LITHUANIA'S INFORMATIVE INVENTORY REPORT 2023

Air Pollutant Emissions 1990-2021

under the UNECE CLRTAP and the EU NECD

Part 4 – Industrial processes and product use

Lithuanian Environmental Protection Agency

Contents

Part 4 – Industrial Processes and Product Use

1. Industrial Processes (NFR 2A, 2B, 2C)

The economic structure of Lithuania has gone through noticeable changes. During the period of 1992–1994, the share of industry in the GDP dropped from 35.5 % to 20.4 %, while the share of trade in the GDP structure grew from 4.5 to 23.5 %. Since 1992, economic recession resulted in the reduction of energy consumption, but the latter was slower than the decline in GDP. Therefore, energy demand of the national economy during this period was growing in relative terms. It is evident that the production output varied between different industries. As the most serious decline was observed in the production of electronic equipment, machinery, metalworking, the likelihood of reaching the former levels of production is quite low for these sectors. Since 1991, Lithuania's export to the western countries has increased from 5.1 % to 54.6 % of total exports. It should be noted that the share of imports from these countries into Lithuania has also increased from 9.8 % to 67.1 % of the total imports. The main trading partners of Lithuania are Russia, Germany, Belarus, Latvia, Ukraine, the Netherlands, Poland, and Great Britain.

This chapter covers emissions from industrial processes (NFR sectors 2A,B,C,D). Dominating industry in Lithuania is manufacturing. Manufacturing constituted 87% of the total industrial production (except construction) in 2011. Four most important sectors within Manufacturing cumulatively produced 78% of production:

- Manufacture of refined petroleum products (~30%);
- Manufacture of food products and beverages (~20%);
- Manufacture of wood products and furniture (~10%);
- Manufacture of chemicals and chemical products (~10%).

1.1. Cement production (NFR 2.A.1)

1.1.1. Overview of the sector

Cement is produced in a single company - AB Akmenės Cementas, which is situated in the North Western part of Lithuania. The factory was constructed in soviet times (1947-1974), cement produced in the factory was exported to other Republics of USSR, Hungary, Cuba and Yugoslavia. The total nominal capacity of the plant is about 5 million tonnes cement per year. The data on clinker production and composition were provided by the AB Akmenės Cementas. Activity data is collected on company level. Sourse description: In Lithuania, cement production takes place only in one factory. Cement production emits both fuels burning and process emissions. 2006 The company has made significant progress in introducing new 4,500 t / d dry production clinker production lines. From 2014 August the process of using a fully dry process stove was initiated, while until 2014 it was only using wet process furnace in cement production. Fuel combustion emissions are provided in the energy sector (CRF 1.A.2.f i), with the exception of NO_X and SO_2 emissions provided in sector 2.A.1. The main emissions from cement production are air emissions from the furnace system. Pollutants are emitted from physical and chemical raw material reactions and fuel. The main components of the exhaust gases are nitrogen and excess oxygen from the combustion air stream and carbon dioxide and water from raw materials and the combustion process, which is an integral part of the process. Outgoing gas also has a small amount of air pollutants.

1.1.2. Methodological issues

Emissions from the stove are a mixture of combustion and emissions released during the process. The main source of emissions (NOx, SOx, CO, NMVOC and NH3) as well as HM and POP, it mainly originates from the combustion of fuels, therefore these emissions are provided in sector 1A.2.f, which deals with the combustion process in the cement production process because it is not possible to separate process and combustion emissions from cement production. Since emission factors are expressed as mass of clinker produced, activity statistics must be converted from cement to clinker production statistics. Most of the cement produced is Portland cement with an average clinker content of 90-97% (IPCC, 2006). The amount of clinker production was obtained from Akmenės cementas since 1990.

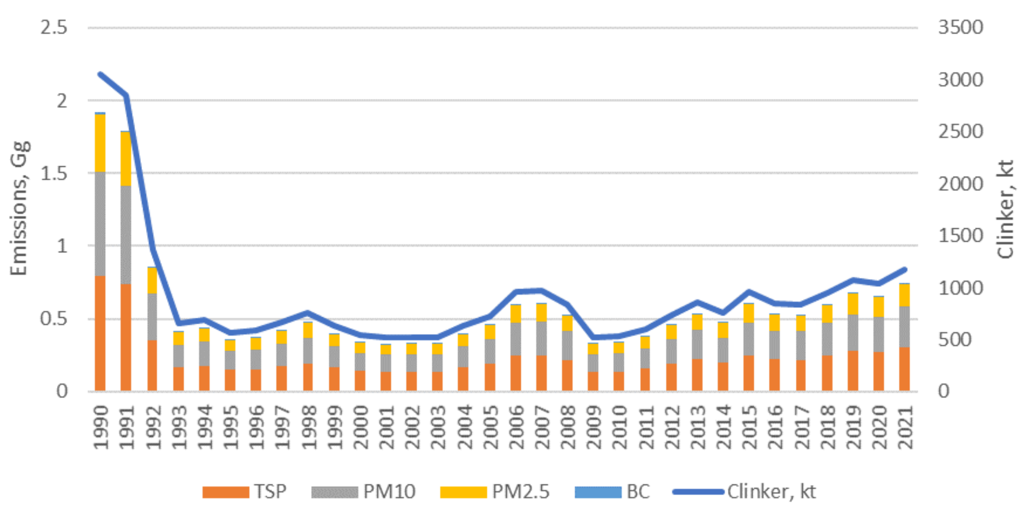

Figure 4-1 Clinker amount and emissions in 2.A.

The Tier 1 approach for process emissions from cement uses the general equation

$$E_{pollutant} = AR_{production} * EF_{pollutant}$$

where:

- *Epollutant* is the emission of a pollutant (kg)
- *ARproduction* is the annual production of cement (in Mg)
- *EFpollutant* is the emission factor of the relevant pollutant (in kg pollutant / Mg cement produced)

This equation is applied at the national level, using annual national total cement production data and EF provided in EMEP/EEA guidebook, 2019.

1.1.3. Activity data

Activity data uncertainty is assumed to be 2%. Data on clinker production provided by the single production company is considered reliable;

1.1.4. Source-specific QA/QC and verification

All quality procedures according to the Lithuanian QA/QC plan have been implemented during the work with this submission.

1.1.5.Source-specific recalculations

No source specific recalculations.

1.1.6.Source-specific planned improvements

No source-specific improvements.

1.2. Lime production (NFR 2.A.2)

1.2.1. Overview of the sector

Emissions from the lime production industry include emissions of PM from limestone mining, processing, splitting, sifting and calcination, and emissions of air pollutants from fuel combustion. Since 1999 data on the production of hydrated lime are provided by the Statistics Lithuania. The hydrated lime fraction ranged from 0% to 4%. National statistical data do not include non-commercial data on lime production from sugar undertakings and therefore for the whole period from 1990 onwards the quantities of lime produced were obtained directly from sugar-producing companies (lime deposited and used in agricultural activities).

Emissions from the lime industry are the result of two main processes of lime processing: quarrying, crushing and sizing of minerals; and fuel burning in lime stoves. Emissions from lime production are determined by both processes and fuel combustion. Emissions from combustion are provided in 1.A.2.f.i Stationary combustion in other manufacturing and construction industries. SOx and NOx emissions are provided in (IE) source category 1.A.2.f.i.

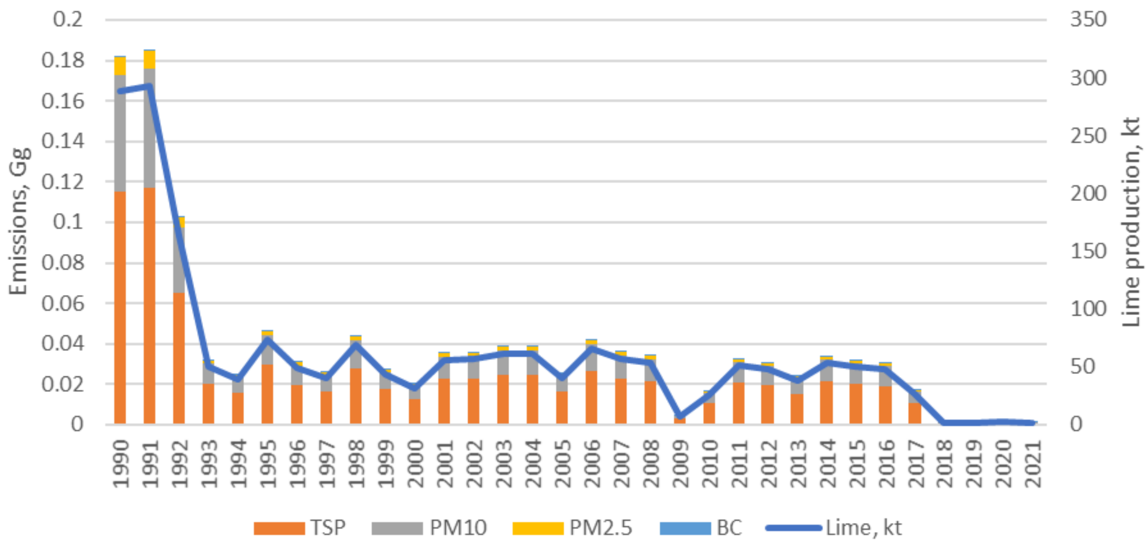

Figure 4-2 Lime production

1.2.2. Methodological issues

Since 2005 the best available technologies (BAT) have been introduced in the installations, and emissions from the production processes are controlled. Therefore, since 2005, for particulate matters and BC are used for controlled processes EF from EMEP / EEA 2019.

The Tier 1 approach for process emissions from cement uses the general equation

$$E_{pollutant} = AR_{production} * EF_{pollutant}$$

where:

- *Epollutant* is the emission of a pollutant (kg)
- *ARproduction* is the annual production of cement (in Mg)
- *EFpollutant* is the emission factor of the relevant pollutant (in kg pollutant / Mg cement produced)

This equation is applied at the national level, using annual national total cement production data and EF provided in EMEP/EEA guidebook, 2019.

1.2.3. Source-specific QA/QC verification

All quality procedures according to the Lithuanian QA/QC plan have been implemented during the work with this submission.

1.2.4.Source-specific recalculations

No source specific recalculations.

1.3. Glass production (NFR 2.A.3)

1.3.1. Overview of the sector

NMVOCs, along with heavy metals (Cr, Cd, Hg, Pb, As) together with Cu, Zn, Se, Ni, NH3, PM2.5, PM10, TSP and BC are released during the industrial production of flat glass, container glass, glass fibers, and glass wool in modest amounts. In Lithuania, statistics are available on the amounts of specific glass produced, such as bottles, flat sheets, glass wool, and so forth.

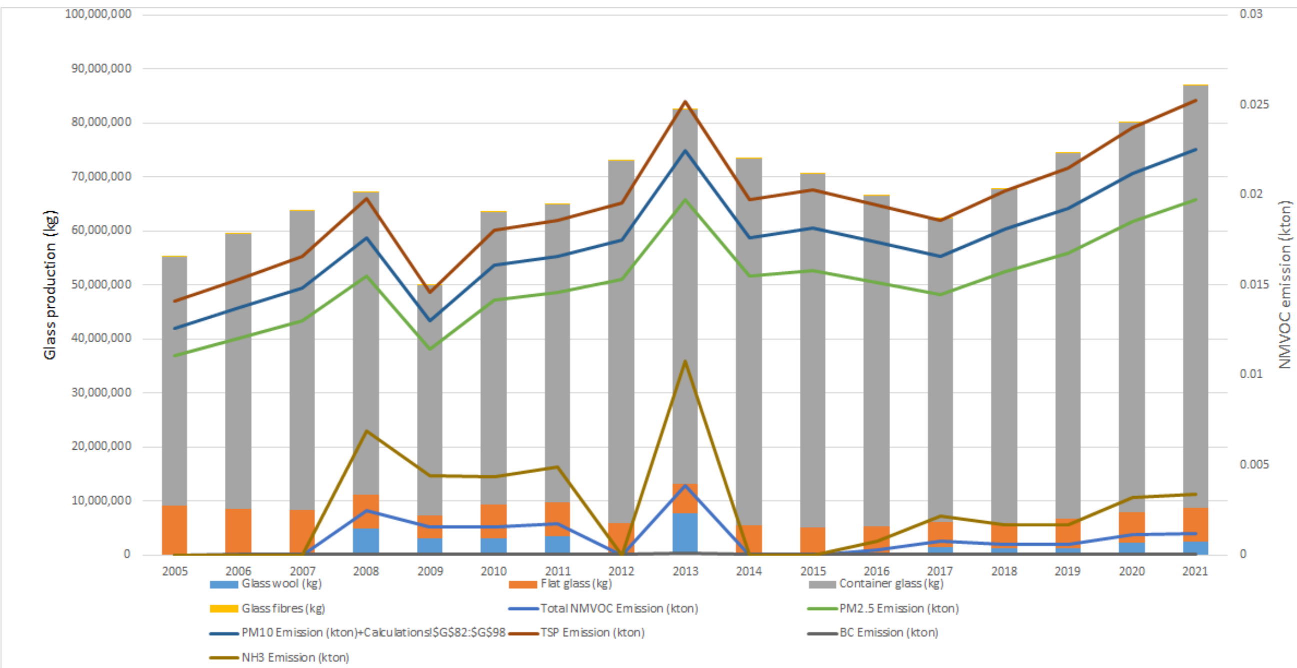

Figure 4-3 Glass production along with emission of relevant pollutants (kton), excluding heavy metals

1.3.2. Activity data

Only local production of glass was considered. We have gathered production values for flat glass, glass wool, container glass, and glass fibers from the Eurostat database. Specifically, woven fabrics of glass fibre, glass fibre mats, glass fibre mats made of glass wool, glass fibres, mats of irregularly laminated glass fibres, sheets of glass, safety glass, other glass mirrors, optical glass, laminated safety glass, insulating glass units, glass jars, bottles, and glass in mass along with slag wool were considered from emission calculations.

1.3.3. Emission factors

For the estimation of pollutant emissions, we have used Tier 2 approach, in which we have taken the Eurostat data on the glass production in four main categories – glass fibre production, production of flat glass, container glass production, and glass wool production. For each catogery we have applied relevant emission factors from the EMEP/EEA guidebook, 2019, 2.A.3, tables 3.2, 3.3, 3.4, and 3.5.

$$E_{pollutant} = AR_{production} * EF_{pollutant}$$

where:

- *Epollutant* is the emission of pollutant (g)
- *ARproduction* – production of relvant glass product (from 4 key categories) (in kg)
- *EFpollutant* is the emission factor of the relevant pollutant (in g pollutant per kg of relevant glass produced)

1.3.4. Source-specific planned imrpvements

In the future, we will consider doing a small study concerning the abatement procedures in glass production, so that the relevant abatement technologies can be applied.

1.4. Quarrying and mining of minerals other than coal (NFR 2.A.5.a)

1.4.1. Overview of the sector

Based on 2016 Technical Guidance, emissions from this sector are insignificant, as their contribution to total national emissions is less than 1% of any pollutant. Although emissions from the sector are significant at local level, emissions at national level are relatively low and only relevant for relatively particulate fraction.

There are several non-metallic minerals quarried in Lithuania: dolomite, limestone, gravel, sand and peat. The occurring emissions from this sector are particulate matters: TSP, PM_{10} and $PM_{2.5}$.

