Air emissions accounts (AEA) – assessment of early estimates for the reference year 2020

Eurostat E2, February 2023

1 Introduction

This note analyses early estimates of annual air emissions accounts (AEA) for the reference year 2020, which Eurostat published in December 2021 (*2021-vintage of early estimate*). Eurostat's early estimates include annual emissions of six greenhouse gases (CO_2, CH_4, N_2O, HFC, PFC, SF6_NF3) in a breakdown by emitting production activities (NACE) and households for each EU Member State and the aggregated EU economy. The procedure for early estimates is fully integrated into the routine annual AEA production cycle, i.e. validation and gap-filling procedures.

GHG proxy inventories for the reference year 2020 as published in autumn 2021 had been the most important input data source for Eurostat's 2021-vintage of early estimation of annual AEA for reference year 2020. The method employed further the UNFCCC GHG inventory submitted in 2021 (reference year 2019) and the AEA submitted in 2021 (reference year 2019). For detailed information, see Eurostat's procedure for early estimates of AEA and the data flow scheme in Annex.

This report assesses the quality of Eurostat's 2021-vintage of early estimates for the reference year 2020 by analysing the estimation error. The AEA estimation error is defined as the difference between the *2021-vintage of early estimate* and the actual *2022-outturn* reported in September 2022 and published in December 2022. Eurostat E2 undertakes this assessment every year enabling a routine monitoring and assessment.

The overall estimation error is decomposed into two effects:

- Effect 1 – due to revisions of input data (between 2021 and 2022):

This effect quantifies the part of the overall estimation error that is due to revisions of the input data sets originally fed into the 2021 early estimation process. First, GHG inventory data revisions (for reference years 2020 and 2019) may have occurred between September 2021 (proxy GHG inventory) and April 2022 (UNFCCC GHG inventory, i.e. first regular reporting for reference year 2020). Secondly, AEA data (reference year 2019) may have changed between transmissions in September 2021 and September 2022.

This effect is quantified by simulating the early estimation procedure with updated (revised) input data available in 2022, i.e. one year later than the initial early estimate (performed in 2021). Effect 1 is the difference between the simulated 2022-vintage of early estimate in comparison to the initial 2021-vintage of early estimate.

- Effect 2 – due to early estimation methodology:

Effect 2 is the remaining part of the overall estimation error, which can be assigned solely to the estimation methodology. It is quantified by deducting the data revision effect 1 from the overall estimation error.

2   Assessment for the EU-27 – aggregate of six greenhouse gases

The 2022-outturn of EU-27's total GHG emissions for reference year 2020 is 3 450 million tonnes. The 2021-vintage of early estimate was 3 503 million tonnes. The difference between the former and the latter is the overall estimation error: 53 million tonnes or 1.5 % (see Table 1). 2020 was the first year of the COVID-19 pandemic and it is not surprising that the 2021-vintage of Eurostat's early estimate is higher than the 2022-outturn.

The overall error is composed of two parts: the revision effect 1 amounts to 26.7 million tonnes (-0.77 %) while the remaining effect 2 (due to estimation method) amounts to 26.3 million tonnes (0.76 %) (see Table 1).

Table 1: Air emissions accounts' early estimates of GHG emissions (million tonnes, MIO_T) for the reference year 20 – Analysis of estimation errors for EU-27

NACE	2021-vintage of early estimate	2022-outturn (reported)	2022-simulation of early estimate	Overall estimation error		Effect 1 (revised input data)		Effect 2 (estimation method)	
	MIO_T			MIO_T	%	MIO_T	%	MIO_T	%
AEA total	**3 503.1**	**3 450.1**	**3 476.4**	**53.0**	**1.54%**	**26.7**	**0.77%**	**26.3**	**0.76%**
Electricity (D)	718.9	670.1	674.7	48.7	7.3%	44.2	6.6%	4.6	0.7%
Land transport (H49)	159.2	141.4	138.1	17.8	12.6%	21.1	14.9%	-3.3	-2.3%
Households-transport	302.0	313.4	315.5	-11.4	-3.6%	-13.5	-4.3%	2.1	0.7%
Air transport (H51)	71.4	61.5	63.2	10.0	16.2%	8.2	13.4%	1.8	2.9%
Manufacture of coke and refined petroleum products (C19)	116.1	125.3	126.8	-9.2	-7.4%	-10.8	-8.6%	1.5	1.2%

Table 1 presents the economic activities contributing the most to the overall estimation error, namely electricity (+48.7 million tonnes), land transport (+17.8 million tonnes), households - transport (-11.4 million tonnes), air transport (+10 million tonnes) and manufacture of coke and refined petroleum products (-9.2 million tonnes).

