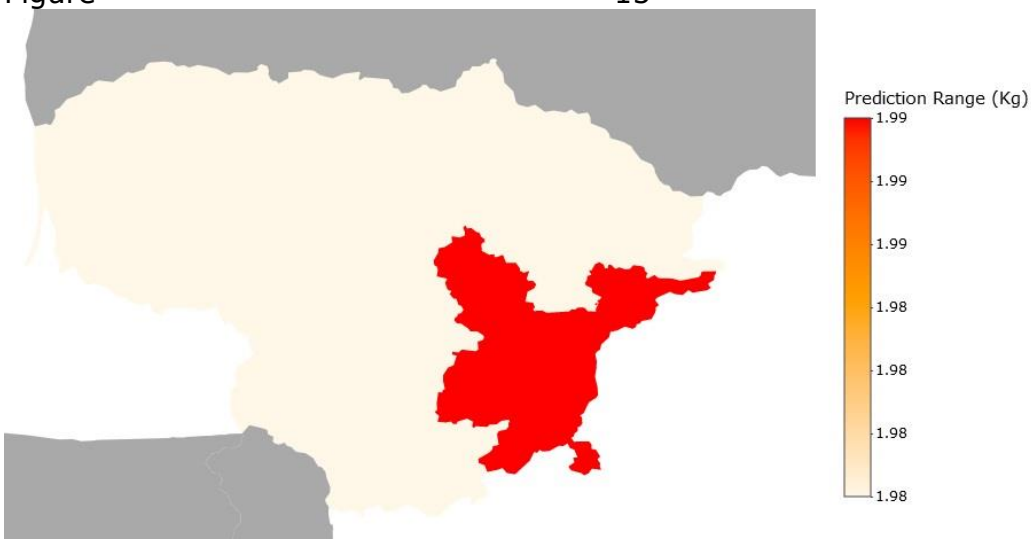

Table 18-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 15: estimated FW per household in Lithuanian regions

Table 18-2: Lithuania – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Sostinės regionas	98.28	56.68	111.8	37,789	21,793	42,987
Vidurio ir vakarų	96.98	55.81	110.5	94,313	54,278	107,461
Lithuania	97.76	56.33	111.28	132,660	76,444	151,007

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Lithuania. considering the actual regional values for GDP per capita and higher education level amounts to **97.76** kg per household and an overall total of almost **132,660** tons per year.
At the regional level the lowest estimated values of food waste are registered in Vidurio ir vakarų. with an average household FW of **96.98** kg per year. while the highest are recorded in Sostinės regions with a value of **98.28** kg per year.

19 Luxembourg

The whole Luxembourg territory is considered as a unique NUTS 2 Region. According to 2017 Eurostat data, the population amounts to **590,667** The Gross Domestic Product (GDP) per capita on purchasing power parity is **74,500** euro. There are **242,400** households with an average size of **2.4** persons.
The average employment rate is **66.3%**, while the level of tertiary education is **44.1%**. Table 19-1 summarizes the baseline values based on Eurostat data.

Table 19-1: Luxembourg - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Luxembourg	74,500	44.1%	39.4	590,667	242,400

Source: author's elaboration on Eurostat data

Table 19-2 summarizes the food waste estimations for the country as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019),

Table 19-2: Luxembourg – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Luxembourg	93.08	39.78	107.12	22,563	9,643	25,966

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Luxembourg, considering the actual regional values for GDP per capita and higher education level amounts to **93.08** kg per household and an overall total of almost **22,563** tons per year.

20 Latvia

The whole Latvian territory is considered as a unique NUTS 2 Region.
According to 2017 Eurostat data, the population amounts to **1,950,116**, according to 2017 Eurostat data. The gross domestic product (GDP) per capita on purchasing power parity is **19,600** euro.
There are **850,100** households with an average size of **2.2** persons.
The average employment rate is **70.1%**, while the level of tertiary education is **33.9%**. Table 20-1 summarizes the baseline values based on Eurostat data.

Table 20-1: Latvia - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Latvia	19,600	33.9%	43.1	1,950,116	850,100

Source: author's elaboration on Eurostat data

Table 20-2 summarizes the food waste estimations for the country as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019),

Table 20-2: Latvia – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Latvia	98.28	56.85	111.8	83,548	48,331	95,041

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Latvia, considering the actual regional values for GDP per capita and higher education level amounts to **98.28** kg per household and an overall total of almost **83,548** tons per year.

21 Malta

The whole Maltese territory is considered as a unique NUTS 2 Region.
According to 2017 Eurostat data, the population amounts to **460,297**, according to 2017 Eurostat data. The gross domestic product (GDP) per capita on purchasing power parity is **28,700** euro.
There are **183,400** households with an average size of **2.5** persons
The average employment rate is **68%**, while the level of tertiary education is **26.3%**. Table 21-1 summarizes the baseline values based on Eurostat data.

Table 21-1: Malta - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Latvia	28,700	26.3%	40.6	460,297	183,400

Source: author's elaboration on Eurostat data

Table 21-2 summarizes the food waste estimations for the country as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Table 21-2: Malta – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Malta	129.48	77.31	143.52	23,747	14,178	26,322

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations,

Source: REFRESH Road Map

The predicted food waste for Malta, considering the actual regional values for GDP per capita and higher education level amounts to **129.48** kg per household and an overall total of almost **23,747** tons per year.

22 The Netherlands

The Netherlands territory is divided in 12 regions (NUTS 2): Groningen, Friesland, Drenthe, Overijssel, Gelderland, Flevoland, Utrecht, Noord-Holland, Zuid-Holland, Zeeland, Noord-Brabant, and Limburg.
According to 2017 Eurostat data, the population amounts to **17,081,507** The Gross Domestic Product (GDP) per capita on purchasing power parity is **37,700** euro, with some regional differences ranging from **25,800** euro per capita of Drenthe area to **49,300** euro per capita of the Noord-Holland region.
There are **7,819,000** households, with an average size of **2.2** persons.
The average employment rate is **75.8%**, while the level of tertiary education is **38.3%**. Table 22-1 summarizes the baseline values based on Eurostat data.

Table 22-1: The Netherlands - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Groningen	35,900	36.2%	41.9	583,581	292,600
Friesland	26,000	31.8%	44.4	646,874	298,400
Drenthe	25,800	31.1%	46.4	491,792	211,700
Overijssel	31,400	33.4%	42.1	1,147,687	509,900
Gelderland	31,800	35.3%	43.6	2,047,901	925,800
Flevoland	28,300	30.2%	38.4	407,818	166,800
Utrecht	45,700	51.2%	39.8	1,284,504	586,000
Noord-Holland	49,300	45.4%	41.3	2,809,483	1,318,100
Zuid-Holland	37,700	38.9%	41.0	3,650,222	1,683,300
Zeeland	30,100	29.1%	46.1	381,568	175,800
Noord-Brabant	38,100	36.0%	43.7	2,512,531	1,131,100
Limburg	33,400	32.2%	47.3	1,117,546	519,600
The Netherlands	37,700	38.3%	42.5	17,081,507	7,819,000

Source: author's elaboration on Eurostat data

Figure 16 and Table 22-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 16: estimated FW per household in Dutch regions