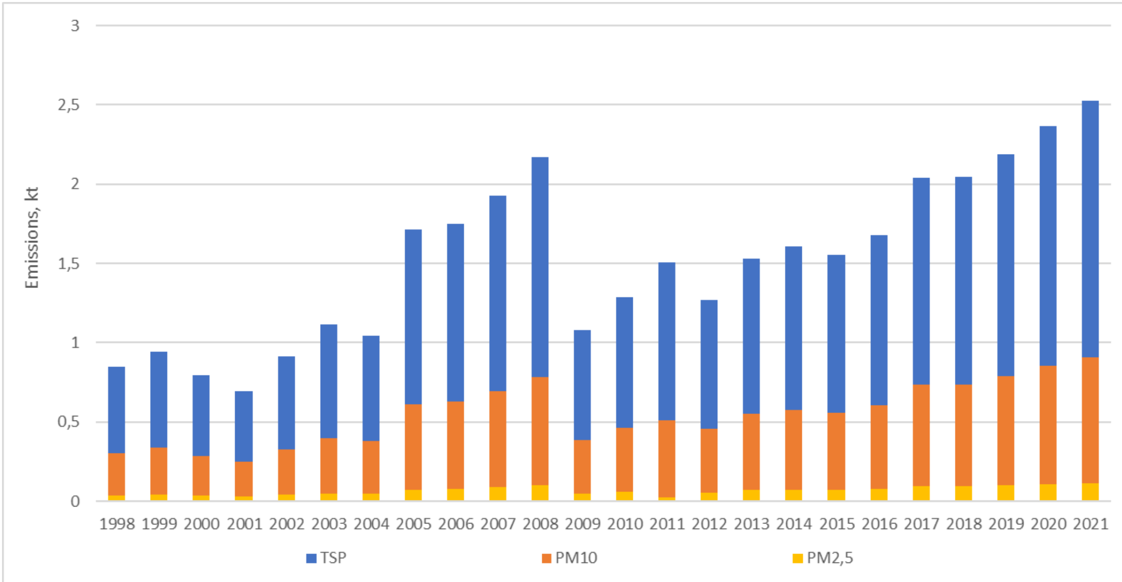

Figure 4-4. Emissions from the sector 2.A.5.a 1998 – 2021

1.4.2. Methodological issues

Activity data for calculating emissions were taken from the Lithuanian Geological Survey Underground register reports. Since there is no possibility for Lithuania to gather the disaggregated activity data required in the spreadsheet available in the 2019 EMEP Guidebook in order to apply 2019 EMEP Guidebook Tier 2 methodology, emissions were calculated using Guidebook 2016 Tier 2 methodology:

$$E_{Pollutant} = AR_{production} \times EF_{pollutant}$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant

$AR_{production}$ – the activity rate for the quarrying/mining

$EF_{pollutant}$ – the emission factor for this pollutant

1.4.3. Source-specific planned improvements

Environmental protection documents (IPPC permits, environmental impact assessments and etc.) suggested previously or company surveys are not suitable methods of data gathering in this case. None of the aforementioned documents provide data required for the calculations, this is seen in the previous analysis of the aforementioned documents. Surveys have also failed to provide representative data for the calculations.

According EU Environmental Protection Agency, countries are not permitted from using methodologies from the older versions of the Guidebook Tier 2 methodologies. Furthermore, it is not permitted to use country's own calculation methodology or well supported methodology developed by other country.

It should also be noted that companies in Lithuania do not gather data required for Tier 2 calculations. Furthermore, the meteorological data required must be processed first and additional calculations should be done before using the data.

Based on the arguments above, we recommend to calculate emissions for 2.A.5.a sector with Guidebook 2016 Tier 2 methodology. In order to apply Guidebook 2019 Tier 2 methodology, a research is necessary to determine the required indicators. Currently, it is financially impossible for Lithuania to conduct such research. The possible ways to resolve the issue and application of 2019 Guidebook Tier 2 methodology will be discussed with the experts during TAIEX-EIR Expert Mission on Air Emission inventory and assessment of the impact of policies and measures on emissions in May.

1.5. Construction and demolition (NFR 2.A.5.b)

1.5.1. Overview of the sector

The following activities are included in this NFR sector: Construction of new roads, Construction of new urban streets, Construction of new bicycle tracks, Construction of new railway tracks, Non-residential construction, Apartment buildings, Detached single/two family houses. The activity data were taken/derived from the information provided by the Statistics Lithuania indicators database.

<u>Thornthwaite precipitation-evaporation index (PE)</u> in Lithuania was used for all above mentioned activites; values of this index are as follows (the input for calculation of these values was provided by Lithuanian Hydrometeorological Service):

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
PE for Lithuania	73,34	62,57	88,14	69,83	80,03	128,32	76,16	112,22	74,54	68,44	61,19	90,52	92,68	59,47	64,18	57,69	73,75
24/PE	0,33	0,38	0,27	0,34	0,30	0,19	0,32	0,21	0,32	0,35	0,39	0,27	0,26	0,40	0,37	0,42	0,33

Figure 4-5 Thornthwaite precipitation-evaporation index (PE) in Lithuania, 2005-2021.

<u>Soil silt content (s) %</u>, is equal 20 and variable (s/9) has value 2,22 for all years. Emissions of TSP were evaluated but not reported due to the large values those were obtained (e.g. 20-40 kt per year in construction of new roads) and taking into account the note in the GB2019: „All emission literature dealing with construction activities states that the estimated emissions by the construction industry are

only a first order quantification of the actual emissions and the uncertainty is high, much higher than for most other sources of primary PM“

1.1.1. Construction of new roads: activity, parameters and emission factors

The Statistics Lithuania indicators database provides only length of roads at the end of the year and these data are as follows:

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2005-2021
Length of roads, km (data in the indicator database)	Total roads	79331	79497	79984	80715	81030	81331	82131	82911	84166	84467	85034	84933	84495	84317	85572	85086	84769	84893	
Difference in relation to the last year, km			166	487	731	315	301	800	780	1255	301	567	-101	-438	-178	1255	-486	-317	124	5562
Length of new roads, km (method A)	Negative values replaced by 0		166	487	731	315	301	800	780	1255	301	567	0	0	0	1255	0	0	124	
Length of new roads, km (method B)	The sum of differences (including the negative values) is devided by amount of years		327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	327,1765	

Figure 4-6 Initial statistics on the lenghts of roads and derivation of the length of new roads

As can be seen from the Figure 4-6, the initial statistics is hard to interpret: the differences between current and last years can be very large (1255) or negative (-438). For the estimating of PM emissions, length of the new roads was evaluated by method B: the sum of differences (including the negative values) in the period 2005-2021 (5562) was devided by amount of years in the period 2005-2021 (17). The method B allows to avoid big fluctuations.

Affected area, (m^2/km), was 36000, duration of construction (d), was 1 year , control efficiency of applied emission reduction measures was evaluated as 0,5 for all years 2005-2021.

Emission factors for PM from the Table 3.4 „Tier 1 emission factors for uncontrolled fugitive emissions for source category 2.A.5.b Construction and demolition – Road construction“ (GB2019, chapter 2.A.5.b Construction and demolition) were used.

1.1.2. Construction of new urban streets: activity, parameters, and emission factors

The Statistics Lithuania indicators database provides only length of urban streets at the end of the year and these data are as follows:

		2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2009-2021*
Length of urban streets at the end of the year, km		6190	6255	6336	6604	6787	7068	7109	7076	7227	7149	6641	6616	6681	6624	
Difference in relation to the last year, km		0	65	81	268	183	281	41	-33	151	-78	-508	-25	65	-57	434
Length of new roads, km (method A)	Negative values replaced by 0		65	81	268	183	281	41	0	151	0	0	0	65	0	
Length of new roads, km (method B)	The sum of differences (including the negative values) is devided by amount of years		33,4	33,4	33,4	33,4	33,4	33,4	33,4	33,4	33,4	33,4	33,4	33,4	33,4	

Figure 4-7 Initial statistics on the lenghts of urban streets and derivation of the length of new streets.

As can be seen from the Figure 4-7, the initial statistics is hard to interpret: the differences between current and last years can be large negative (-438). For the estimating of PM emissions, length of the new roads was evaluated by method B: the sum of differences (including the negative values) in the period 2009-2021 (434) was devided by amount of years in the period 2009-2021 (13). The method B allows to avoid big fluctuations. For years 2005-2008, the value equal to 33,4 was applied.

Parameters: Affected area, (m^2/km), was 36000, duration of construction (d), was 1 year , control efficiency of applied emission reduction measures was evaluated as 0,5 for all years 2005-2021.

Emission factors for PM from the Table 3.4 „Tier 1 emission factors for uncontrolled fugitive emissions for source category 2.A.5.b Construction and demolition – Road construction“ (GB2019, chapter 2.A.5.b Construction and demolition) were used.

1.1.3. Construction of new bicycle tracks: activity, parameters and emission factors

The Statistics Lithuania indicators database provides only length of bicycle tracks at the end of the year and these data are as follows:

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Length of bicycle paths at the end of the year, km					552,9	564	658,7	762,1	863,5	909	1001	1042,1	1064,7	1284,9	1344	1405,2	1543,3
Difference in relation to the last year, km						11,1	94,7	103,4	101,4	45,5	92	41,1	22,6	220,2	59,1	61,2	138,1
Length of new paths, km	11,1	11,1	11,1	11,1	11,1	11,1	94,7	103,4	101,4	45,5	92	41,1	22,6	220,2	59,1	61,2	138,1

Figure 4-8 Initial statistics on the lenghts of new bicycle tracks

In this case, length of new bicycle tracks is equal to the difference in relation to the last year.

Parameters: Affected area, (m^2/km), was 9000 (1/4 of „normal roads“), duration of construction (d), was 1 year , control efficiency of applied emission reduction measures was evaluated as 0,5 for all years 2005-2021.

Emission factors for PM from the Table 3.4 „Tier 1 emission factors for uncontrolled fugitive emissions for source category 2.A.5.b Construction and demolition – Road construction“ (GB2019, chapter 2.A.5.b Construction and demolition) were used.

1.1.4. Construction of new railway tracks: activity, parameters and emission factors

The length of the new railway tracks was derived from Statistics Lithuania published data.

		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Single track railway	Length, km:	0	0	0	0	2,4	0	1	0	0	0	147	56,3	0	0,6	0	0	0

Figure 4-9 Initial statistics on the lenghts of new railway tracks

Parameters. Affected area, (m^2/km), was 12000 (1/3 of „normal roads“), duration of construction (d), was 1 year , control efficiency of applied emission reduction measures was evaluated as 0,5 for all years 2005-2021.

Emission factors for PM from the Table 3.4 „Tier 1 emission factors for uncontrolled fugitive emissions for source category 2.A.5.b Construction and demolition – Road construction“ (GB2019, chapter 2.A.5.b Construction and demolition) were used.

1.1.5. Construction of new buildings: activity, parameters and emission factors

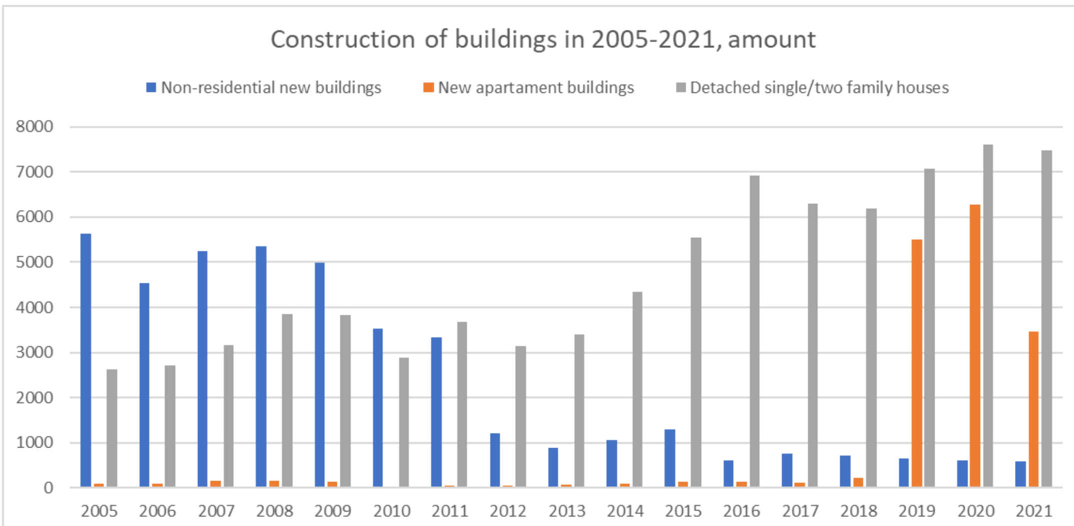

Figure 4-10 Number of new buildings in 2005-2021

The parameters and emission factors those were used: for the new non-residentials buildings, the apartement buildings and residential houses the affected area and duration were default (taken from GB2019). The emission factors for the new non-residentials buildings were taken from the Table 3.3 „Tier 1 emission factors for uncontrolled fugitive emissions for source category 2.A.5.b Construction and demolition – Non-residential construction“, for the apartement buildings - Table 3.2 „Tier 1 emission factors for uncontrolled fugitive emissions for source category 2.A.5.b Construction and demolition – Construction of apartment building“, for the residential houses - Table 3.1 „Tier 1 emission factors for uncontrolled fugitive emissions for source category 2.A.5.b Construction and demolition – Construction of houses“ (GB2019, chapter 2.A.5.b Construction and demolition).

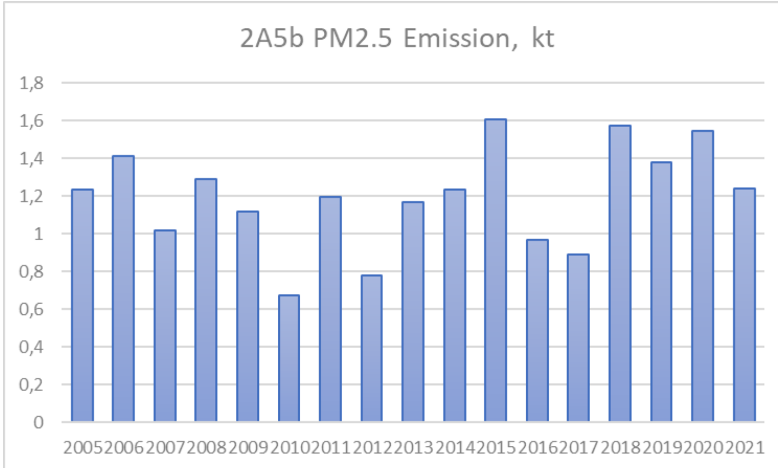

Figure 4-11 PM2.5 emission in 2A5b

Emissions of PM10 were 10 times higher. PM2.5 emissions in 2021 have increased 0,5% vs 2005.

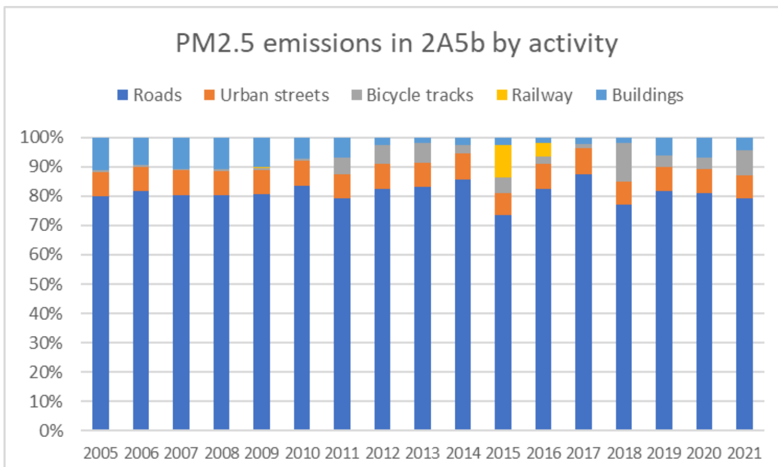

Figure 4-12 PM2.5 emission in 2A5b by activity

1.6. Storage, handling and transport of mineral products and steel production (NFR 2.A.5.c)

1.6.1. Overview of the sector

The activity data for storage, handling and transport of mineral products covers the crude and manufactured minerals, building materials, unloaded in Klaipėda state seaport and Būtingė terminal. The emissions from this sector include particulate matters: TSP, PM_{10} and $PM_{2.5}$.