In all mentioned categories, revisions of input data (effect 1) were the main source of the estimation error.

3 Assessment by country

The overall estimation error – about 53 million tonnes – can also be broken down by country (see Table 2). By far, Germany (+31.6 million tonnes) shows the estimation error with the largest effect in relation to EU's overall estimation error. Further, the estimation errors for France (+9.7 million tonnes) and Czechia (+6.3 million tonnes) significantly affect the overall estimation error at EU level.
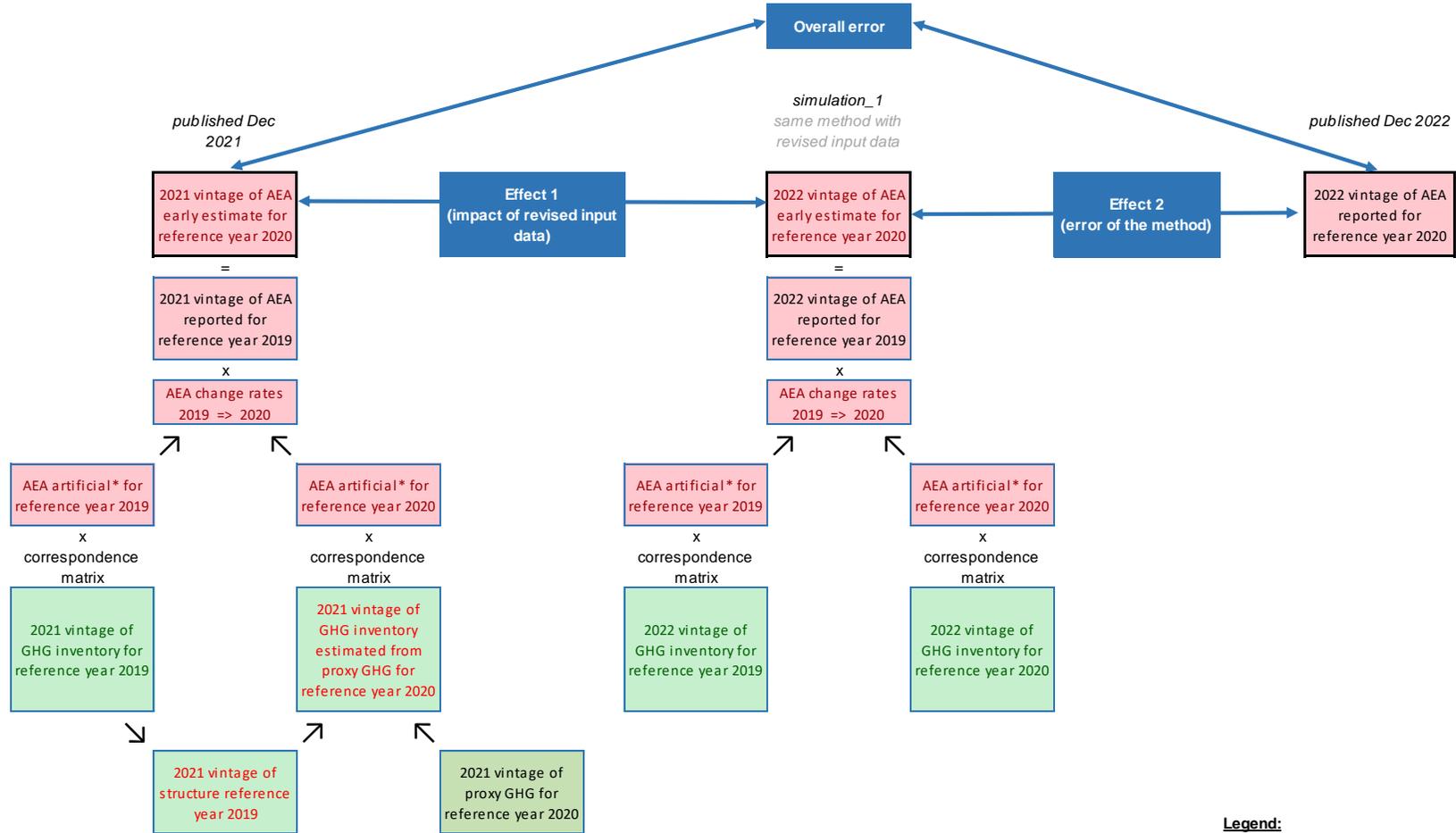
Table 2: Air emissions accounts' early estimates of GHG emissions (thousand tonnes, THS_T) for the reference year 2020 – Analysis of estimation errors by country