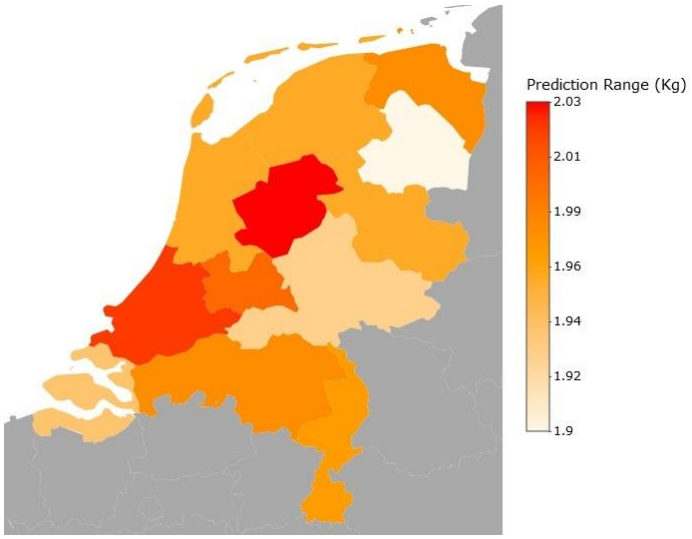

Table 22-2: the Netherlands – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Flevoland	99.84	57.55	113.36	16,653	9,599	18,908
Zuid-Holland	99.32	57.20	113.1	167,185	96,285	190,381
Utrecht	98.80	56.85	112.84	57,897	33,316	66,124
Groningen	97.24	55.81	110.76	28,452	16,331	32,408
Noord-Brabant	97.24	55.99	110.76	109,988	63,327	125,281
Limburg	96.46	55.47	109.98	50,121	28,820	57,146
Friesland	96.20	55.47	109.46	28,706	16,551	32,663
Overijssel	96.20	55.12	109.72	49,052	28,106	55,946
Noord-Holland	96.20	55.12	109.98	126,801	72,654	144,965
Zeeland	95.16	54.43	108.68	16,729	9,568	19,106
Gelderland	94.64	54.25	108.68	87,618	50,228	100,616
Drenthe	93.08	53.39	106.6	19,705	11,302	22,567
The Netherlands	96.72	55.64	110.24	756,254	435,049	861,967

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for the Netherlands, considering the actual regional values for GDP per capita and higher education level amounts to **96.72** kg per household and an overall total of almost **756,254** tons per year,
At the regional level the lowest estimated values of food waste are registered in Drenthe, with an average household FW of **93.08** kg per year, while the highest are recorded in Flevoland, with a value of **99.84** kg per year.

23 Poland

Poland territory is divided in 17 regions (NUTS 2): Małopolskie, Śląskie, Wielkopolskie, Zachodniopomorskie, Lubuskie, Dolnośląskie, Opolskie, Kujawsko-pomorskie, Warmińsko-mazurskie, Pomorskie, Łódzkie, Świętokrzyskie, Lubelskie, Podkarpackie, Podlaskie, Warszawski stołeczny, and Mazowiecki regionalny.
According to 2017 Eurostat data, the population amounts to **37,972,964** The Gross Domestic Product (GDP) per capita on purchasing power parity is **20,500** euro, with relevant regional differences ranging from **14,100** euro per capita of Lubelskie area to **44,900** euro per capita of the Warszawski stołeczny region.
There are **14,465,800** households, with an average size of **2.6** persons.
The average employment rate is **66.1%**, while the level of tertiary education is **30.9%**. Table 23-1 summarizes the baseline values based on Eurostat data.

Table 23-1: Poland - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Małopolskie	18,700	33.0%	41.9	3,339,803	1,196,300
Śląskie	21,200	29.7%	39.0	4,510,528	1,838,900
Wielkopolskie	22,400	26.5%	41.7	3,457,473	1,245,000
Zachodniopomorskie	17,100	28.6%	39.0	1,681,246	667,000
Lubuskie	16,900	24.8%	40.9	1,004,892	371,500
Dolnośląskie	22,700	31.7%	40.1	2,866,218	1,174,400
Opolskie	16,300	25.9%	41.1	950,710	351,400
Kujawsko-pomorskie	16,600	25.3%	41.8	2,060,575	772,000
Warmińsko-mazurskie	14,400	23.6%	40.2	1,410,641	528,700
Pomorskie	19,800	32.8%	39.5	2,285,800	869,700
Łódzkie	19,200	29.0%	39.1	2,471,620	969,900
Świętokrzyskie	14,600	28.9%	42.0	1,237,518	427,800
Lubelskie	14,100	28.8%	41.5	2,112,787	759,600
Podkarpackie	14,300	28.4%	40.3	2,084,722	664,600
Podlaskie	14,700	32.3%	39.2	1,156,947	431,900

Warszawski stołeczny	44,900	57.4%	40.5	3,002,278	1,297,200
Mazowiecki regionalny	17,500	23.6%	40.3	2,339,206	900,000
Poland	20,500	30.9%	40.3	37,972,964	14,465,800

Source: author's elaboration on Eurostat data

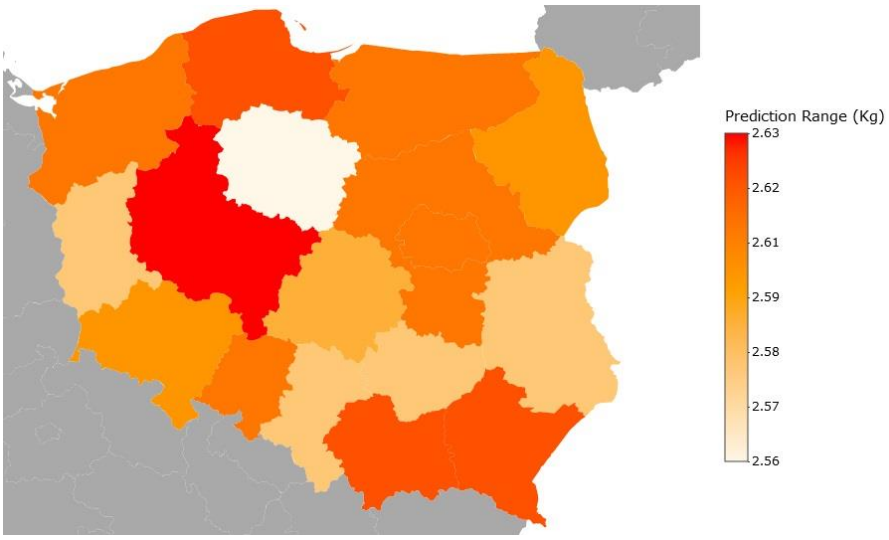

Figure 17 and Table 23-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 17: estimated FW per household in Polish regions