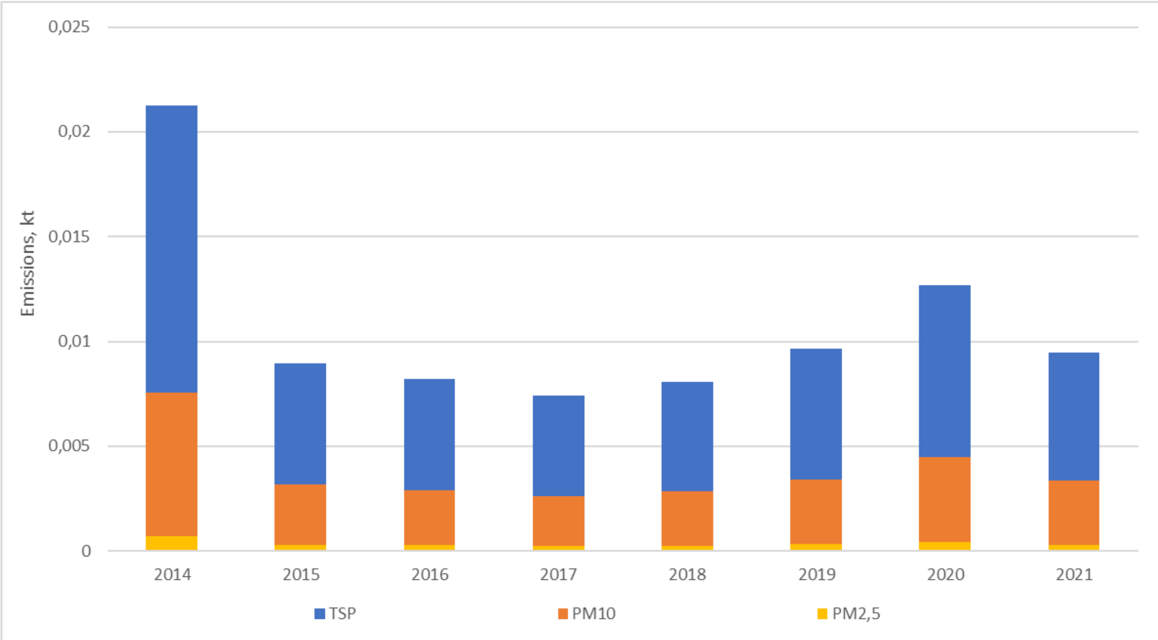

Figure 4-13 . Emissions from the sector 2.A.5.c 2014 – 2021

1.6.2. Methodological issues

Activity data for calculating emissions were taken from national statistics. Emissions were reported since 2014, for earlier years activity data were not available. Emission factors were taken from 2019 Guidebook, Tier 2 methodology was used.

$$E_{Pollutant} = AR_{production} \times EF_{pollutant}$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant

$AR_{production}$ – the activity rate for the storage, handling and transport

$EF_{pollutant}$ – the emission factor for this pollutant

1.6.3.Source-specific recalculations

Emissions of PM_{10} were estimated for 2014-2021 and included in the submission.

1.7. Ammonia production (NFR 2.B.1)

1.7.1. Overview of the sector

AB Achema is a single ammonia production company in Lithuania. In the production plant ammonia is produced at 22.0-24.0 MPa pressure from hydrogen and nitrogen, which are generated at 800-1000 °C by conversion of natural gases (mostly methane). The converted gas is cleaned from impurities CO, CO_2, and H_2O impurities. In the ammonia production process, pollutants such as CO, NMVOCs (toluene, xylene, low mass alcohols), NH_3, TSP, SOx and NOx are released.

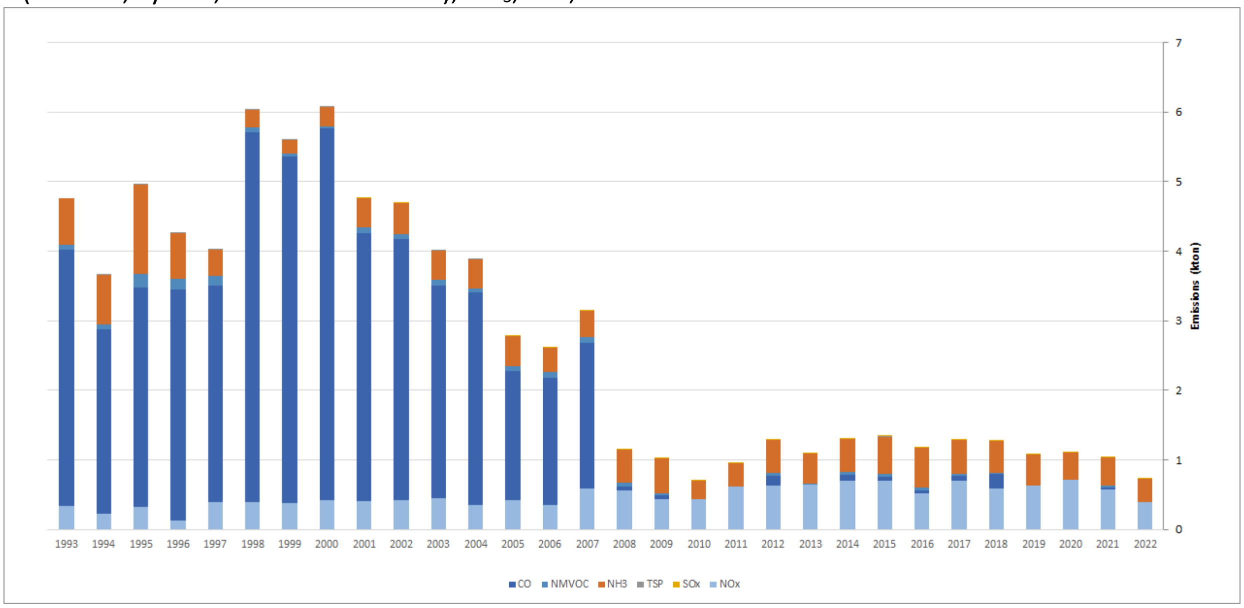

Figure 4-14 . Emissions of main pollutants (in kton) from the production of ammonia

1.7.2. Activity data and emission factors

Tier 3 approach was used in estimating emissions from the ammonia production, as the company provides CLRTAP reports and measures all the major emissions occurring from the manufacturing facility. Reports indicate that NH_3, CO, TSP, SOx and NOx and NMVOCs are emitted during ammonia production.

1.8. Chemical industry: Other (please specify in the IIR) (NFR 2.B.10A)

1.8.1. Overview of the sector

This sector includes emissions of the pollutants from the production of sulfuric acid. Ammonia, NMVOCs, NOx, SOx, CO, and TSP are the main pollutants directly emitted during the industrial sulfuric acid production. The only sulfuric acid manufacturing plant in Lithuania, AB Lifosa, directly measures and reports all the major pollutant emissions that occur during the manufacturing process.

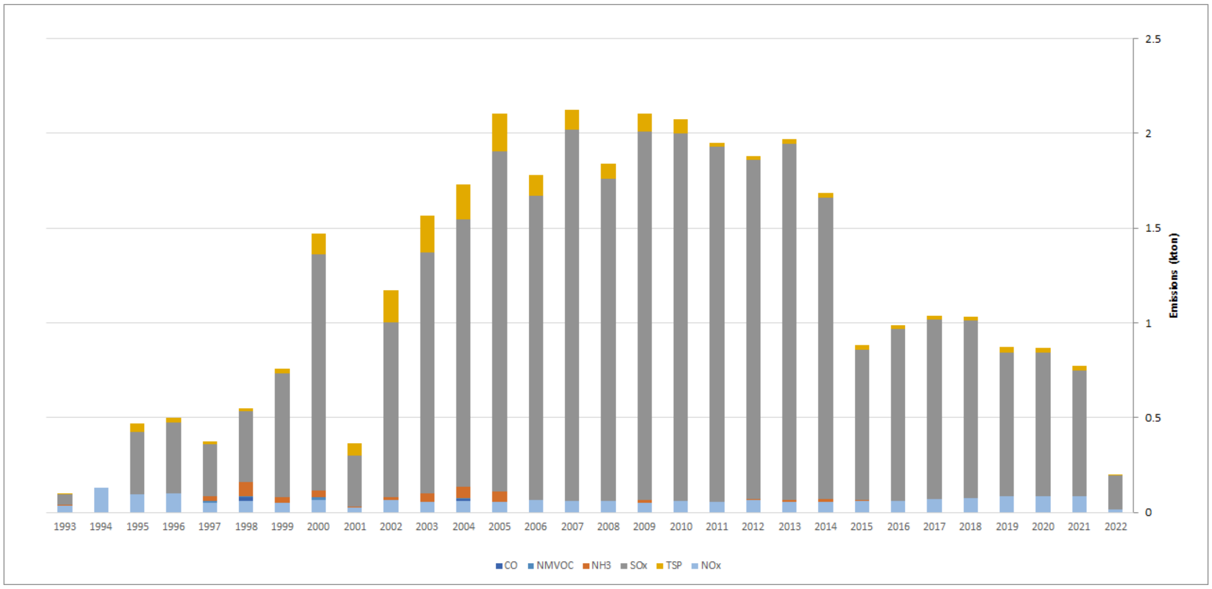

Figure 4-15. Emissions of main pollutants (in kton) from the production of sulfuric acid

1.9. Iron and Steel production (NFR 2.C.1)

1.9.1. Overview of the sector

There are two companies producing cast iron. One is producing cast iron in blast furnace and the other was producing cast iron in blast furnace until 2011, after 2011 it has been using induction furnace. In the blast furnace cast iron is made by remelting scrap pig iron along with coke and limestone. In the induction furnace only, limestone is added.

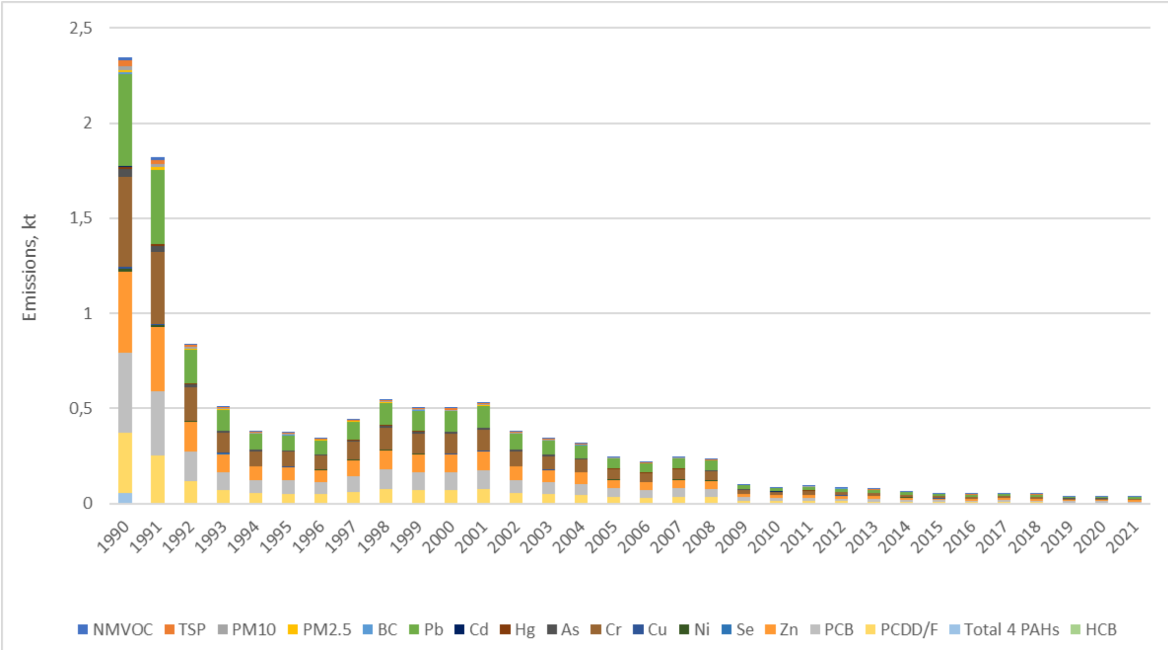

Figure 4-16. Emissions from the sector 2.C.1 2014 – 2021

1.9.2. Methodological issues

Activity data for calculating emissions were taken from national GHG report. Under 2C1 sector NMVOC, PM2.5, PM10, TSP, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/PCDF, total PAHs, HCB emissions from Iron and steel production were reported. Emission factors were taken from 2019 Guidebook, Tier 1 methodology was used.

$$E_{Pollutant} = AR_{production} \times EF_{pollutant}$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant

$AR_{production}$ – the activity rate for the iron and steel production

$EF_{pollutant}$ – the emission factor for this pollutant

1.1.1. Source-specific recalculations

$PM_{2.5}$ and PM_{10} emissions were estimated for this sector for 1990-2021 and included in the submission. BC recalculations were made, as its value wasn't in compliance to TSP-PM-BC ratios and was estimated to be higher than $PM_{2.5}$.

1.10. Production of ferro-alloys (NFR 2.C.2)

Production of ferro-alloys in Lithuania is not carried out, therefore emissions from source category 2.C.2 Iron alloys are not produced and the marking key "NO" is used.

1.11. Aluminum production (NFR 2.C.3)

1.11.1. Overview of the sector

On a major scale, only the primary aluminum production takes place in Lithuania. Small quantities of CO, NOx, SOx, PM2.5, PM10, TSP, BC, along with benzo(a)pyrene, benzo(b)fluoranthene, Benzo(k)fluoranthene and indeno(1,2,3- cd)pyrene are emitted during the aluminum production. All the data on the local aluminum (alloy bars, plates, foils, tubes, powders and flakes) production is taken from the Eurostat database. Overall, only CO emissions contribute significantly to the total national emissions.

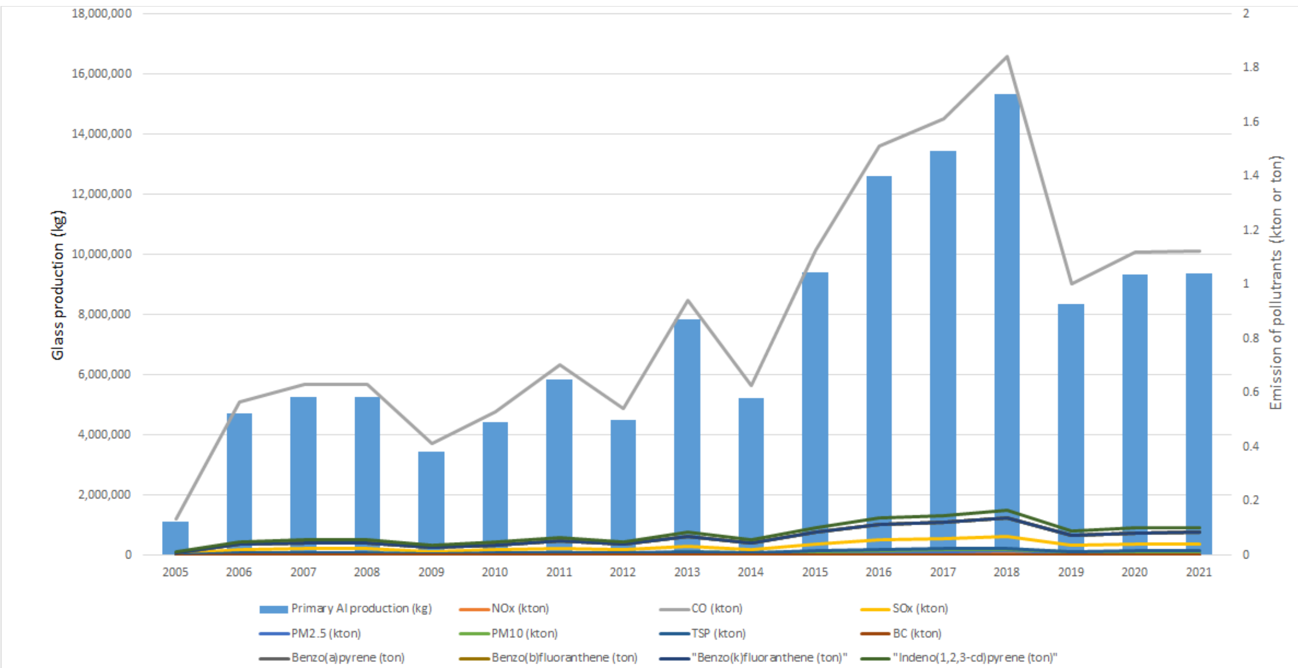

Figure 4-17. Aluminum production along with emission of relevant pollutants (kton or ton)

1.11.2. Activity data

All statistical data on the aluminum production was taken directly from the Eurostat database. Only the local aluminum production was considered. Production of aluminum alloy bars, plates, sheets, tubes, foil, pipes, powders and flakes was taken into account.

