LITHUANIA'S FOURTH BIENNIAL REPORT

under the United Nations Framework Convention on Climate Change

Vilnius 2020

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A. Jakšto 4/9, Vilnius LT-01105 Lithuania
E-mail: info@am.lt
Website: https://am.lrv.lt

Cover photo: www.gamtosknyga.lt

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INTRODUCTION

Lithuania is pleased to submit its Fourth Biennial Report (BR4) under the United Nations Framework Convention on Climate Change (hereinafter – UNFCCC).

The Biennial Report is elaborated following the UNFCCC biennial reporting guidelines for developed country Parties (Decision 2/CP.17 of the Conference of the Parties under UNFCCC). As defined in the guidelines, the report structure is the following:

- information on greenhouse gas (hereinafter – GHG) emissions and trends;
- quantified economy-wide emission reduction target;
- progress in the achievement of quantified economy-wide emission reduction targets;
- GHG projections;
- provision of financial, technological, and capability-building support to developing country Parties.

This biennial report contains summary information on GHG inventory information for the period 1990-2017, provides summary information on Lithuania's progress made concerning Lithuania's contribution to the joint EU quantified economy-wide emission reduction target, on GHG projections until 2040. Information provided on GHG and trends is consistent with the information in Lithuania's National GHG inventory submission to the UNFCCC secretariat in 2019.

The Biennial report is prepared to take into account remarks by the UNFCCC expert review team, provided in the Report of the technical review of the Third biennial report of Lithuania (FCCC/TRR.3/LTU).

The EU and the Member States are committed to achieving a joint quantified economy-wide emission reduction target – 20% by 2020, compared to 1990 levels. The details of the EU joint target under the UNFCCC are clarified in the Report. Additional information related to the quantified economy-wide emission reduction targets presented in the document "Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention (FCCC/SB/2011/INF.1/Rev.1).

Tabular information to be reported electronically in the Common Tabular Format (CTF) following "UNFCCC biennial reporting guidelines for developed country Parties" (Decision 19/CP.18 of the Conference of the Parties under UNFCCC) is enclosed to the BR4 submission (submitted to the UNFCCC using the CTF software).

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INFORMATION ON GREENHOUSE GAS EMISSIONS AND TRENDS

1. INFORMATION ON GREENHOUSE GAS EMISSIONS AND TRENDS

Lithuania provided GHG inventory data for the first time in its first National Communication under the UNFCCC in 1996. Since 2004, inventory data is reported using common reporting format (CRF) and from 2006 using CRF Reporter software, developed by the UNFCCC secretariat. In 2006 for the first time, complete time series 1990-2004 have been estimated and submitted to the European Commission and the UNFCCC secretariat together with Lithuania's Initial Report under the Kyoto Protocol.

The data used in Lithuania's 4th Biennial Report is following its National Inventory Report (NIR) that was submitted in 2019 (September 2019 resubmission) to the Secretariat of the UNFCCC in compliance with the decision 24/CP.19 "Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to Convention" (FCCC/CP/2013/10/Add.3). This submission covers the inventory of GHG emissions of Lithuania for the period 1990-2017. It has also been submitted to the European Commission in compliance with European Parliament and the Council Regulation (EU) No 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC. The NIR includes a description of the methodologies and data sources used for estimating emissions by sources and removals by sinks and a review of their trends.

1.1. Greenhouse gas emissions trends

1.1.1. General greenhouse gas emissions trends

In 2017, Lithuania's total GHG emissions amounted to 20 706 kt CO_2 eq. excluding LULUCF and 15 409 kt CO_2 eq. including LULUCF. GHG emission level drastically fell down in 1992 and remained steady at approx. 22 Mt CO_2 eq. during the last 25 years (Figure 1-1).

A significant decrease in 1992 was caused by the collapse of Soviet economy, which led to the transition from a centrally-planned economy to a market-based economy by restructuring manufacturing industries, energy industries and agriculture. Upon its independence from the Soviet Union in 1990, after 50 years of annexation, Lithuania inherited an economy with high energy intensity. A blockade of resources, imposed by USSR during 1991-1993 led to a sharp fall in economic activity, as reflected by the decrease of the GDP in the beginning of nineties. The economic situation improved in the middle of the last decade and GDP has been increasing until 1999 (during 1999-2000, GDP decreased due to the economic crisis in Russia) and GDP continued increasing from 2001 to 2008.