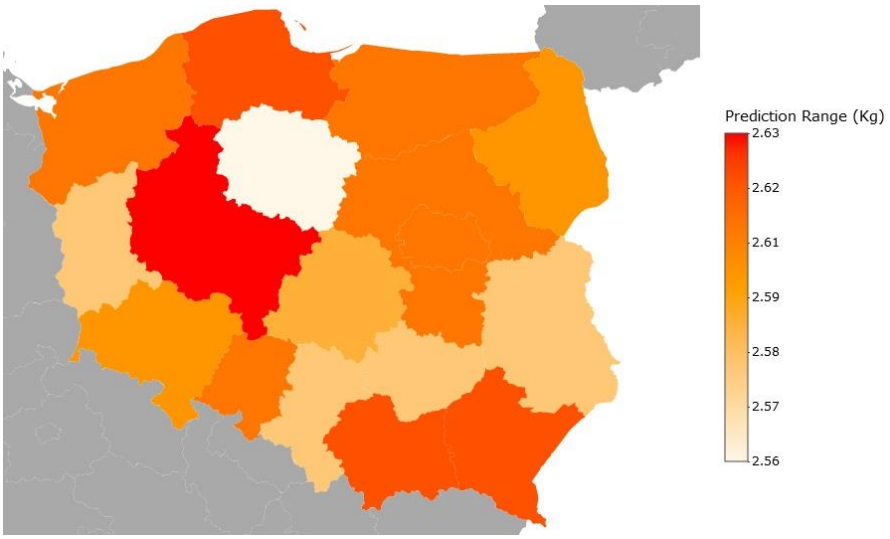

Table 23-2: Poland – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Wielkopolskie	131.04	78.35	144.56	163,145	97,542	179,977
Warszawski stołeczny	130.78	78.17	144.56	169,648	101,406	187,523
Małopolskie	130.52	78.00	144.04	156,141	93,311	172,315
Pomorskie	130.52	78.00	144.04	113,513	67,837	125,272
Podkarpackie	130.52	78.00	144.04	86,744	51,839	95,729
Zachodniopomorskie	130.00	77.65	143.52	86,710	51,795	95,728
Mazowiecki regionalny	130.00	77.65	143.52	117,000	69,888	129,168
Opolskie	129.74	77.48	143.78	45,591	27,226	50,524
Warmińsko-mazurskie	129.74	77.48	143.52	68,594	40,964	75,879
Podlaskie	129.48	77.65	143.00	55,922	33,538	61,762
Dolnośląskie	129.22	77.31	142.48	151,756	90,789	167,329
Łódzkie	128.96	76.96	142.48	125,078	74,644	138,191

Poland	129.48	77.31	143.00	1,873,032	1,118,303	2,068,609

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Poland, considering the actual regional values for GDP per capita and higher education level amounts to **129.48** kg per household and an overall total of almost **1,873,032** tons per year.
At the regional level, the lowest estimated values of food waste are registered in Kujawsko-pomorskie, with an average household FW of **127.14** kg per year, while the highest are recorded in Wielkopolskie, with a value of **131.04** kg per year.

24 Portugal

Portugal territory is divided in 7 regions (NUTS 2): Norte, Algarve, Centro, Área Metropolitana de Lisboa, Alentejo, Região Autónoma dos Açores, and Região Autónoma da Madeira.
According to 2017 Eurostat data, the population amounts to **10,309,573** The Gross Domestic Product (GDP) per capita on purchasing power parity is **22,600** euro, with some regional differences ranging from **19,100** euro per capita of Norte area to **29,600** euro per capita of the Área Metropolitana de Lisboa region.
There are **4,102,700** households, with an average size of **2.5** persons.
The average employment rate is **67.8%**, while the level of tertiary education is **25%**. Table 24-1 summarizes the baseline values based on Eurostat data.

Table 24-1: Portugal - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Norte	19,100	21.8%	44.3	3,584,575	1,350,600
Algarve	24,400	22.4%	43.7	441,469	182,400
Centro (PT)	19,600	24.2%	46.4	2,243,934	914,600
Área Metropolitana de Lisboa	29,600	32.8%	43.3	2,821,349	1,173,900
Alentejo	21,300	20.2%	46.9	718,087	305,800
Região Autónoma dos Açores	20,200	15.2%	38.7	245,283	82,400
Região Autónoma da Madeira	21,600	21.2%	41.7	254,876	92,900
Portugal	22,600	25.0%	44.4	10,309,573	4,102,700

Source: author's elaboration on Eurostat data

Figure 18 and Table 24-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 18: estimated FW per household in Portuguese regions

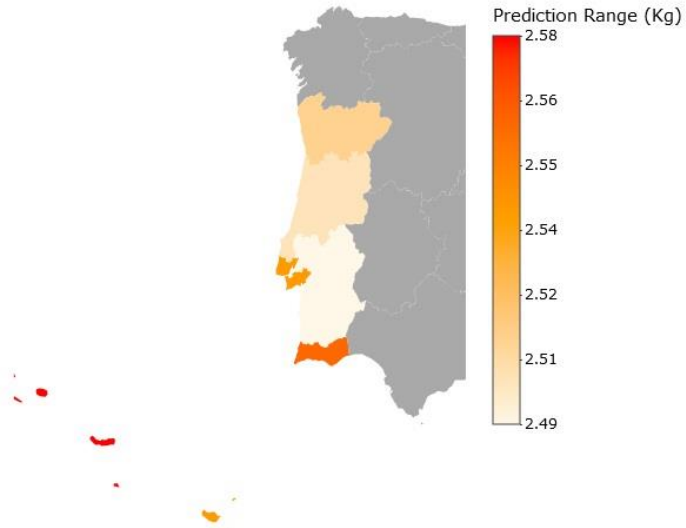

Table 24-2: Portugal – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Região Autónoma dos Açores	127.92	76.44	141.7	10,541	6,299	11,676
Algarve	127.14	75.92	140.92	23,190	13,848	25,704
Área Metropolitana de Lisboa	126.88	75.75	140.4	148,944	88,919	164,816
Região Autónoma da Madeira	126.10	75.23	139.88	11,715	6,989	12,995
Norte	124.54	74.19	138.32	168,204	100,197	186,815
Centro (PT)	124.02	74.01	137.28	113,429	67,693	125,556
Alentejo	123.24	73.32	137.02	37,687	22,421	41,901
Portugal	125.84	75.05	139.36	516,284	307,921	571,752

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Portugal, considering the actual regional values for GDP per capita and higher education level amounts to **125.84** kg per household and an overall total of almost **516,284** tons per year,
At the regional level, the lowest estimated values of food waste are registered in Alentejo, with an average household FW of **123.24** kg per year, while the highest are recorded in Região Autónoma dos Açores, with a value of **127.92** kg per year.

25 Romania

Romania territory is divided in 8 regions (NUTS 2): Nord-Vest, Centru, Nord-Est, Sud-Est, Sud-Muntenia, București-Ilfov, Sud-Vest Oltenia, and Vest.
According to 2017 Eurostat data, the population amounts to **19,644,350** The Gross Domestic Product (GDP) per capita on purchasing power parity is **18,400** euro, with some regional differences ranging from **11,400** euro per capita of Nord-Est area to **42,400** euro per capita of the București-Ilfov region.
There are **7,482,400** households, with an average size of **2.6** persons.
The average employment rate is **63.9%**, while the level of tertiary education is **17.8%**. Table 25-1 summarizes the baseline values based on Eurostat data.