1.11.3. Emission factors

As the exact methodologies by which aluminum is produced are not known, general Tier 1 approach was chosen for the estimation of pollutant emissions. For each pollutant, relevant emission factor was applied from the EMEP/EEA guidebook, 2019, 2.C.3, table 3.1.

$$E_{pollutant} = AR_{production} * EF_{pollutant}$$

where:

- *Epollutant* is the emission of pollutant (g)
- *ARproduction* – production of primary aluminum (in kg)
- *EFpollutant* is the emission factor of the relevant pollutant (in g pollutant per kg of relevant glass produced)

1.12. Magnesium production (NFR 2.C.4)

Emissions from magnesium production are not occurring in Lithuania so for the category " source category 2.C.4 Magnesium Production" notation key "NO" is used.

1.13. Lead production (NFR 2.C.5)

Emissions from lead production are not occurring in Lithuania so for the category " source category 2.C.5 Lead Production" notation key "NO" is used.

1.14. Zinc production (NFR 2.C.6)

Emissions from zinc production are not occurring in Lithuania so for the category " source category 2.C.6 Zinc Production" notation key "NO" is used.

1.15. Other (NFR 2.C.7)

Emissions from other production are not occurring in Lithuania so for the category " source category 2.C.7 Other" notation key "NO" is used.

2. Product Use (NFR 2D, 2H, 2I)

NMVOC emissions occur from the use of products, which contain organic solvents. Some of these products, such as printing inks and paints are used in the industry, other products, such as washing solutions, hair lacquers, car care products, and cooking fats are used in private households. This category covers such areas as the industrial and non-industrial coatings, degreasing of metals, manufacture of furniture, industrial printing, dry cleaning, domestic use of solvents, road paving with asphalt, asphalt roofing and manufacture of chemical products.

Briefly, the main source of NMVOC emissions in 2.D.3 occur from the use of paints for coatings (2.D.3.d), industrial printing (2.D.3.h), and from domestic solvent use (2.D.3.a). In the case of coating applications, paints based on organic solvents are still relatively popular and contribute significantly to the total NMVOC emissions. From the domestic solvent use, large consumption of car care products, such as antifreeze and car brake fluids, seems to be the main contributor to the 2.D.3.a subsector.

Overall, coating applications contributed the most to the total Lithuania NMVOC emissions in 2021 (60 %) from 2.D.3 category. Domestic solvent use was the second largest contributor to the total NMVOC in Lithuania (11%).

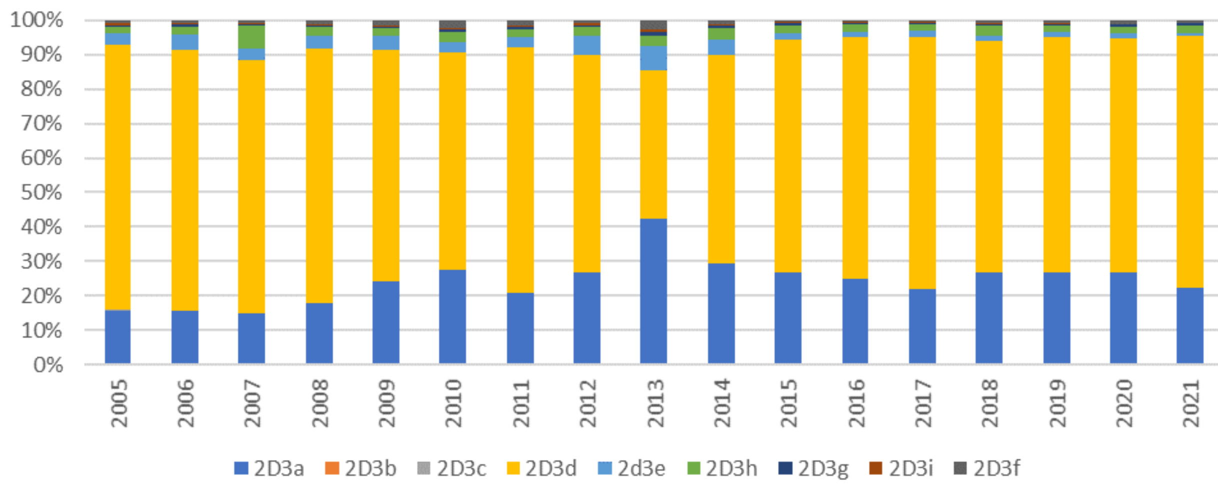

Figure 4-18. NMVOC emission share from 2005 to 2021 by each subsector

2.1. Domestic solvent use including fungicides (NFR 2.D.3.a)

2.1.1.Overview of the sector

NMVOCs are used in many products sold for use by the public. Overall, more than 200 products contribute to the NMVOC emissions domestically – some of the sources are solvents in perfumes, shampoos, cleaning solutions, brake fluids, antifreezes, paint thinners, glues, shoe polishes, soaps and detergents and so forth.

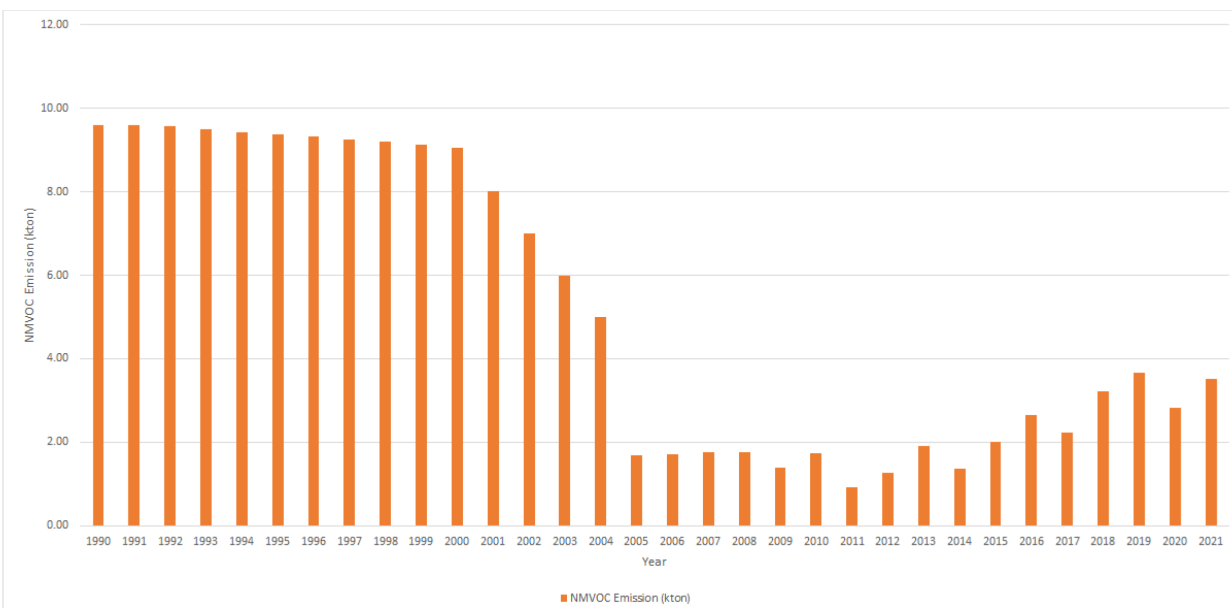

Figure 4-19. NMVOC emissions in Lithuania in sector 2.D.3.a

2.1.2. Activity data

Prior to 2005, NMVOC emissions were calculated using Tier 1 approach by estimating emissions based on the population. From 2005 onwards, selected products or product categories are used for NMVOC calculations using Tier 2 approach. The statistical data on the use of selected products is gathered from the Eurostat database. Some of the products used for calculations are listed below:

- *Perfumes*
- *Scent sprays and similar toilet sprays, and mounts and heads therefor (excluding reservoirs for scent sprays presented separately, rubber bulbs)*
- *Soap in forms excluding bars, cakes or moulded shapes, paper, wadding, felt and non-wovens impregnated or coated with soap/detergent, flakes, granules or powders*
- *Washing preparations and cleaning preparations, with or without soap, p.r.s. including auxiliary washing preparations excluding those for use as soap, surface-active preparations*
- *Washing preparations and cleaning preparations, with or without soap, n.p.r.s. including auxiliary washing preparations excluding those for use as soap, surface-active preparations*
- *Anti-freezing preparations and prepared de-icing fluids*
- *Fungicides, bactericides and seed treatment based on triazoles or diazoles, put up in forms or packings for retail sale or as preparations or articles (excluding hazardous pesticides)*
- *Disinfectants based on quaternary ammonium salts put up in forms or packings for retail sale or as preparations or articles (excluding hazardous pesticides)*
- *Disinfectants based on halogenated compounds put up in forms or packings for retail sale or as preparations (excluding hazardous pesticides)*
- *Disinfectants put up in forms or packings for retail sale or as preparations or articles (excluding those based on quaternary ammonium salts, those based on halogenated compounds and those being hazardous pesticides)*
- *Polishes, creams and similar preparations, for footwear or leather (excluding artificial and prepared waxes)*
- *Polishes, creams and similar preparations, for the maintenance of wooden furniture, floors or other woodwork (excluding artificial and prepared waxes)*
- *Polishes and similar preparations, for coachwork (excluding artificial and prepared waxes, metal polishes)*
- *Other polishes, creams and similar preparations, n.e.c.*
- *Organic composite solvents and thinners used in conjunction with coatings and inks; based on butyl acetate.*
- *Disinfectants based on halogenated compounds put up in forms or packings for retail sale or as preparations (excluding hazardous pesticides)*
- *Hydraulic brake fluids and other prepared liquids for hydraulic transmission; not containing or containing < 70 % by weight of petroleum oils or oils obtained from bituminous mineral*
- *Toilet waters*
- *Manicure or pedicure preparations*
- *Pre-shave, shaving and after-shave preparations (excluding shaving soap in blocks)*
- *Hair lacquers*
- *Hair preparations (excluding shampoos, permanent waving and hair straightening preparations, lacquers)*
- *Mixtures of odoriferous substances (excluding those of a kind used in the food or drink industries)*

We also note that Lithuania does not collect statistics official statistics on the use of fungicides, pesticides, and similar products, thus we have assumed that emissions from these fungicides were negligibly small.

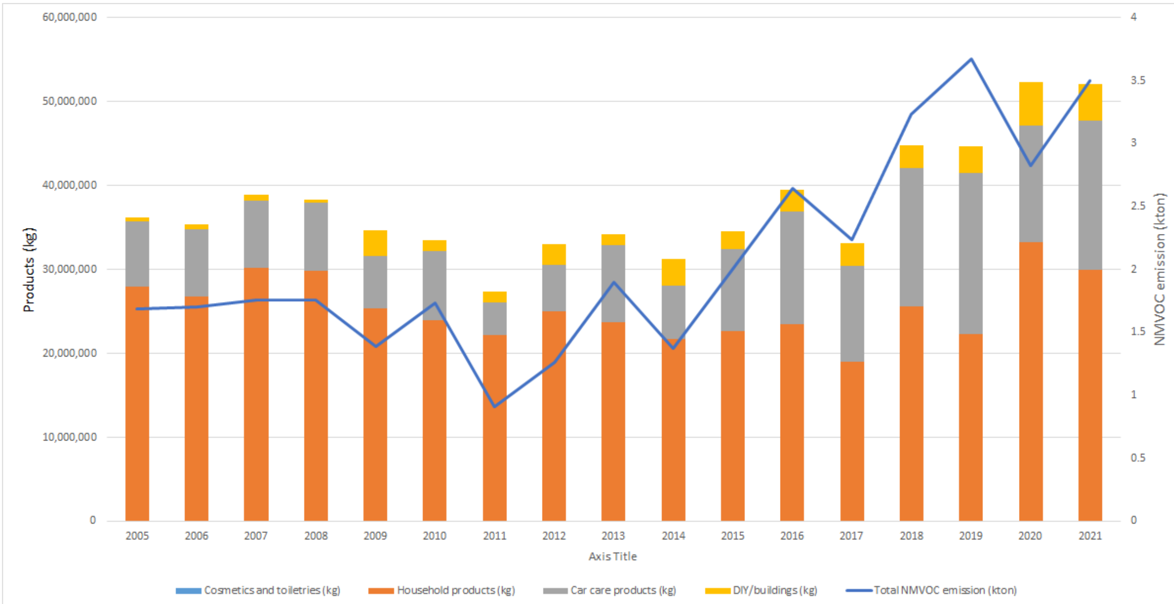

Figure 4-20. Products for domestic solvent use including fungicides

2.2. Road paving with asphalt (NFR 2.D.3.b)

2.2.1. Overview of the sector

Asphalt is commonly referred to as bitumen, asphalt cement, asphalt concrete or road oil. This sector covers emissions from asphalt paving operations as well as subsequent releases from the paved surfaces. Asphalt roads are a compacted mixture of aggregate and an asphalt binder. Statistics Lithuania collects data on production of bitumen (data available for 2002-2021), but not on consumption of bitumen, therefore data available from Statistics Lithuania, was used to extrapolate consumption of bitumen for the period 2002-2006. To extrapolate data on the consumption of bitumen in 1990-2001 the data on installed, rebuilt and modified asphalt roads (1989-2000) were used. This data was taken from 2002-2015 program on the maintenance and development of the Lithuanian state roads (UNFCCC submission, 2022).

	Bitumen consumption, Gg	E (NMVOC), Gg	E (TSP)	E (PM10)	E (PM2,5)	E (BC)
1990	50.436	0.001	0.008	0.001	0.000	0.000
1995	39.590	0.001	0.006	0.001	0.000	0.000
2000	42.673	0.001	0.006	0.001	0.000	0.000
2005	68.491	0.001	0.010	0.001	0.000	0.000
2010	80.000	0.001	0.012	0.002	0.000	0.000
2015	100.000	0.001	0.014	0.002	0.000	0.000
2016	100.000	0.002	0.015	0.002	0.000	0.000

2017	100.000	0.002	0.015	0.002	0.000	0.000
2018	100.000	0.002	0.015	0.002	0.000	0.000
2019	100.000	0.002	0.015	0.002	0.000	0.000
2020	100.000	0.002	0.015	0.002	0.000	0.000
2021	100.000	0.002	0.015	0.002	0.000	0.000
2005-2021, %	**46.00**	**46.00**	**46.00**	**46.00**	**46.00**	**46.00**
1990-2021, %	**98.27**	**98.27**	**98.27**	**98.27**	**98.27**	**98.27**

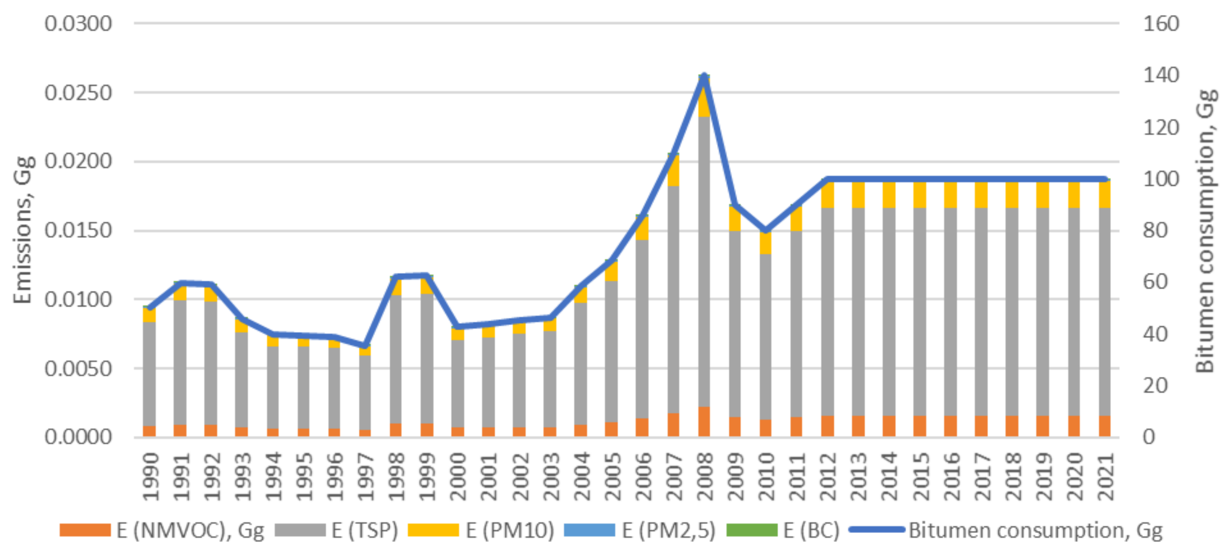

Figure 4-21. Pollutant emissions and bitument consumption in sector 2.D.3.b

According to GHG emissions inventory NMVOC emissions from road paving with asphalt are calculated based on annual consumption of bitumen. NMVOC emission was calculated using default emission factor 0.016 kg/tonne of asphalt (EMEP/EEA, 2.D.3.b Road paving with asphalt). Abetment for PMs was applied – 99%.