	2021-vintage of early estimate	2022-outturn (reported)	2022-simulation of early estimate	Overall estimation error		Effect 1 (revised input data)		Effect 2 (estimation method)	
	THS_T			THS_T	%	THS_T	%	THS_T	%
EU27_2020	**3 503 108**	**3 450 087**	**3 476 395**	**53 021**	**1.53**	**26 713**	**0.77**	**26 308**	**0.76**
Austria	67 801	68 581	68 023	-780	-1.15	-222	-0.33	-558	-0.82
Belgium	110 307	106 140	109 297	4 168	3.81	1 010	0.92	3 157	2.89
Bulgaria	53 057	50 645	50 512	2 412	4.78	2 545	5.04	-133	-0.26
Croatia	23 305	23 929	24 111	-624	-2.59	-806	-3.34	182	0.76
Cyprus	8 673	8 548	9 327	125	1.33	-655	-7.02	779	8.35
Czechia	109 477	103 132	104 238	6 345	6.09	5 240	5.03	1 105	1.06
Denmark*	80 445	77 468	77 468	2 976	3.84	2 976	3.84	0	0.00
Estonia	12 066	11 875	11 766	191	1.62	299	2.54	-108	-0.92
Finland	50 878	49 404	50 572	1 474	2.91	306	0.61	1 168	2.31
France	405 954	396 211	401 199	9 743	2.43	4 755	1.19	4 988	1.24
Germany	794 997	763 415	782 374	31 582	4.04	12 623	1.61	18 958	2.42
Greece	87 441	89 426	86 952	-1 985	-2.28	489	0.56	-2 474	-2.85
Hungary	67 696	65 698	66 231	1 998	3.02	1 465	2.21	533	0.80
Ireland	64 658	63 401	64 722	1 257	1.94	-63	-0.10	1 321	2.04
Italy*	393 308	391 781	391 781	1 527	0.39	1 527	0.39	0	0.00
Latvia*	12 077	11 635	11 635	442	3.80	442	3.80	0	0.00
Lithuania	25 248	27 038	25 206	-1 790	-7.10	42	0.17	-1 832	-7.27
Luxembourg	9 939	9 899	9 740	40	0.41	199	2.04	-159	-1.63
Malta	2 218	2 293	2 388	-75	-3.13	-169	-7.10	95	3.96
Netherlands*	179 424	181 116	181 116	-1 692	-0.93	-1 692	-0.93	0	0.00
Poland	391 525	393 146	393 308	-1 622	-0.41	-1 783	-0.45	161	0.04
Portugal	61 680	59 437	59 217	2 243	3.79	2 463	4.16	-220	-0.37
Romania	111 114	115 764	115 410	-4 650	-4.03	-4 296	-3.72	-354	-0.31
Slovak Republic	37 575	37 071	36 909	504	1.37	667	1.81	-162	-0.44
Slovenia	17 950	16 410	16 270	1 541	9.47	1 680	10.32	-139	-0.86
Spain*	274 575	279 007	279 007	-4 433	-1.59	-4 433	-1.59	0	0.00
Sweden*	49 721	47 617	47 617	2 104	4.42	2 104	4.42	0	0.00

* not estimated by Eurostat because countries provided their own early estimates

Annex: Data flow scheme for AEA early estimates of greenhouse gas emissions for reference year 2020

AEA tool for quality assessment of early estimates - scheme

Overall error

published Dec 2021

simulation_1
same method with revised input data

published Dec 2022

| 2021 vintage of AEA early estimate for reference year 2020 | **Effect 1 (impact of revised input data)** | 2022 vintage of AEA early estimate for reference year 2020 | **Effect 2 (error of the method)** | 2022 vintage of AEA reported for reference year 2020 |

=

2021 vintage of AEA reported for reference year 2019

x

AEA change rates 2019 => 2020

=

2022 vintage of AEA reported for reference year 2019

x

AEA change rates 2019 => 2020

AEA artificial* for reference year 2019

x correspondence matrix

AEA artificial* for reference year 2020

x correspondence matrix

AEA artificial* for reference year 2019

x correspondence matrix

AEA artificial* for reference year 2020

x correspondence matrix

2021 vintage of GHG inventory for reference year 2019

2021 vintage of GHG inventory estimated from proxy GHG for reference year 2020

2022 vintage of GHG inventory for reference year 2019

2022 vintage of GHG inventory for reference year 2020

2021 vintage of structure reference year 2019

2021 vintage of proxy GHG for reference year 2020

Legend:

NACE-HH vector

CRF vector

simplified CRF vector

* *AEA artificial* denotes an AEA questionnaire populated from GHG inventory using a specific correspondence matrix

For further details see: Eurostat's early estimation method