In the beginning of 1990s, mostly fossil fuel was combusted in manufacturing industries, energy industries and agriculture. A comparison of annual general fuel balances in the period of 1990-2015 shows a significant decrease of use of fuel oil (e.g. from about annual quantity of 57 800 TJ in 1990-1991, to 19 307 TJ in 1992, to about 17 200 TJ in 1993-1994 and 13 126 TJ in 1995, to less than 600 TJ since 2008), also a decrease of use of coal, petrol, natural gas, but increase of wood use. Decrease of use of fuel oil first of all was influenced by environmental requirements: since 1 January 2004 a

restriction on sulphur content in fuel oil consumed came into power and it was followed with the even stricter requirements since 2008. As elimination of sulphur from fuel oil was not economically efficient for companies, these requirements led to the shift of fuel oil to other fuel types (e.g. natural gas), resulting in a considerable decrease in annual GHG emissions.

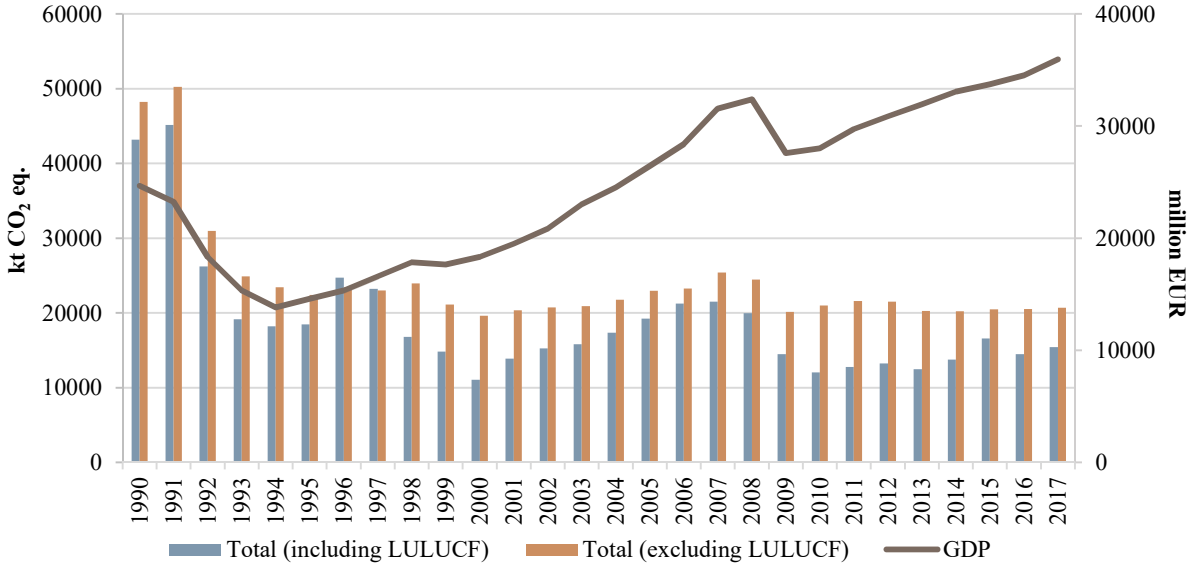

Figure 1-1. GHG emissions 1990-2017 in Lithuania

Last considerable decrease in 2009 was related with the economic crisis in Europe, while after 2009 GHG emissions stabilized at approx. 21 Mt CO_2 eq.

Comparing with 2016 the total GHG emissions have increased by 1% (excl. LULUCF) in 2017.

The composition of GHG emissions by sector in 2017 is presented in Figure 1-2.