2.3. Asphalt roofing (NFR 2.D.3.c)

2.3.1. Overview of the sector

There is only one manufacturer in Lithuania producing asphalt roofing materials: flexible roofing tiles of different modifications, thickness and bitumen flexible roofing tiles of different geometric shapes for pitched roofs as well as membrane roofing for flat roofs. Activity data on production of roofing materials was provided by the producer for the period 2001-2021. Production of the asphalt roofing materials in 1990-2000 was estimated based on annual average use of bitumen.

	E (NMVOC), Gg	E (TSP)	E (PM10)	E (PM2,5)	E (BC)	CO
1990	0.007	0.081	0.020	0.004	0.000	0.000
1995	0.005	0.063	0.016	0.003	0.000	0.000

2000	0.006	0.068	0.017	0.003	0.000	0.000
2005	0.009	0.110	0.027	0.005	0.000	0.001
2010	0.010	0.128	0.032	0.006	0.000	0.001
2015	0.013	0.160	0.040	0.008	0.000	0.001
2016	0.013	0.160	0.040	0.008	0.000	0.001
2017	0.013	0.160	0.040	0.008	0.000	0.001
2018	0.013	0.160	0.040	0.008	0.000	0.001
2019	0.013	0.160	0.040	0.008	0.000	0.001
2020	0.013	0.160	0.040	0.008	0.000	0.001
2021	0.013	0.160	0.040	0.008	0.000	0.001
2005-2021, %	**46.00**	**46.00**	**46.00**	**46.00**	**46.00**	**46.00**
1990-2021, %	**98.27**	**98.27**	**98.27**	**98.27**	**98.27**	**98.27**

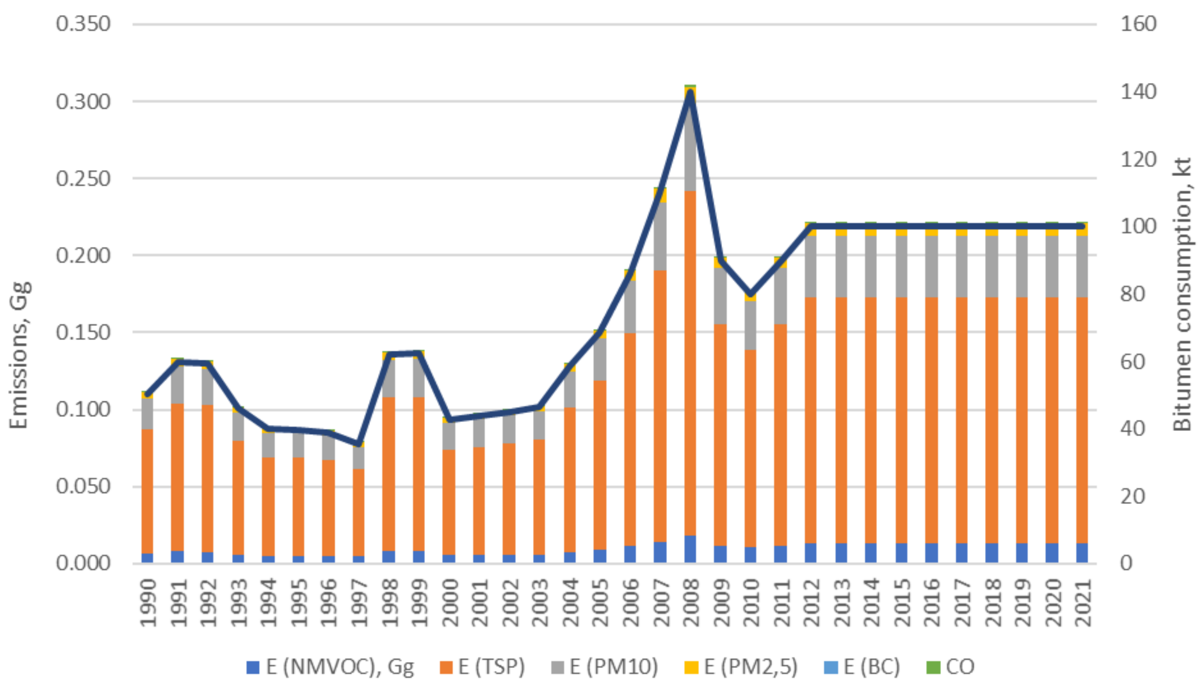

Figure 4-4 Pollutant emissions in sector 2.D.3.c

2.3.2. Emission factors

Emissions were calculated using Tier 2 approach, emission factors were taken from 2019 EMEP/EEA guidebook, chapter 2.D.3.b Road paving with asphalt (Table 3.2 Tier 2 emission factors or source category 2.D.3.c, Asphalt roofing, dip saturator). Abetment for PMs was applied – 99%.

2.4. Coating applications (NFR 2.D.3.d)

2.4.1. Overview of the sector

The sector of coating applications covers the use of paints and varnishes in both industrial and domestic applications. Most paints contain organic solvents, which evaporate during paint curing/drying, producing substantial NMVOC emissions. Overall, paints and varnishes in 2.D.3.d category are used in:

- Decorative coating applications
- Industrial coating applications

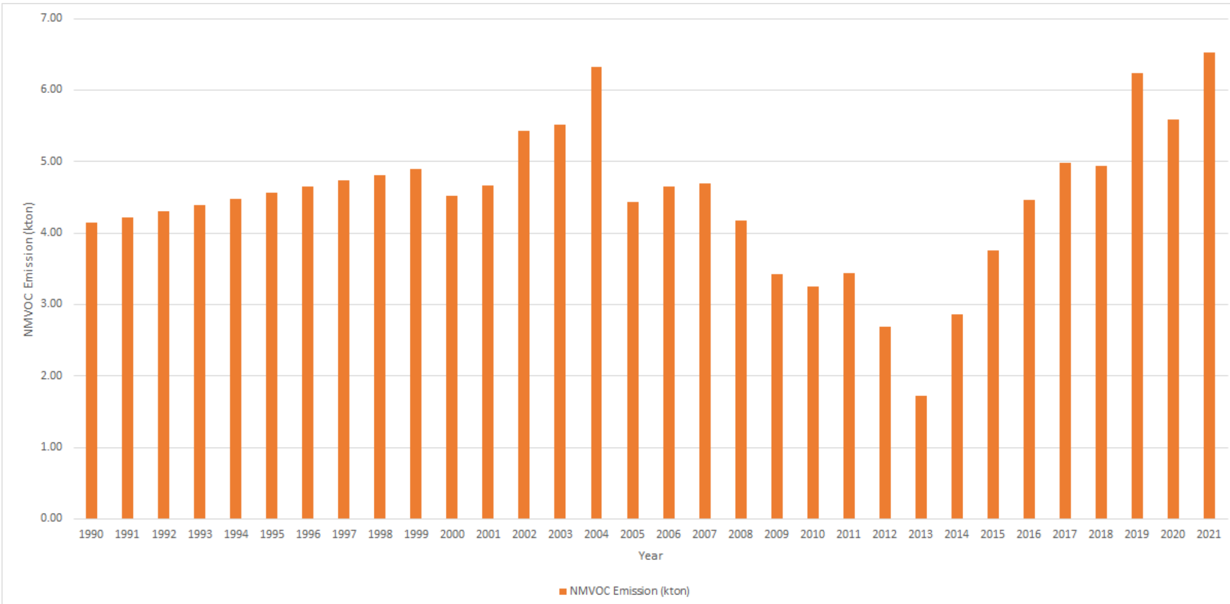

Figure 4-5 NMVOC emissions (kton) from coating applications

2.4.2. Activity data

The activity data for years 1990 to 2004 was extrapolated and verified with emissions based on IIASA calculations. Currently (2005-onwards), the activity data is based on Eurostat paint usage (Import-Export+Production). Overall, paints and varnishes can be divided into three main categories: solvent-based paints, water-based paints and unspecified paints. This method was suggested by an expert Rianne Dröge during the country review in 2022. The expert Rianne Dröge also assumed that 50% of the paints used are consumed in industry and 50% are used for decorative purposes.

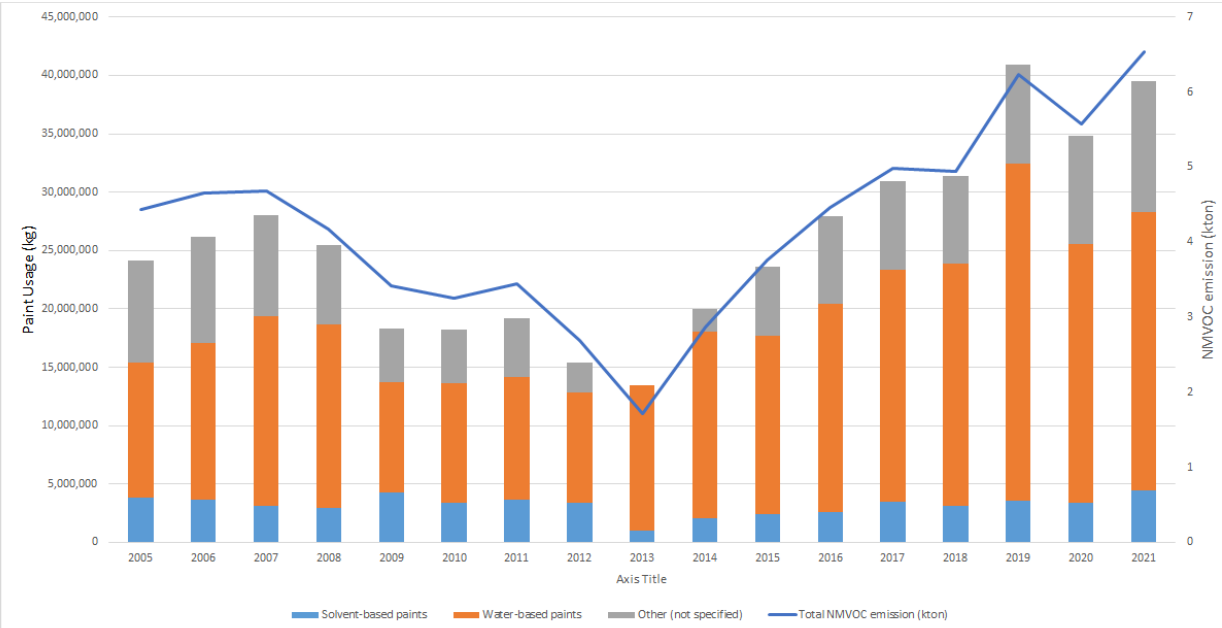

Figure 4-6 NMVOC emissions (kton) and paint usage (in kg)

2.4.3.Emission factors

Decorative paint applications			
Solvent-based paints	230	g/kg paint	EMEP/EEA Guidebook 2019, 2D3d, table 3-4 and 3-5
Water-based paints	80.5	g/kg paint	EMEP/EEA Guidebook 2019, 2D3d, table 3-4 and 3-5, combined with abatement efficiency of 65.2% (EMEP/EEA Guidebook 2019, 2D3d, table 3-17)
Other (not specified)	155.25	g/kg paint	Average of solvent-based and water-based paints
Industrial paint applications			
Solvent-based paints	685	g/kg paint	Average of: EMEP/EEA Guidebook 2019, 2D3d, table 3-7, table 3-8, table 3-9 and table 3-16
Water-based paints	239.75	g/kg paint	Average of: EMEP/EEA Guidebook 2019, 2D3d, table 3-7, table 3-8, table 3-9 and table 3-16, combined with abatement efficiency of 65% (average of: EMEP/EEA Guidebook 2019, 2D3d, table 3-18, table 3-20, table 3-22, table 3-23, table 3-24, table 3-25, table 3-26, abatement for water-based coatings)
Other (not specified)	462.375	g/kg paint	Average of solvent-based and water-based paints

In addition, we have applied 40% abatement for all the industrial coating applications, as we assumed that most of the paints are used for car refinishing and repairs in the industry (EMEP/EEA Guidebook 2019, 2D3d, table 3-18, p. 28). Consequently, all car repair shops in Lithuania use at least thermal incinerators along with activated carbon adsorption spray booths for efficient NMVOC capture during car painting.

2.4.4. Source specific recalculations

Recalculations of NMVOC emissions was done for years 2005 to 2020. Activity data was taken from Eurostat database based on reviewer proposed calculation template.

	Submission 2022, kt	Submission 2023, kt	**Absolute difference, kt**	**Relative difference, %**
2005	6.328	4.435	1.893	70.08
2006	2.809	4.650	1.841	165.53
2007	3.144	4.686	1.542	149.04
2008	3.126	4.172	1.046	133.46
2009	1.910	3.425	1.515	179.31
2010	1.682	3.251	1.569	193.28
2011	1.706	3.443	1.737	201.81
2012	2.024	2.690	0.666	132.90
2013	1.646	1.722	0.076	104.61
2014	1.956	2.868	0.912	146.62
2015	2.075	3.759	1.684	181.15
2016	1.788	4.461	2.673	249.49
2017	1.942	4.979	3.037	256.38
2018	7.053	4.945	2.108	70.11
2019	8.889	6.232	2.657	70.10
2020	7.962	5.582	2.38	70.10
2021		6.530		

2.4.5. Source specific planned improvements

Currently, large amount of paints use fall into the “non-specified” category, meaning that it is unclear whether these paints are solvent-free, or whether they are water-based or largely solvent-based. In the future, we are planning on collecting statistics on solvent free paints, to eliminate to eliminate a likely overestimation of NMVOC emissions from “non-specified” paints.

2.5. Degreasing (NFR 2.D.3.e)

2.5.1. Overview of the sector

Degreasing within the industry is a minor source of NMVOC. The major users of solvent degreasing are the metal-working industries. Solvent degreasing is also used in industries as printing and production of chemicals, plastics, rubber, textiles, glass, paper and electric power.

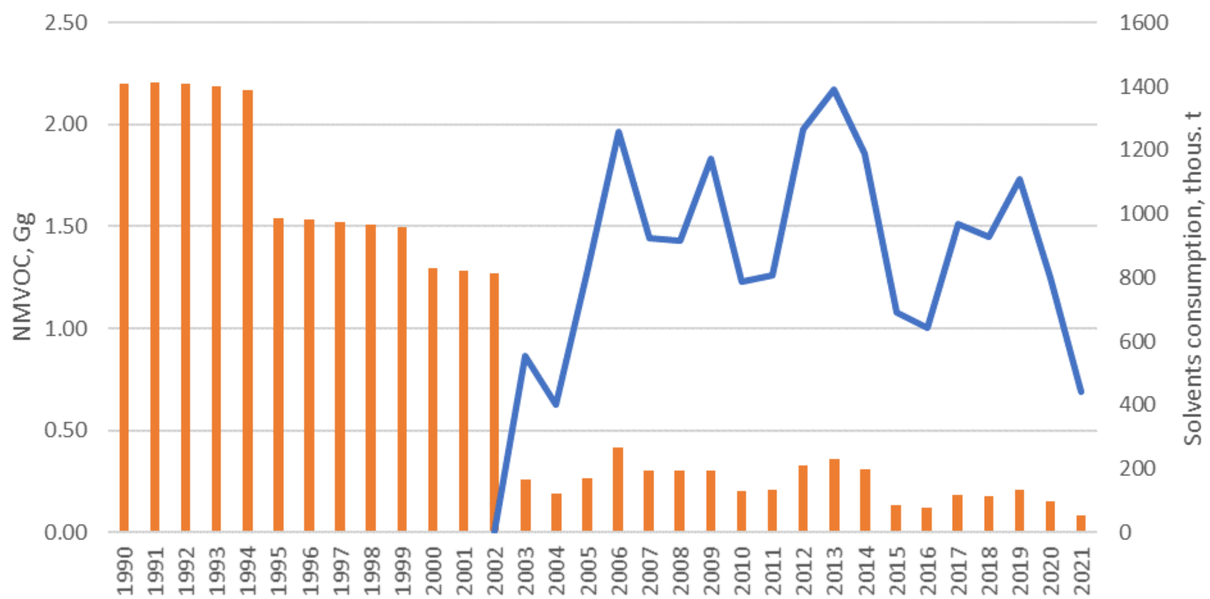

Figure 4-7 NMVOC emissions and solvents consumption in sector 2.D.3.e

During LRTAP in-depth review of national emission inventories in 2019 Solvent Use sector experts Ardi Link and Kristina Saarinen (personal communication) provided organic solvents list needed to incorporate to NMVOC emissions evaluation:

- methylene chloride (MC)
- tetrachloroethylene (PER)*
- trichloroethylene (TRI)[1]
- xylenes (XYL).