Table 25-1: Romania - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Nord-Vest	16,600	17.7%	40.6	2,568,730	952,500
Centru	17,500	18.1%	41.3	2,332,935	874,600
Nord-Est	11,400	12.7%	40.3	3,239,612	1,221,300
Sud-Est	15,500	13.1%	43.0	2,446,734	954,200
Sud-Muntenia	14,800	12.7%	43.5	3,003,349	1,127,200
București-Ilfov	42,400	37.5%	40.1	2,287,347	903,000
Sud-Vest Oltenia	13,400	14.7%	43.9	1,973,140	762,000
Vest	19,600	15.7%	42.1	1,792,503	687,500
Romania	18,400	17.8%	41.8	19,644,350	7,482,400

Source: author's elaboration on Eurostat data

Figure 19 and

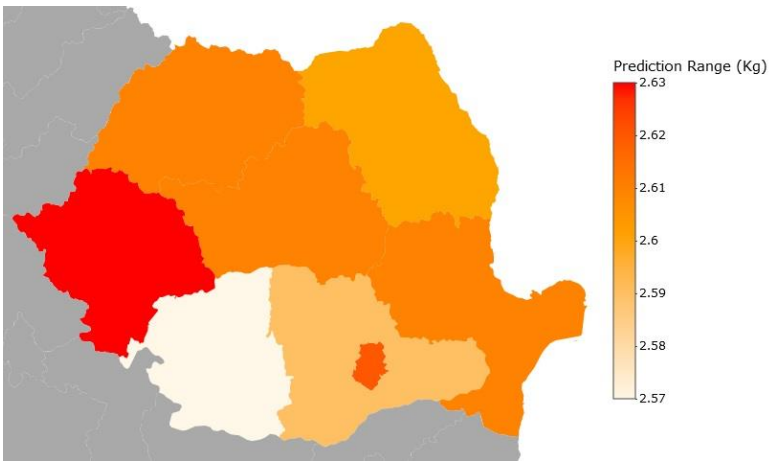

Table 25-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 19: estimated FW per household in Romanian regions

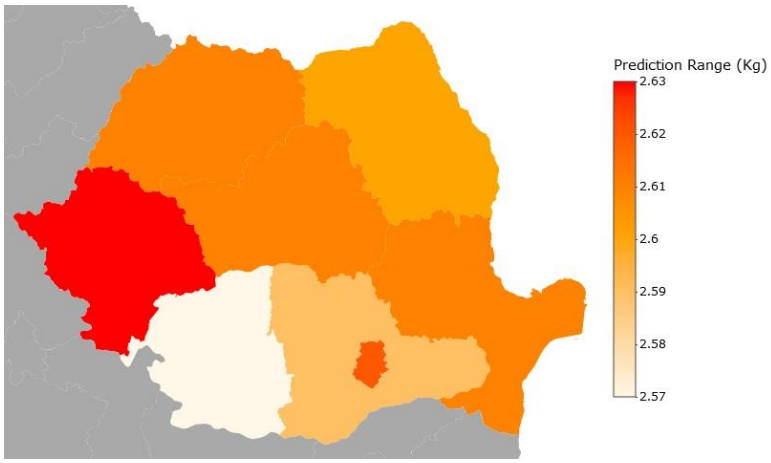

Table 25-2: Romania – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
București-Ilfov	123.76	77.48	143.26	111,755	69,964	129,364
Vest	123.76	77.31	143	85,085	53,148	98,313
Centru	122.72	76.61	141.96	107,331	67,006	124,158
Nord-Vest	122.20	76.27	141.96	116,396	72,644	135,217
Sud-Est	122.20	76.44	141.96	116,603	72,939	135,458
Nord-Est	121.68	76.09	140.92	148,608	92,933	172,106
Sud-Muntenia	121.16	75.92	140.92	136,572	85,577	158,845
Sud-Vest Oltenia	120.12	75.23	139.36	91,531	57,323	106,192
Romania	122.20	76.44	141.7	914,349	571,955	1,060,256

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Romania, considering the actual regional values for GDP per capita and higher education level amounts to **122.20** kg per household and an overall total of almost **914.349** tons per year,
At the regional level, the lowest estimated values of food waste are registered in Sud-Vest Oltenia, with an average household FW of **120.12** kg per year, while the highest are recorded in București-Ilfov, with a value of **123.76** kg per year.

26 Slovenia

Slovenia is divided in 2 regions (NUTS 2): Vzhodna Slovenija and Zahodna Slovenija.
According to 2017 Eurostat data, the population amounts to **2,065,895** The Gross Domestic Product (GDP) per capita on purchasing power parity is **25,100** euro, **20,600** euro per capita in Vzhodna Slovenija area and **30,000** euro per capita in the Zahodna Slovenija region.
There are **881,100** households, with an average size of **2.3** persons.
The average employment rate is **71.6%**, while the level of tertiary education is **44.5%**. Table 26-1 summarizes the baseline values based on Eurostat data.

Table 26-1: Slovenia - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Vzhodna Slovenija	20,600	27.9%	44.3	1,091,159	465,000
Zahodna Slovenija	30,000	37.7%	42.6	974,736	416,100
Slovenia	25,100	32.5%	43.5	2,065,895	881,100

Source: author's elaboration on Eurostat data

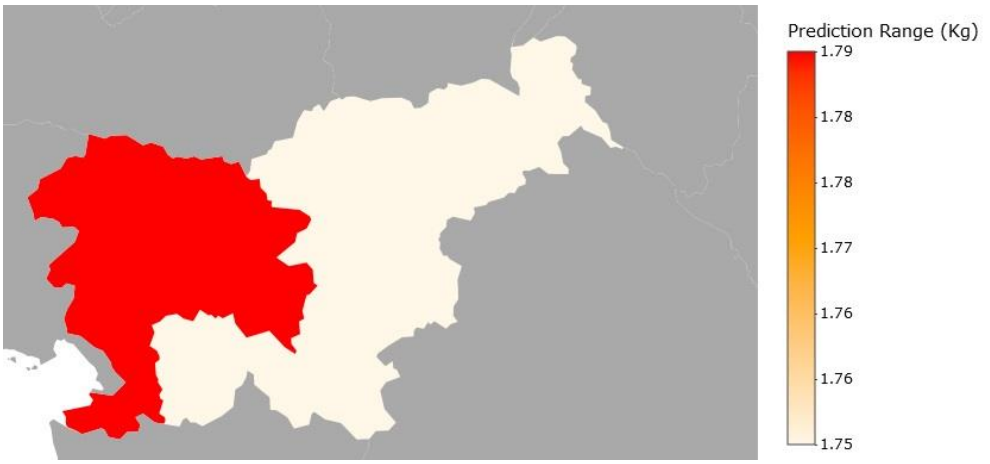

Figure 20 and Table 26-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 20: estimated FW per household in Slovenia regions

Table 26-2: Slovenia – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Zahodna Slovenija	98.80	57.03	112.32	41,111	23,729	46,736
Vzhodna Slovenija	96.72	55.64	110.24	44,975	25,873	51,262
Slovenia	97.76	56.33	111.28	86,136	49,635	98,049

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Slovenia considering the actual regional values for GDP per capita and higher education level amounts to **97.76** kg per household and an overall total of almost **86,136** tons per year.
At the regional level the lowest estimated values of food waste are registered in Vzhodna Slovenija. with an average household FW of **98.80** kg per year while the highest are recorded in Zahodna Slovenija with a value of **98.80** kg per year.

27 Slovakia

Slovakia is divided in 4 regions (NUTS 2): Bratislavský kraj, Západné Slovensko, Stredné Slovensko, and Východné Slovensko.
According to 2017 Eurostat data, the population amounts to **5,434,343** The Gross Domestic Product (GDP) per capita on purchasing power parity is **22,400** euro, with consistent regional differences ranging from **17,900** euro per capita of Stredné Slovensko area to **52,800** euro per capita of the Bratislavský kraj region. There are **1,874,500** households, with an average size of **2.7** persons.
The average employment rate is **71.6%**, while the level of tertiary education is **44.5%**. Table 27-1 summarizes the baseline values based on Eurostat data.