* As **PER** is also used for dry cleaning, this **is not included** as a degreaser.

2.5.2. Emission factors

So far NMVOC emissions were calculated and reported based on Tier 1 method using data on per capita emission. By the year 2018 this method was considered obsolete because essential assumptions about EFs were out of date. For calculations the algorithm need to be revised and a new become available data source using Lithuanian solvent user consumer's reports and Statistics Lithuania data on Production of Commodities 2002-2020.

As no facility level data available on Vapour cleaning and Cold cleaning operations, so the NMVOC EF for the activity without the application of an abatement technology is 0.72 t/t. For the different abatement technologies (closed system) the degree of implementation, the technical efficiency and the applicability

[1] The use of 1,1,1,-trichloroethane (TCA) has been banned since the Montreal Protocol and replaced by trichloroethylene (TRI).

are provided by EGTEI (2005) and De Roo et al. 2009 – 89 %. The following equation can be applied (D'Haene et al. 2002):

$$E_{i,j} = \sum_{i=1}^{n}(A_{i,j} * EF_{I,J} * \gamma_{i,j,t} * (1 - \eta_{i,j,t} * \alpha_{i,j,t}))$$

Where:

$E_{i,j}$ - NMVOC emission for activity i and year j

$A_{i,j}$ - total activity figure for activitiy i (t solvent/year)

t - abatement technology

$EF_{i,j}$ - NMVOC EF of activity i without application of an abatement technology (hypothetical)

$\Upsilon_{i,j,t}$ - degree of implementation of the abatement technology for the activity (-)

$\eta_{i,j,t}$ - technical efficiency of the abatement technology t (-)

$\alpha_{i,j,t}$ - applicability of the technology t = the part of the emission on which the technology can be applied

It is very difficult to get a reliable picture of the penetration of the different techniques. Assuming a stationary situation for practical reasons is practicing, based on statement that the open-top tanks, however, have been phased out in the European Union due to the Solvents Emissions Directive 1999/13/EC (only small facilities, using not more than 1 or 2 tonnes of solvent per year (depending on the risk profile of the solvent) are still allowed to use open top tanks) and closed tanks offer much better opportunities for recycling of solvents. The distribution of technologies based on expert judgement is provided in the table below. There is also no information available how different degreasing process types are stratified in Lithuania, but an expert judgement how the penetration of different technologies within the degreasing industry could have been evolved.

	Abatement efficiency		**Distribution abatement technology**	
	Semi open-top degreaser and good housekeeping	Sealed chamber system using chlorinated solvents	Semi open-top degreaser and good housekeeping	Sealed chamber system using chlorinated solvents
1990	25%	95%	100	0
1995	25%	95%	80	20
2000	25%	95%	60	40
2005	25%	95%	40	60
2010	25%	95%	20	80
2015	25%	95%	10	90
2020	25%	95%	0	100

Figure 4-8 Expert judgement-based abatement efficiency factors and the distribution between abatement technologies

2.6. Dry cleaning (NFR 2.D.3.f)

2.6.1. Overview of the sector

Dry Cleaning refers to any process to remove contamination from furs, leather, down leathers, textiles or other objects made of fibers, by using organic solvents. Emissions arise from evaporative losses of solvent, primarily from the final drying of the clothes, known as deodorization. Emissions may also arise from the disposal of wastes from the process.

Please note that for EU Member States, the European Solvent Directive 1999/13/EC has led to a phase-out of the open-circuit machine, because their emissions exceed the limits.

In the European Union, the dry-cleaning sector is essentially made up of small units, using one to two machines of 10/12 kg capacity.

2.6.2. Activity data

Chlorinated organic solvent tetrachloroethylene is not produced in Lithuania, all used amount are imported.

The most widespread solvent used in dry cleaning, accounting for about 90% of total consumption, is **tetrachloroethene** (also called tetrachloroethylene or perchloroethylene (PER)). The most significant pollutants from dry cleaning are NMVOCs, including chlorinated solvents. Heavy metals and POPs emissions are unlikely to be significant. The sales figures of tetrachloroethylene use in 2.D.3.f in EPA database are obtained each year from operator's report.

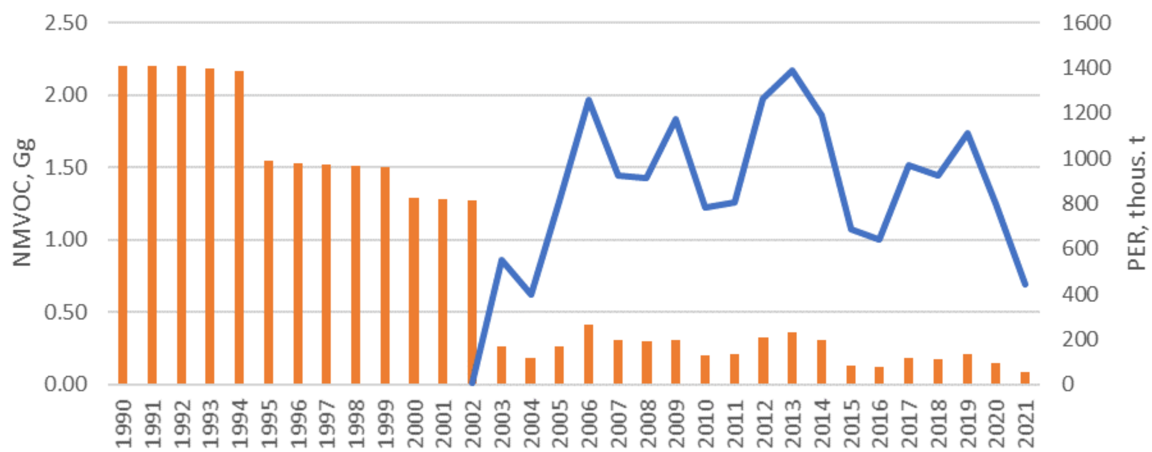

Figure 4-27. NMVOC emissions and tetrachlorethene consumption in sector 2.D.3.f

2.6.3. Emission factors

EF of 400 g/kg was used (Estonia NIR) for dry cleaning activity. The emissions of NMVOC from solvents and other product use are calculated using a simplified version of the detailed methodology GB2019. It represents a mass balance per PER amount. Where emissions are calculated by multiplying relevant activity data with an EF, according to the equation:

$$Consumption = Production + Import + Export$$
$$Emission = Consumption \times EF_{(\text{fraction emitted.control strategies applied})}$$

Information regarding emissions when using Best Available Techniques is available from the BREF documents for the Surface Treatment of Metals and the Surface Treatment using Organic Solvents. 1990 – 2003 NMVOC emissions were calculated by IIASA.

2.7. Chemical products (NFR 2.D.3.g)

2.7.1. Overview of the sector

The sector of chemical products includes many activities, however, many of these activities are considered insignificant, as the emissions from these activities contribute less than 1 % to the national total emissions for every pollutant. To avoid double counting Asphalt blowing is included in sector 2.D.3.c. Emissions from activities such as the use of fireworks and use of tobacco products are included in 2.D.3.i. Emissions from bitumen processing are covered in 2.D.3.b. and 2.D.3.c.

Generally, activities such as polystyrene and rubber processing, manufacture of paints, glues and inks, production of footwear, manufacture of drugs, manufacture of adhesive tapes and polyurethane processing release small amount of NMVOCs. In the case of shoes, NMVOCs are released during sole gluing process, production of drugs requires organic solvents, some of which inevitably evaporate, processing of polymers also usually takes place in organic solvent media.

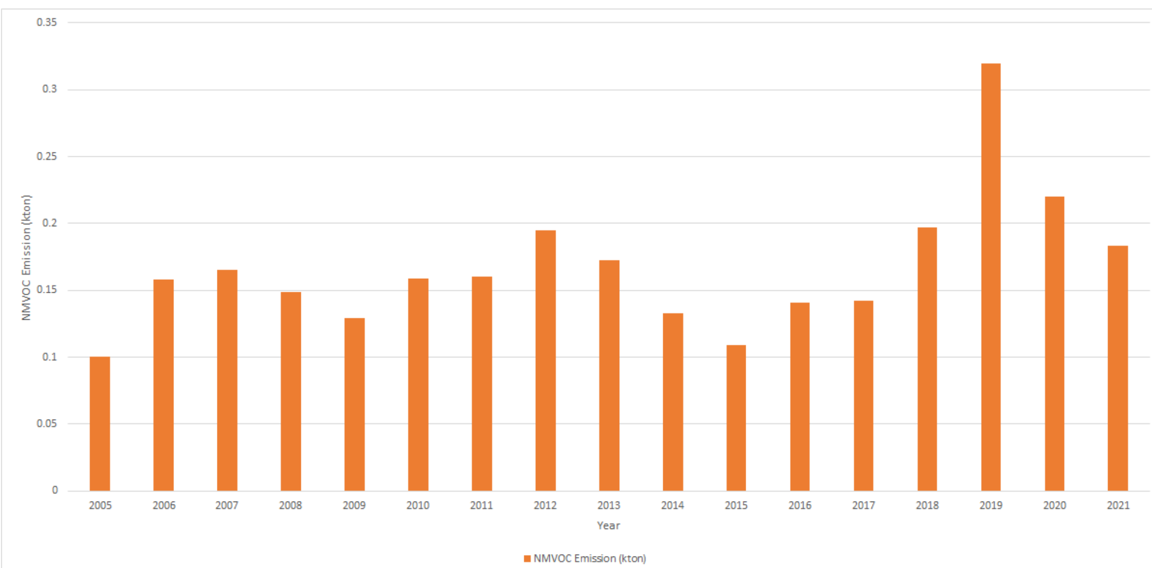

Figure 4-9 NMVOC emissions from 2.D.3.g sector

2.7.2. Activity data

All the statistics on manufacture of chemical products were collected from the Eurostat database. In Lithuania, the production of polyester fibers and manufacture of tyres occurs on a very small scale and are not covered in Eurostat statistics. In the production of polyurethane, emissions of NMVOCs occur during polymer foam activation, when the foaming agents evaporate. Similarly, production of rubber, polystyrene and pharmaceutical goods occur on a very small scale. In the case of drug production, Eurostat data is only available from 2020. Leather tanning is practically non-existent in Lithuania, thus, the statistics on leather tanned are not collected. Overall, the main contributors to NMVOC emissions come from the glue, ink, and paint production, and from the manufacture of adhesive tapes.

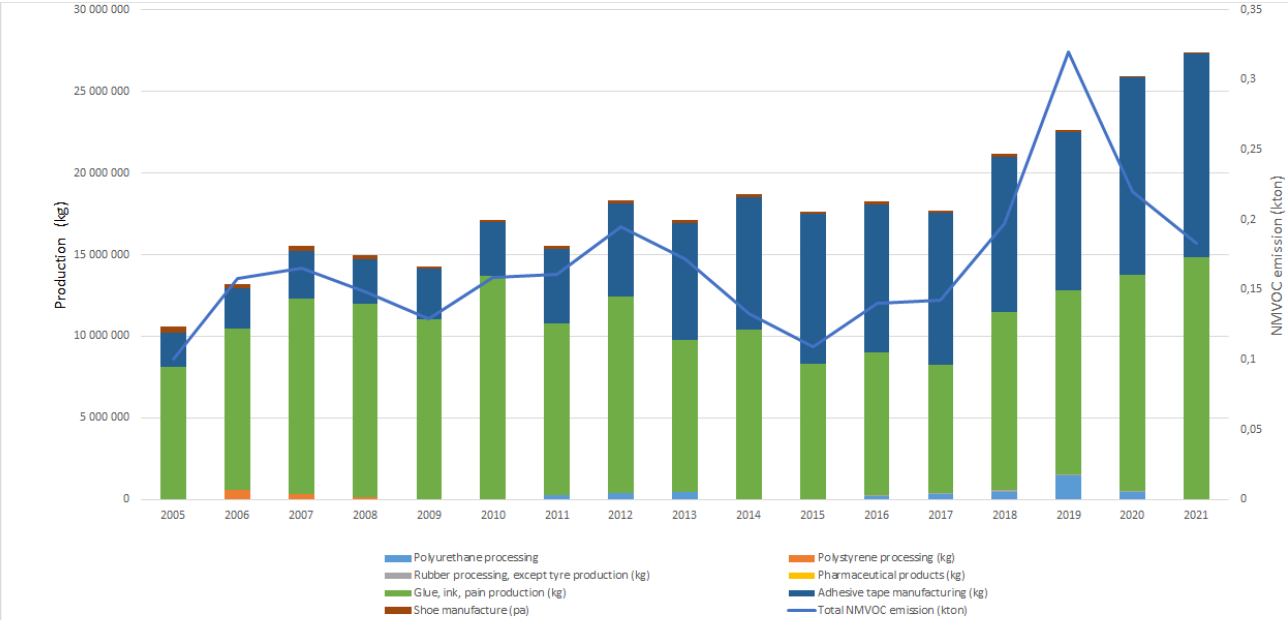

Figure 4-10 Activity data along with NMVOC emissions for 2.D.3.g

2.7.3. Emission factors

Tier 2 approach was used in calculating NMVOC emission. For this purpose, we have collected Eurostat production data for polyurethane foam production, production of inks, glues, and adhesives, total amount of manufactured adhesive tapes, number of shoes produced, amount of pharmaceutical goods synthesized, polystyrene and rubber processed. For each product, we have applied its own specific Tier 2 emission factor, which is associated with manufacturing technology used. Briefly, for polyurethane foam processing we used 120 g NMVOC/kg polyurethane processed (EMEP/EEA Guidebook 2019, 2D3g, table 3-3), 60 g NMVOC/kg polystyrene produced (EMEP/EEA Guidebook 2019, 2D3g, table 3-4), 8 g NMVOC/kg rubber processes (EMEP/EEA Guidebook 2019, 2D3g, table 3-5), 300 g NMVOC/kg of pharmaceutical good produced (EMEP/EEA Guidebook 2019, 2D3g, table 3-7), 11 g NMVOC/kg of paints, ink and adhesives manufactured (EMEP/EEA Guidebook 2019, 2D3g, table 3-11), 3 g NMVOC/m^2 of adhesive tapes manufactured (EMEP/EEA Guidebook 2019, 2D3g, table 3-12), 0.045 g NMVOC/pair of manufactured shoes (EMEP/EEA Guidebook 2019, 2D3g, table 3-13).

$$Emission = Production \times EF_{(\text{technology}-\text{specific})}$$

2.8. Printing (NFR 2.D.3.h)

2.8.1. Overview of the sector

We have used Tier 2 approach to estimate the production of NMVOCs during the industrial printing. In order to do so, we have estimated the ink usage with regard to the printing process. We have collected Eurostat data on the industrial printing machines sold in Lithuania during 2005-2021 period. The results indicate that about 83% of the industrial printing machines operate by heat offset printing and about 17% of the machines operate by flexography. Thus, we have assumed that 17% of the total inks used for printing are being consumed in the flexography printing process and the rest, 83%, are being used in the heat offset printing.