Table 27-1: Slovakia - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Bratislavský kraj	52,800	43.8%	40.1	641,892	258,800
Západné Slovensko	20,800	20.6%	41.4	1,830,751	645,800
Stredné Slovensko	17,900	21.6%	39.9	1,342,287	468,800
Východné Slovensko	16,000	23.6%	37.6	1,620,413	501,100
Slovakia	22,400	24.6%	39.8	5,435,343	1,874,500

Source: author's elaboration on Eurostat data

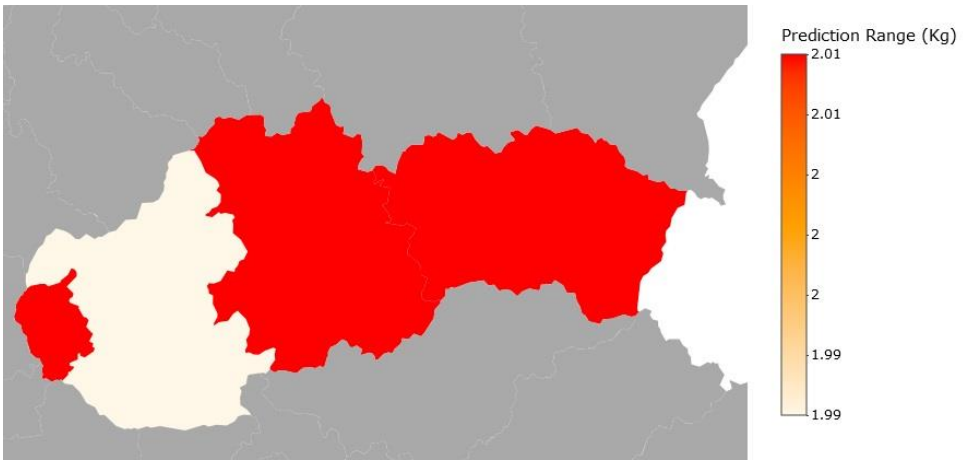

Figure 21 and Table 27-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 21: estimated FW per household in Slovakia regions

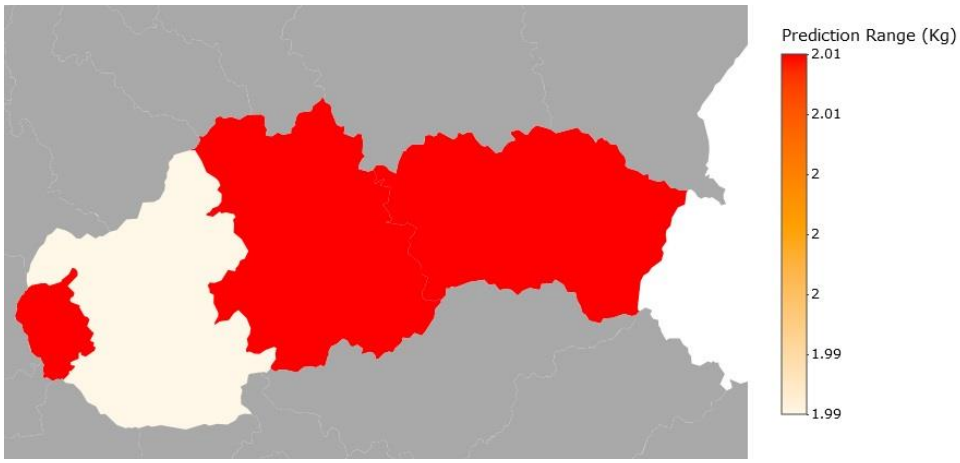

Table 27-2: Slovakia – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Bratislavský kraj	129.48	77.48	143.00	33,509	20,052	37,008
Východné Slovensko	129.48	77.31	143.00	64,882	38,738	71,657
Stredné Slovensko	129.22	77.31	143.00	60,578	36,241	67,038
Západné Slovensko	128.44	76.79	141.44	82,947	49,589	91,342
Slovenia	128.96	77.31	142.74	241,736	144,911	267,566

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Slovakia considering the actual regional values for GDP per capita and higher education level amounts to **128.96** kg per household and an overall total of almost **241,736** tons per year.
At the regional level, the lowest estimated values of food waste are registered in Západné Slovensko with an average household FW of **128.44** kg per year while the highest are recorded in Bratislavský kraj with a value of **129.48** kg per year.

28 Spain

Spain is divided in 19 regions (NUTS 2): Galicia, Principality of Asturias, Cantabria, Basque Community, Navarre, La Rioja, Aragon, Madrid Community, Castile-Leon, Castile-La Mancha, Extremadura, Catalonia, Valencian Community, Balearic Islands, Andalusia, Region of Murcia, Ceuta, Melilla, and Canary Islands.
According to 2017 Eurostat data, the population amounts to **46,528,024** The Gross Domestic Product (GDP) per capita on purchasing power parity is **27.100** euro, with some regional differences ranging from **19,000** euro per capita of Extremadura area to **36,600** euro per capita of the Madrid region.
There are **18,512,500** households, with an average size of **2.5** persons.
The average employment rate is **53.5%**, while the level of tertiary education is **31.7%**. Table 28-1 summarizes the baseline values based on Eurostat data.

Table 28-1: Spain - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Galicia	27,100	36.9%	47.1	2,710,216	1,089,700
Principality of Asturias	24,200	43.1%	48.8	1,034,302	456,100
Cantabria	24,000	40.6%	45.6	581,490	240,500
Basque Community	24,500	49.6%	46.0	2,167,323	902,100
Navarre	35,600	45.4%	43.4	640,353	256,500
La Rioja	33,400	38.7%	44.4	312,624	129,900
Aragon	28,300	38.4%	44.8	1,316,072	537,500
Madrid Community	29,900	47.2%	42.2	6,476,838	2,587,700
Castile-Leon	36,600	36.2%	47.9	2,435,951	1,025,000
Castile-La Mancha	25,300	28.4%	42.5	2,040,977	784,700
Extremadura	21,.400	26.5%	44.2	1,077,525	430,500
Catalonia	19,000	40.8%	42.8	7,441,284	2,993,300
Valencian Community	32,500	35.7%	43.3	4,935,182	1,998,000
Balearic Islands	23,800	29.7%	41.1	1,150,962	448,100

Andalusia	28,400	30.3%	41.5	8,408,976	3,209,100
Region of Murcia	20,100	31.2%	40.3	1,472,991	539,400
Ceuta	22,300	26.5%	36.6	85,034	28,300
Melilla	21,100	29.9%	33.9	84,946	25,100
Canary Islands	19,500	30.5%	42.3	2,154,978	831,000
Spain	19,800	37.3%	43.2	46,528,024	18,512,500