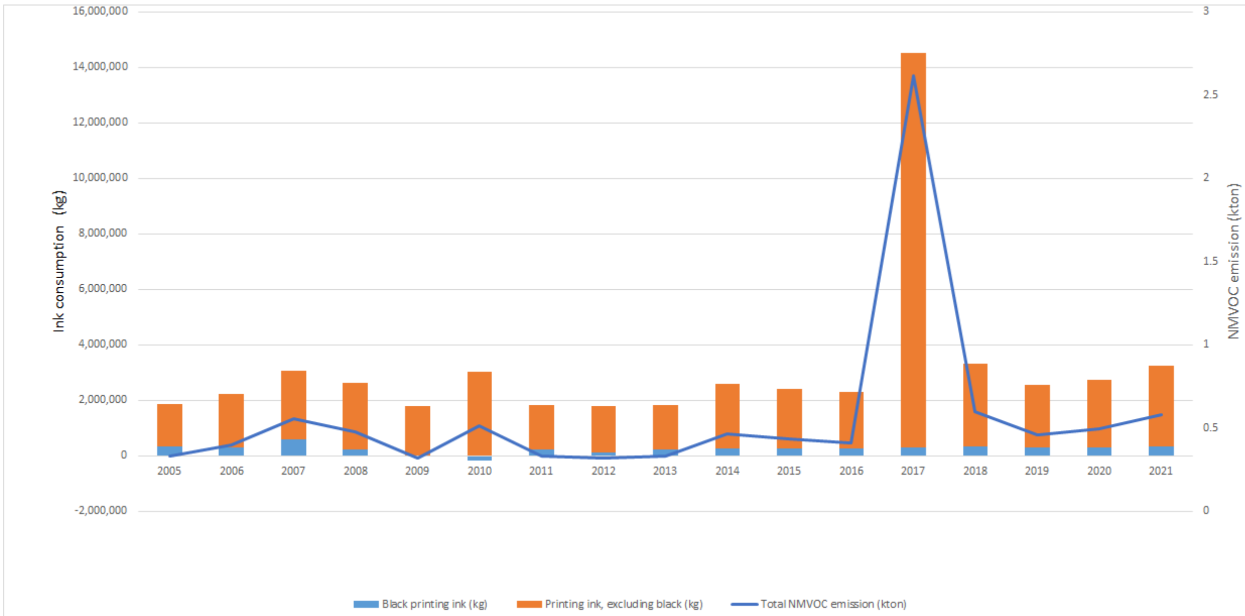

Figure 4-30. Printing ink consumption along with NMVOC release

2.8.2. Activity data

Data on the total ink consumption for printing are taken directly from the Eurostat (Export Import+Production). Overall, black, and non-black ink consumption was taken into account, as the statistics on water-based inks are not collected and emissions from water-based inks are considered insignificant.

2.8.3. Emission factors

Data on the total ink consumption for printing are taken directly from the Eurostat (Export-Import+Production). Total paint consumption was estimated by summing up local production and import, and subtracting the export.

$$AR_{Consumption} = Production - Export + Import$$

For heat offset printing, the emission factor of 730 g NMVOC/kg ink was used (EMEP/EEA, 2019, table 3-2).

$$E_{NMVOC} = AR_{Production} \cdot EF$$

Since flexography printing is further divided into small flexography printing (emission factor 900 g NMVOC/kg ink; EMEP/EEA, 2019, table 3-4) and large flexography printing (emission factor 800 g NMVOC/kg ink used; EMEP/EEA, 2019, table 3-5) categories, we have taken an average of the two emission factors (850 g NMVOC/kg ink used) and assumed that 50% of the flexography printing occurs on via small flexography, and 50% of the printing occurs via large flexography.

$$E_{NMVOC} = AR_{Production} \cdot EF_{Average}$$

In addition, we have applied 76% abatement efficiency for the industrial printing (EMEP/EEA, 2019, table 3-11), since most of the printing facilities in Lithuania are equipped with thermal incinerators, thus effectively burning the solvents evaporating during the printing process. We have assumed that implementation of thermal incinerators started from 2005 in small scale printing companies, and in 2014-2020 large scale printing companies, such as manufacturers of food packaging, finished implementing thermal incinerators with the help of European Union Structural Funds 2014-2020.

2.9. Other solvent and product use (NFR 2.D.3.i-2.G)

2.9.1. Overview of the sector

The sector of other solvent and product use (2D3i) covers the release of pollutants from the use of tobacco, emissions from fireworks, NMVOC emission from the usage of lubricants and adhesives, NMVOC release during dewaxing of new vehicles, evaporation of solvents during wood and furniture lacquering, as well as solvent use in glass and mineral wool enduction.

Information on cigarette consumption (cigarettes per inhabitant per year) from 2000 to 2021 is available from Statistics Lithuania database. Averaged 2000 – 2021 (i.e. 1092.9 cigarettes/ inhabitant/ year) value was used to estimate tobacco consumption for years before 2000. Emissions from tobacco consumption were estimated using emission factors from 2019 EMEP/EEA guidebook.

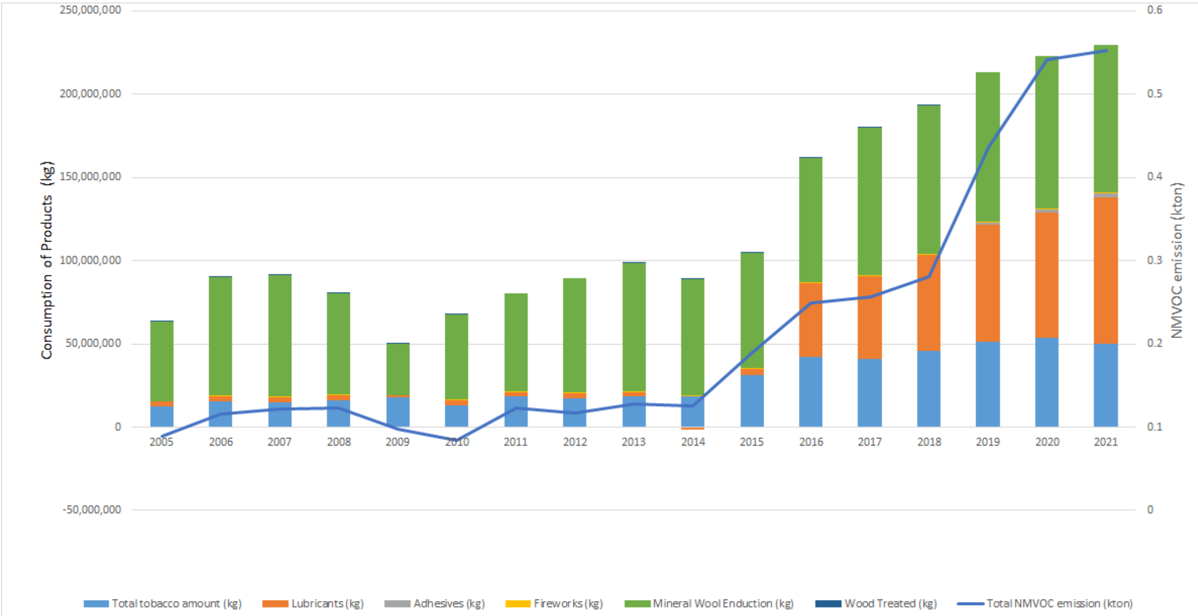

Figure 4-31. Consumption of relevant products along with NMVOC emissions (kton), 1990-2021

2.9.2. Activity data

All statistical data in this sector was taken directly from the Eurostat database. Briefly, such activities as wood treated with preservatives, import of new vehicles, use of adhesives, use of fireworks, consumption of tobacco (cigars, cigarettes, other), use of lubricating preparations, and consumption of hydraulic brake fluids for hydraulic transmissions. Activity data on the use of tobacco products was calculated assuming that 1 cigarette has a mass of 1 gram; for all tobacco products, the activity data was collected by summing up production and import with subtraction of export. For new vehicle dewaxing, the activity data was calculated by subtracting import from the export, as the new vehicles produced locally are not waxed. Similarly, in the case of fireworks, adhesives and lubricants, the activity data was calculated by summing up production and import with subtraction of export. For glass and mineral wool enduction, only the local mineral and glass wool production was taken into account. Similarly, for the wood treatment category, only local production of wood treated with paint and preservatives was taken into account. Such emission sources as the deicing of airports or NMVOC produced from the extraction of oil were not considered as there are no official statistics in these categories. We have assumed that NMVC emission from deicing and seed oil extraction were insignificantly small. This is justified by considering small amount and area of airports in Lithuania.

2.9.3. Emission factors

Emissions were estimated using Tier 2 approach from 2005 onward, applying relevant technology-specific emission factors for each specific product. Prior to 2005, the emissions were estimated by extrapolating data.

$$Emission = Consumption \times EF_{(\text{technlogoy}-\text{specific emission factor})}$$

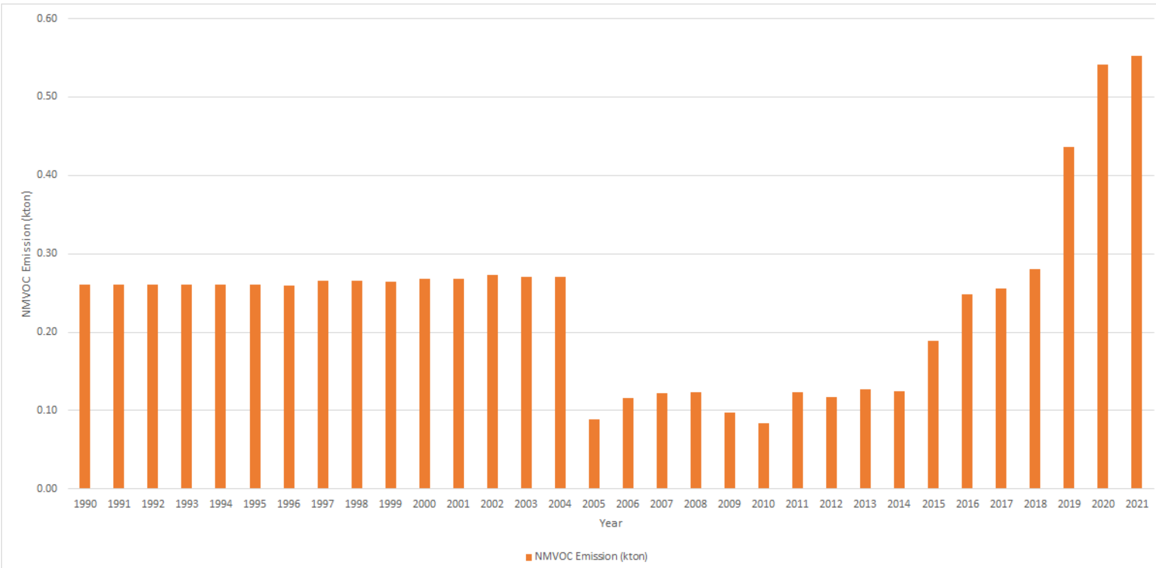

Figure 4-32. NMVOC emission from sector 2.D.3.i

The following emission factors were used: for glass wool enduction 250 g NMVOC/t glass wool produced (EMEP/EEA Guidebook 2019, 2.D.3.i-2.G, table 3-2), 1000 g NMVOC/vehicle dewaxed (EMEP/EEA Guidebook 2019, 2.D.3.i-2.G, table 3-9), 522 g NMVOC/kg of adhesives consumed (EMEP/EEA Guidebook 2019, 2.D.3.i-2.G, table 3-11), 3020 SO2 g/t of fireworks used (EMEP/EEA Guidebook 2019, 2.D.3.i-2.G, table 3-14) along with all the relevant emission factors for heavy metals, particulate matter from the firework usage (EMEP/EEA Guidebook 2019, 2.D.3.i-2.G, table 3-14), 4.84 kg NMVOC/Mg tobacco consumed (EMEP/EEA Guidebook 2019, 2.D.3.i-2.G, table 3-15) along with all relevant pollutant emission factors for heavy metals, particulate matter, and main pollutants for tobacco (EMEP/EEA Guidebook 2019, 2.D.3.i-2.G, table 3-15).

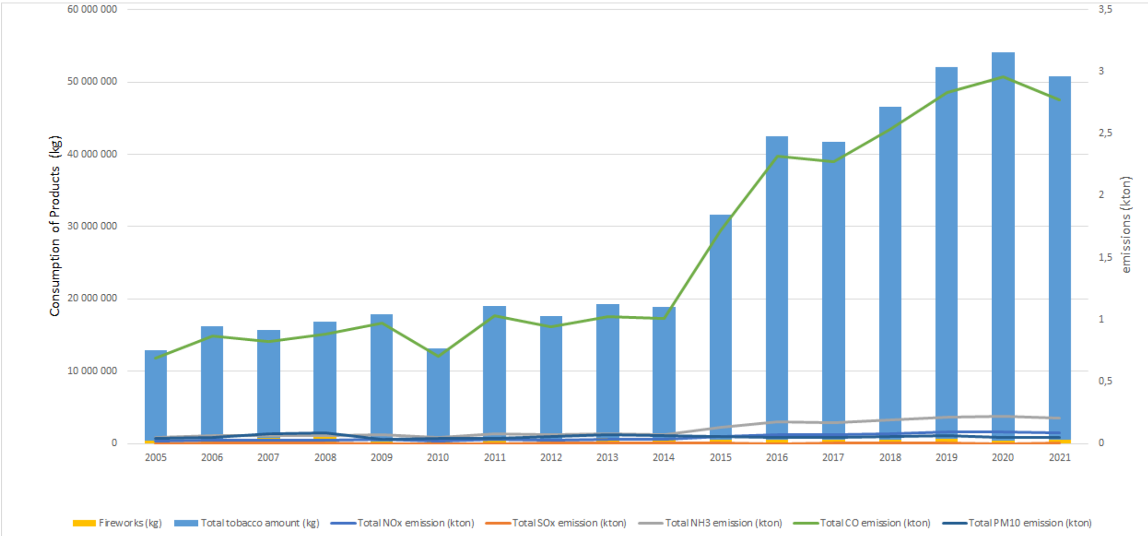

Figure 4-33. Selected emissions from use of tobacco products and/or the use of fireworks

2.10. Food and beverages industry (NFR 2.H.2)

2.10.1. Overview of the sector

The sector of food and beverages industry (2.H.2) covers the release of NMVOCs from the production of fermented beverages (such as beer, wine), sugar production, meat, fish and bread preparing, margarine and cooking oil usage, as well the release of PM10 from handling of agricultural goods (soya, wheat).

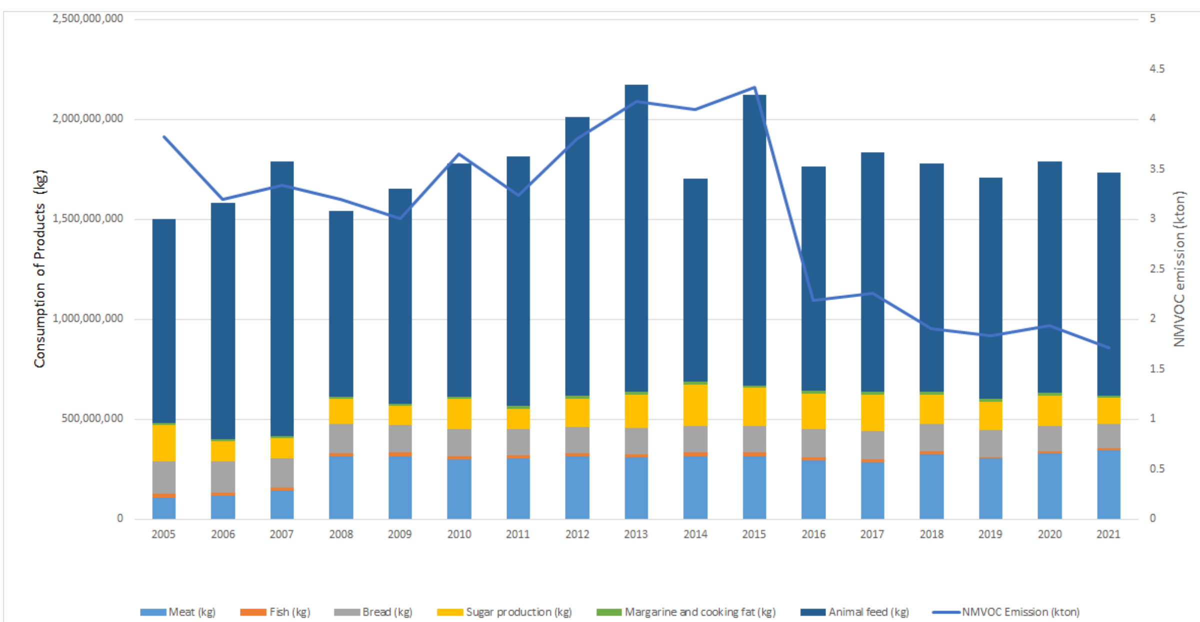

Figure 4-34. Consumption of relevant products along with NMVOC emissions (kton), 2005-2021.