Source: author's elaboration on Eurostat data

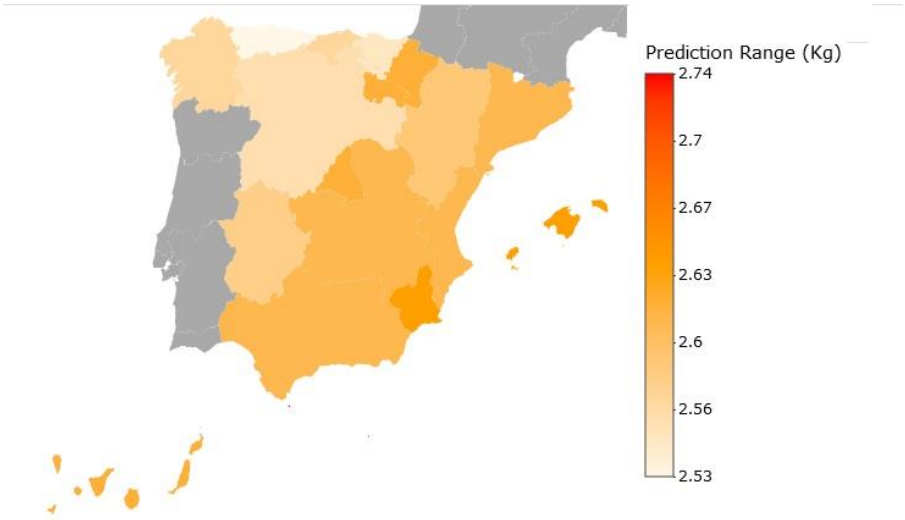

Figure 22 and
Table 28-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 22: estimated FW per household in Spanish regions

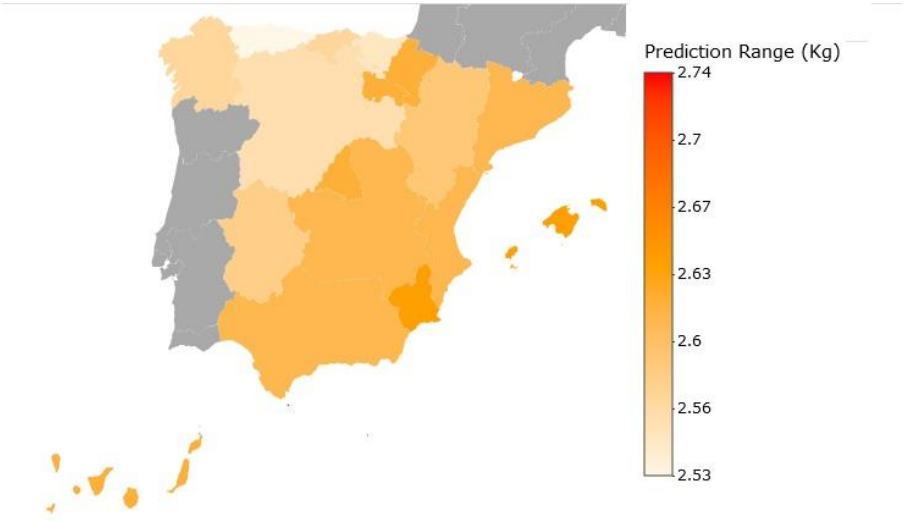

Table 28-2: Spain – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Melilla	142.48	85.97	162.24	3,576	2,158	4,072
Ceuta	133.90	80.08	147.94	3,789	2,266	4,187
Navarre	128.70	76.96	142.22	33,012	19,740	36,479
Balearic Islands	128.70	76.79	142.48	57,670	34,408	63,845
Murcia	128.96	76.96	142.74	69,561	41,512	76,994
La Rioja	128.44	76.79	142.48	16,684	9,975	18,508
Madrid	128.44	76.79	141.96	332,364	198,701	367,350
Catalonia	127.14	75.75	140.66	380,568	226,732	421,038
Valencian Community	127.92	76.27	141.44	255,584	152,381	282,597
Andalusia	127.92	76.27	141.44	410,508	244,747	453,895
Canary Islands	127.92	76.61	141.7	106,302	63,666	117,753
Castile-La Mancha	127.40	76.27	140.92	99,971	59,846	110,580

Aragon	126.88	75.57	140.4	68,198	40,621	75,465
Cantabria	126.10	75.23	139.88	30,327	18,092	33,641
Galicia	125.84	74.88	139.36	137,128	81,597	151,861
Extremadura	125.58	74.88	139.1	54,062	32,236	59,883
Basque Community	125.32	74.88	139.1	113,051	67,549	125,482
Castile-Leon	124.54	74.19	138.06	127,654	76,041	141,512
Asturias	124.02	74.01	137.54	56,566	33,757	62,732
Spain	127.92	76.27	141.44	2,368,119	1,411,887	2,618,408

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Spain, considering the actual regional values for GDP per capita and higher education level amounts to **127.92** kg per household and an overall total of almost **2,368,119** tons per year.
At the regional level the lowest estimated values of food waste are registered in Principality of Asturias, with an average household FW of **124.02** kg per year, while the highest are recorded in Melilla, with a value of **142.48** kg per year.

29 Sweden

Sweden territory is divided in 8 regions (NUTS 2): Stockholm, Östra Mellansverige, Småland med öarna, Sydsverige, Västsverige, Norra Mellansverige, Mellersta Norrland, and Övre Norrland.
According to 2017 Eurostat data, the population amounts to **9,995,153** The Gross Domestic Product (GDP) per capita on purchasing power parity is **35,600** euro, with some regional differences ranging from **28,600** euro per capita of Norra Mellansverige area to **48,800** euro per capita of the Stockholm region.
There are **4,862,700** households, with an average size of **1.8** persons.
The average employment rate is **76.9%**, while the level of tertiary education is **43.3%**. Table 29-1 summarizes the baseline values based on Eurostat data.

Table 29-1: Sweden - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Stockholm	48,800	52.0%	38.1	2,269,060	1,130,400
Östra Mellansverige	30,800	40.2%	41.1	1,664,145	809,200
Småland med öarna	30,700	36.2%	42.7	847,667	395,600
Sydsverige	30,700	45.4%	40.6	1,483,018	703,700
Västsverige	35,100	42.3%	40.7	1,992,116	956,200
Norra Mellansverige	28,600	34.0%	44.5	848,451	420,200
Mellersta Norrland	30,000	36.5%	44.4	374,245	185,600
Övre Norrland	32,800	39.9%	42.8	516,451	261,800
Sweden	35,600	43.3%	40.8	9,995,153	4,862,700

Source: author's elaboration on Eurostat data

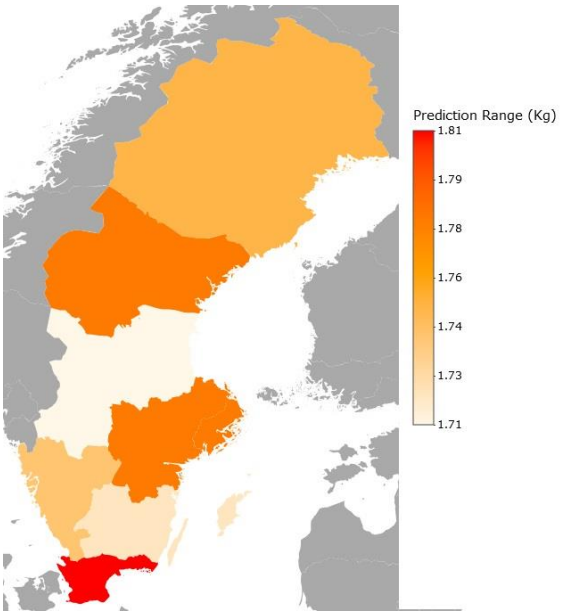

Figure 23 and Table 29-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 23: estimated FW per household in Swedish regions