2.10.2. Activity data

All statistical data in this sector was taken directly from the Eurostat database. For NMVOC calculations total consumption of meat, fish, poultry, and cooking far usage were taken into account (Production+Import-Export). Local production values for animal feed, sugar, bread, biscuits, as well as coffee roasting, and production of beer, wine and other fermented beverages (ciders, vermouth, distilled spirits) were also taken into account. For PM10 calculations handling of agricultural goods (cereal grains and wheat) was taken into account. Overall, production or consumption of more than 200 different products was taken into account.

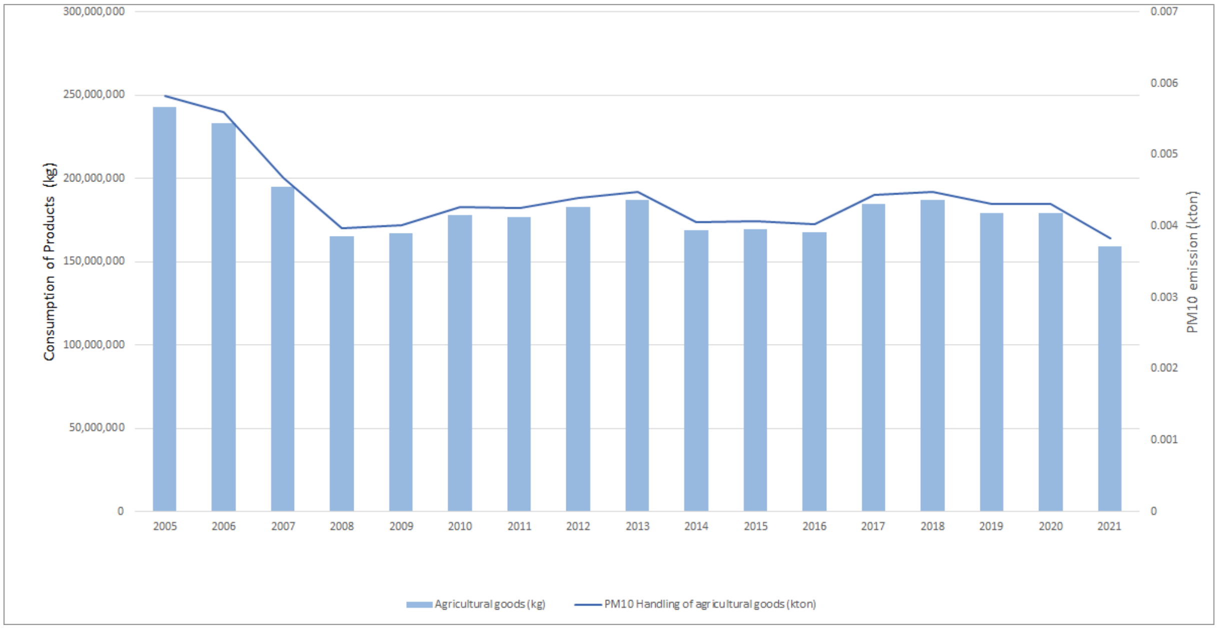

Figure 4-35. PM10 emissions (kton) from the handling of agricultural goods, 2005-2021.

2.10.3. Emission factors

Emissions were estimated using Tier 2 approach from 2005 onward, applying relevant emission factors for each specific product or technology. Emissions prior to 2005 were not estimated. For NMVOC calculations, the following emission factors were applied: 0.3 g NMVOC/kg meat consumed (EMEP/EEA Guidebook 2019, table 3.19), 0.3 g NMVOC/kg fish consumed (EMEP/EEA Guidebook 2019, table 3.19), 4.5 g NMVOC/kg bread produced (EMEP/EEA Guidebook 2019, table 3.13), 1 g NMVOC/kg cereal produced (EMEP/EEA Guidebook 2019, table 3.18), 10 g NMVOC/kg sugar produced (EMEP/EEA Guidebook 2019, table 3.20), 10 g NMVOC/kg fats used (EMEP/EEA Guidebook 2019, table 3.21), 1 g NMVOC/kg animal feed produced (EMEP/EEA Guidebook 2019, table 3.22), 0.55 g NMVOC/kg coffee roasted (EMEP/EEA Guidebook 2019, table 3.23), 0.35 g NMVOC/l beer produced (EMEP/EEA Guidebook 2019, table 3.27), 0.8 g NMVOC/l red wine produced (EMEP/EEA Guidebook 2019, table 3.25), 0.4 g NMVOC/l other fermented beverages produced (EMEP/EEA Guidebook 2019, table 3.32). In the case of handling agricultural goods, emission factor of 0.024 g NMVOC/kg agricultural goods handled was applied (EMEP/EEA Guidebook 2019, table 3.10).

$$E_{NMVOC} = AR_{Production} \cdot EF$$

In addition, from 2016 onwards, 90% abatement efficiency was applied to NMVOC emissions from the production of animal feed, spirits, bread, and cereal. We have assumed that the European Parliament Directive 2010/75/ES was fully implemented by 2016 in the industry, and thus large industrial manufacturers of bread, cereal, animal feed and spirits are required to have abatement equipment, such as NMVOC adsorption filters or thermal incinerators.

2.11. Other Industrial Processes (NFR 2.H.3)

2.11.1. Overview of the sector

The sector of other industrial processes (2.H.3) covers the release of NMVOCs, NOx, TSP, SO_2, NH_3 and CO from the major manufacturer of furniture (IKEA) and from the major manufacturer of acetate textile fibers (DP Acetate). Both facilities directly measure and report their pollutant emissions to the government of Lithuania. In the case of furniture manufacturing, the NMVOCs, NOx, TSP, SO_2, NH_3 and CO are released from the wood preservation, furniture cutting and coating. From the manufacture of acetate fibers, only the NMVOCs are released during polymerization process.

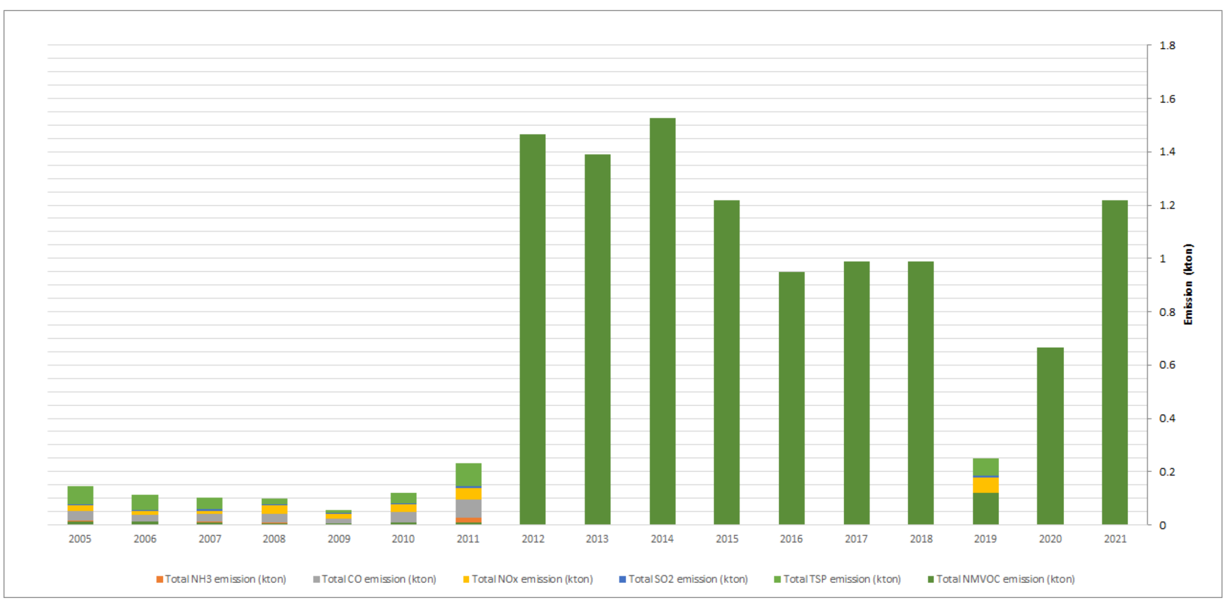

Figure 4-36. PM10 emissions (kton) from the handling of agricultural goods, 2005-2021.

2.11.2. Emission factors

Tier 3 approach was used in pollutant estimations as both IKEA and DP Acetate directly measure and report their emissions from the facility.

2.12. Consumption of POPs and heavy metals (e. g. electrical and scientific equipment (NFR 2.K)

2.12.1. Overview of the sector

In most cases, emissions from this sector are considered to be insignificant as they account for less than 1% of total national emissions. However, for some POPs, the use of electrical equipment may be an important source of emissions. In Lithuania, PCB emissions from electrical equipment constitute the biggest part of all PCB emissions.

Currently, in 2021, only one company in Lithuania still uses electrical equipment which produces PCB. As there is no information on the PCB amount in the liquid of the electric equipment still in use, assumption was made that PCB is equal to 0.05% of the liquid mass.

According to the requirements of the Rules on PCB/PCT Management, adopted on 26 September 2003 by Order No 473 of the Minister of Environment (as amended in 2004), holders of equipment containing PCBs shall compile inventory of equipment where PCB content exceeds 5 dm^3 and equipment containing PCBs from 0.05% to 0.005% by fluid weight. The Rules on PCB/PCT Management are aimed at implementing the PCB Directive – Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT). The updated inventory reports are submitted to the Regional Environmental Protection Departments annually.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Number of the transformers that contain PCBs (units)	2562	2330	2118	875	61	8	8	8	8	8	8	8	7	7	7

Figure 4-37. Number of electrical devices (transformers) in years 2007-2021.

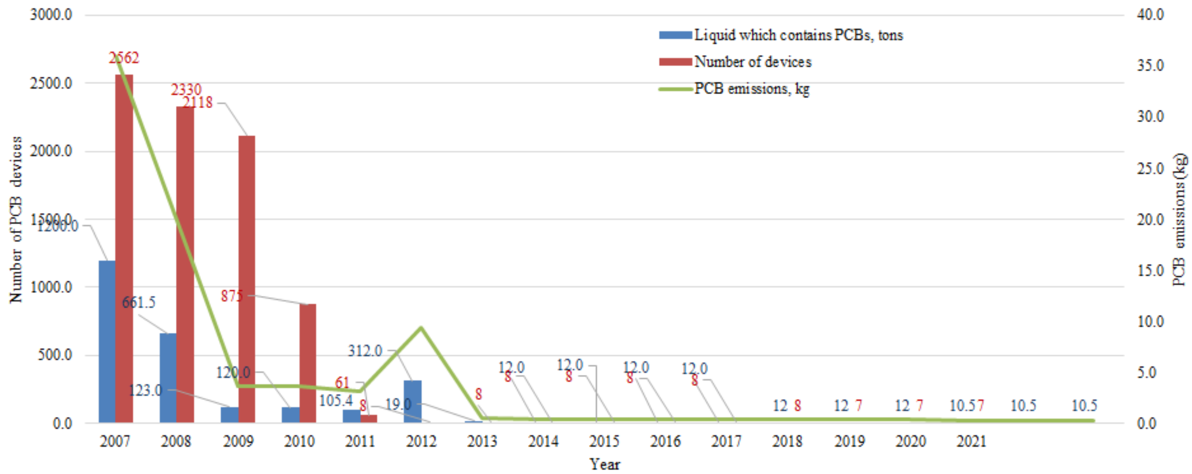

Figure 4-38. PCB emissions (kg) from 2.K sector in 2005-2021.

According to the Rules on PCB/PCT Management. PCB-containing equipment was to be decontaminated and/or disposed by the end of 2010 at the latest. The major part of the equipment inventoried before the end of 2010 in Lithuania has been disposed by this deadline. It should be noted that not all companies holding PCB–containing equipment managed to comply with this deadline. The Regional Environmental Departments are observing such companies concerning their situation, actions and plans for disposal/decontamination of PCB equipment no longer permitted. However, transformers the fluids in which contain between 0.05% and 0.005% of PCBs by weight are to be either decontaminated or disposed of at the end of their useful lives.

2.12.2. Activity data

Data on electrical equipment containing liquids with PCBs was provided by the specialists of waste licensing division in Lithuanian EPA. No information on the amount of liquid containing PCBs was available for year 2006. Thus, average of 2005 and 2007 was taken. Mercury emissions were estimated using Tier 1 approach by considering the total population of Lithuania.

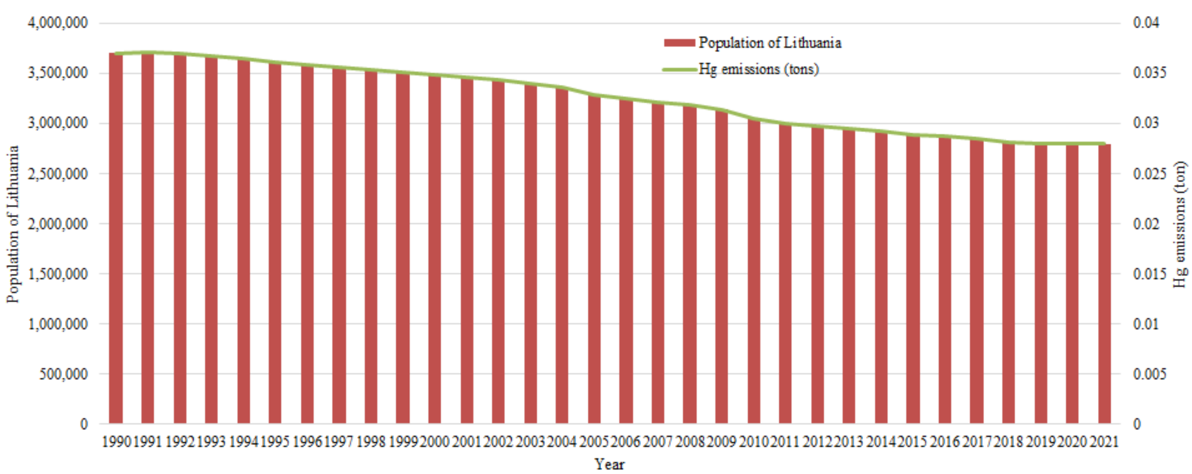

Figure 4-39. Hg emissions (ton) along with the total population of Lithuania in 1990-2021.

2.12.3. Emission factors

For the estimation of Hg emissions, emission factor of 0.01 g Hg/capita was used. For PCBs, we used emission factor of 0.06 kg PCBs/kg of PCB in electrical equipment. The amount of pollutants released were calculated by multiplying activity data with emission relevant factors.

$$E_{Pollutant} = AR_{production} \times EF_{pollutant}$$

2.13. Wood processing (NFR 2.I)

2.13.1. Overview of the sector

Emissions form this sector occurs from production of wood products: sawnwood, veneer sheets, plywood, particle board and fibre board. Occuring emissions are TSP.

Activity data for wood processing were retrieved from national forest agency. Emission factors were taken from 2019 Guidebook, Tier 1 methodology was used.

$$E_{Pollutant} = AR_{production} \times EF_{pollutant}$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant

$AR_{production}$ – the annual wood production

$EF_{pollutant}$ – the emission factor for this pollutant

Figure 0-11 Pollutant emissions and fuel consumption in sector 1.A.3.e.i