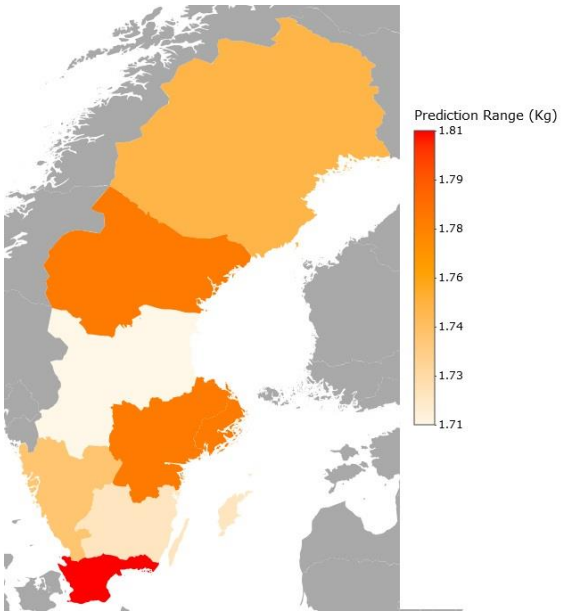

Table 29-2: Sweden – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)
Sydsverige	100.62	58.24	114.14	70,806	40,983	80,320
Stockholm	98.80	56.85	112.84	111,684	64,267	127,554
Östra Mellansverige	98.28	56.85	111.8	79,528	46,006	90,469
Mellersta Norrland	98.28	56.68	111.8	18,241	10,520	20,750
Västsverige	96.72	55.47	110.24	92,484	53,037	105,411
Övre Norrland	96.72	55.81	110.5	25,321	14,612	28,929
Småland med öarna	95.68	54.77	109.2	37,851	21,668	43,200
Norra Mellansverige	94.64	54.25	108.16	39,768	22,797	45,449
Sweden	97.50	56.16	111.28	474,113	273,089	541,121

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations.

Source: REFRESH Road Map

The predicted food waste for Sweden, considering the actual regional values for GDP per capita and higher education level amounts to **97.50** kg per household and an overall total of almost **474,113** tons per year,

At the regional level, the lowest estimated values of food waste are registered in Norra Mellansverige, with an average household FW of **96.94** kg per year, while the highest are recorded in Sydsverige, with a value of **100.62** kg per year.

30 United Kingdom

United Kingdom is divided in 41 regions (NUTS 2): Tees Valley and Durham, Northumberland and Tyne and Wear, Cumbria, Greater Manchester, Lancashire, Cheshire, Merseyside, East Yorkshire and Northern Lincolnshire, North Yorkshire, South Yorkshire, West Yorkshire, Derbyshire and Nottinghamshire, Leicestershire, Rutland and Northamptonshire, Lincolnshire, Herefordshire, Worcestershire and Warwickshire, Shropshire and Staffordshire, West Midlands, East Anglia, Bedfordshire and Hertfordshire, Essex, Inner London — West, Inner London — East, Outer London — East and North East, Outer London – South, Outer London — West and North West, Berkshire, Buckinghamshire and Oxfordshire, Surrey, East and West Sussex, Hampshire and Isle of Wight, Kent, Gloucestershire, Wiltshire and Bristol/Bath Area, Dorset and Somerset, Cornwall and Isles of Scilly, Devon, West Wales and The Valleys, East Wales, North Eastern Scotland, Highlands and Islands, Eastern Scotland, West Central Scotland, Southern Scotland, and Northern Ireland. According to 2017 Eurostat data, the population amounts to **65,844,122** The Gross Domestic Product (GDP) per capita on purchasing power parity is **31,100** euro, with consistent regional differences ranging from **19,000** euro per capita of Southern Scotland area to the **49,600** euro per capita of the Inner London — East region, and with the relevant exception of the Inner London – West region, with a GDP of **184,600** euro per capita
There are **28,830,100** households, with an average size of **2.3** persons, and the number of households is, according to Eurostat data.
The average employment rate is **74.1%**, while the level of tertiary education is **43.2%**. Table 30-1 summarizes the baseline values based on Eurostat data.

Table 30-1: United Kingdom - parameters for FW estimation at regional level

Region	GDP PPP (EUR)	Tertiary education level	Median age	Population	N° of households
Tees Valley and Durham	20,600	32.2%	42.1	1,194,437	544,600
Northumberland and Tyne and Wear	24,500	34.7%	41.7	1,446,249	632,700
Cumbria	26,200	35.1%	47.1	498,641	243,500
Greater Manchester	26,800	38.8%	37.1	2,789,735	1,198,000
Lancashire	24,800	37.8%	42.0	1,487,102	633,800
Cheshire	37,700	46.6%	44.3	924,261	403,400
Merseyside	23,400	36.6%	40.5	1,541,473	696,200

East Yorkshire and Northern Lincolnshire	22,600	31.5%	43.2	929,189	422,000
North Yorkshire	26,400	47.7%	45.2	818,141	363,000
South Yorkshire	21,100	39.4%	39.1	1,389,426	609,100
West Yorkshire	26,000	37.3%	37.7	2,301,000	987,000
Derbyshire and Nottinghamshire	24,000	37.2%	41.3	2,187,643	953,500
Leicestershire, Rutland and Northamptonshire	27,300	38.8%	39.8	1,812,852	739,800
Lincolnshire	20,400	35.9%	45.4	747,996	329,500
Herefordshire, Worcestershire and Warwickshire	28,700	42.8%	44.4	1,338,055	580,800
Shropshire and Staffordshire	22,500	36.9%	43.4	1,613,788	687,100
West Midlands	26,000	32.6%	35.6	2,883,905	1,129,800
East Anglia	27,500	38.0%	43.1	2,493,326	1,108,800
Bedfordshire and Hertfordshire	32,000	46.4%	39.2	1,841,673	770,900
Essex	24,600	33.5%	42.0	1,813,609	767,900
Inner London — West	184,600	71.5%	34.9	1,163,136	573,600
Inner London — East	49,600	62.6%	32.6	2,367,065	1,150,400
Outer London — East and North East	21,300	46.3%	35.5	1,899,556	772,800
Outer London - South	26,400	52.7%	37.9	1,295,666	576,700
Outer London — West and North West	37,900	55.9%	36.4	2,071,842	851,000

Berkshire, Buckinghamshire and Oxfordshire	42,700	53.0%	39.3	2,385,514	978,400
Surrey, East and West Sussex	32,100	50.4%	43.0	2,871,387	1,259,900
Hampshire and Isle of Wight	30,600	42.9%	41.8	1,973,952	866,900
Kent	25,500	37.7%	41.4	1,824,794	786,500
Gloucestershire, Wiltshire and Bristol/Bath Area	31,200	45.7%	40.7	2,474,784	1,107,900
Dorset and Somerset	24,000	39.4%	46.2	1,322,286	590,800
Cornwall and Isles of Scilly	19,900	41.2%	46.8	560,526	257,800
Devon	22,800	43.1%	45.4	1,180,517	546,900
West Wales and The Valleys	19,400	37.0%	43.5	1,960,764	864,400
East Wales	27,700	43.2%	40.5	1,158,491	529,800
North Eastern Scotland	42,800	46.7%	40.0	491,323	226,600
Highlands and Islands	27,500	44.6%	46.4	469,420	227,100
Eastern Scotland	31,900	52.3%	41.0	1,976,392	908,300
West Central Scotland	26,700	44.4%	39.8	1,531,216	717,000
Southern Scotland	19,000	43.8%	45.9	946,372	435,900
Northern Ireland	23,900	37.2%	38.4	1,866,638	800,000
United Kingdom	31,100	43.2%	40.0	65,844,142	28,830,100

Source: author's elaboration on Eurostat data

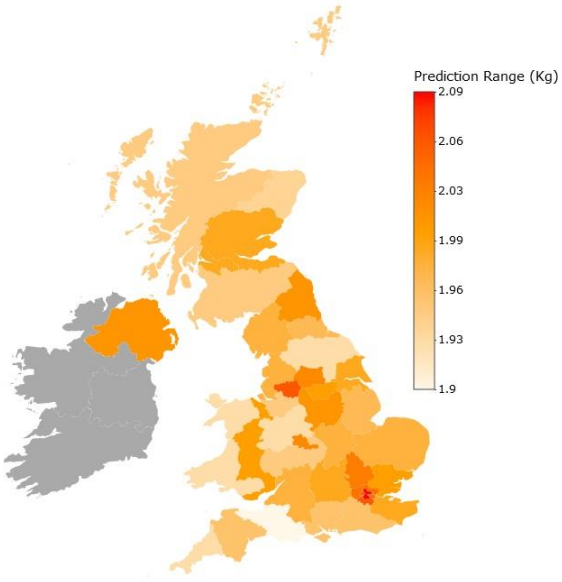

Figure 24 and
Table 30-2 summarize the food waste estimations for the country, both at the regional and national level, as developed by on basis of simulations run with the REFRESH Road Map (Stewart et al, 2019).

Figure 24: estimated FW per household in English regions

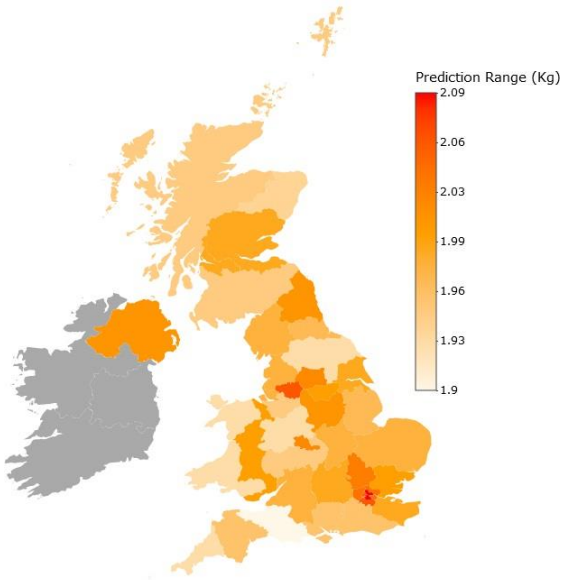

Table 30-2: United Kingdom – FW estimation at regional level

Region	*Household FW (kg/ year)*	Low 95% (kg/ year)	Up 95% (kg/year)	*Total FW (tons/year)*	Low 95% (tons/ year)	Up 95% (tons/ year)

Inner London — East	103.48	59.97	117.00	119,,043	68,,993	134,,597
Outer London - South	101.92	59.11	115.70	58,,777	34,,087	66,,724
Greater Manchester	101.40	58.59	114.92	121,,477	70,187	137,,674
Outer London — East and North East	100.88	58.07	114.40	77,,960	44,,874	88,,408
Outer London — West and North West	100.88	58.07	114.40	85,,849	49,,415	97,,354
Bedfordshire and Hertfordshire	99.84	57.55	113.36	76,,967	44,,363	87,,389
West Yorkshire	99.32	57.20	112.84	98,,029	56,,456	111,,373
West Midlands	99.06	57.20	112.58	111,,918	64,,625	127,,193
Derbyshire and Nottinghamshire	98.80	56.85	112.32	94,,206	54,,210	107,,097
Inner London — West	98.80	57.03	112.58	56,,672	32,,710	64,,576
Northern Ireland	98.80	56.68	112.84	79,,040	45,344	90,272
Northumberland and Tyne and Wear	98.28	56.51	111.80	62,,182	35,752	70,736
South Yorkshire	98.28	56.51	112.06	59,,862	34,418	68,256
Essex	98.28	56.51	111.54	75,,469	43,391	85,652
East Wales	98.28	56.85	112.06	52,069	30,121	59,369
Eastern Scotland	98.28	56.68	111.54	89,268	51,482	101,312
West Central Scotland	98.02	56.51	111.80	70,280	40,515	80,161
Berkshire, Buckinghamshire and Oxfordshire	97.76	56.33	111.80	95,648	55,117	109,385
East Yorkshire and Northern Lincolnshire	97.24	55.81	110.76	41,035	23,553	46,741

Leicestershire, Rutland and Northamptonshire	97.24	55.99	110.76	71,938	41,419	81,940
Kent	97.24	56.16	110.76	76,479	44,170	87,113
Gloucestershire, Wiltshire and Bristol/Bath Area	97.24	56.16	110.76	107,732	62,220	122,711
Lancashire	96.98	55.81	110.76	61,466	35,374	70,200
Cumbria	96.72	55.64	110.76	23,551	13,548	26,970
Merseyside	96.72	55.81	110.76	67,336	38,857	77,111
Lincolnshire	96.72	55.81	110.24	31,869	18,390	36,324
East Anglia	96.72	55.81	110.24	107,243	61,886	122,234
Tees Valley and Durham	96.46	55.47	109.98	52,532	30,207	59,895
Surrey, East and West Sussex	96.20	55.47	109.72	121,202	69,882	138,236
Hampshire and Isle of Wight	96.20	55.47	109.72	83,396	48,084	95,116
Devon	96.20	55.29	109.72	52,612	30,240	60,006
Southern Scotland	96.20	55.12	109.98	41,934	24,027	47,940
Highlands and Islands	95.94	55.12	109.46	21,788	12,518	24,858
Cheshire	95.68	54.77	109.72	38,597	22,096	44,261
Herefordshire, Worcestershire and Warwickshire	95.68	54.95	109.72	55,571	31,913	63,725
North Yorkshire	95.16	54.60	108.68	34,543	19,820	39,451
North Eastern Scotland	95.16	54.77	108.68	21,563	12,412	24,627
Cornwall and Isles of Scilly	94.64	54.43	108.68	24,398	14,031	28,018
West Wales and The Valleys	94.64	54.08	108.16	81,807	46,747	93,494

Shropshire and Staffordshire	94.12	54.08	107.64	64,670	37,158	73,959
Dorset and Somerset	93.08	53.04	106.60	54,992	31,336	62,979
United Kingdom	97.76	56.16	111.28	2,818,431	1,619,098	3,208,214

Note: differences among the national values estimation and the sum of single regional values are due to computational approximations,

Source: REFRESH Road Map

The predicted food waste for United Kingdom, considering the actual regional values for GDP per capita and higher education level amounts to **97.76** kg per household and an overall total of almost **2,818,431** tons per year,
At the regional level, the lowest estimated values of food waste are registered in Dorset and Somerset, with an average household FW of **97.76** kg per year, while the highest are recorded in Inner London — East, with a value of **103.48** kg per year.

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