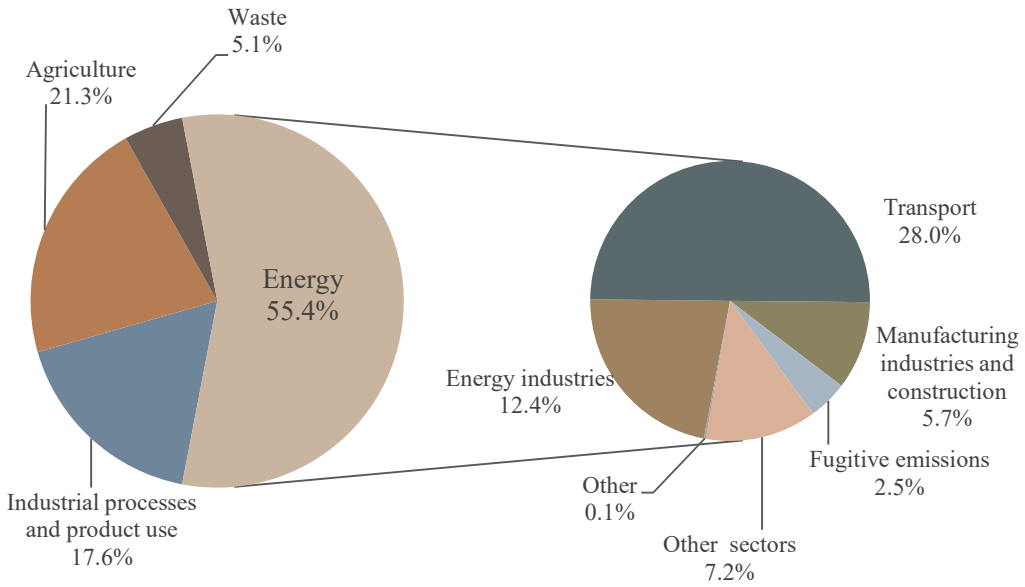

Figure 1-2. The composition of Lithuanian GHG emissions (%) by sector (excl. LULUCF) in 2017

Energy sector is the most significant source of GHG emissions in Lithuania with 55.4% share of the total emissions (excl. LULUCF) in 2017. CO_2 emission from energy sector contained 80% of the total

national CO_2 emissions (excl. LULUCF) in 2017. The main categories are transport and energy industries which contribute 42% and 18% to the total national CO_2 emission (excl. LULUCF) respectively. During the period 1990-2017 the share of transport sector significantly increased. In 1990 transport sector accounted for 18% of total GHG emission in energy sector whereas in 2017 – 50%. Although efficiency of transport vehicles increased during this period, the growth of GHG share of transport sector was influenced by the rapid increase of the density of transport routes and the number of road vehicles as well as significant GHG reduction in other energy sub-sectors. Comparing with 2016, GHG emissions in energy sector have decreased by 0.3% in 2017.

Agriculture sector is the second most important source of GHG emissions in Lithuania contributing 21% of the total national GHG emissions (excl. LULUCF). This sector is the most significant source of CH_4 and N_2O emissions accounting for 54% and 84% of the total CH_4 and N_2O emissions, respectively. The main source of CH_4 emissions is enteric fermentation contributing 87% to the total agricultural CH_4 emissions. Agricultural soils are the most significant source of N_2O emissions accounting for 93% of the total agricultural N_2O emissions. Comparing with 2016 GHG emissions in agriculture sector have decreased by 1.7% in 2017.

Emissions from industrial processes and product use sector (referred to as non-energy related ones) amounted to 18% of the total GHG emissions (excl. LULUCF) in 2017. The main categories are: ammonia production, nitric acid production and cement production. Ammonia production is the largest source of CO_2 emissions in industrial processes and product use sector contributing 16% to the total national CO_2 emissions (excl. LULUCF) in 2017. Nitric acid production is the main source of N_2O emissions in industrial processes sector and accounts for 7% in the total national N_2O emissions (excl. LULUCF) in 2017. GHG emissions in 2017 from industrial processes and product use sector have increased by 9% comparing with 2016.

Waste sector accounted for 5% of the total GHG emissions in 2017 (excl. LULUCF). The solid waste disposal on land is the second important source of CH_4 emissions. It contributes 30% to the total CH_4 emissions (excl. LULUCF). GHG emissions in 2017 from waste sector have increased by 0.7% comparing with 2016.

1.1.2. Greenhouse gas emissions trends by gas

The most important greenhouse gas is CO_2 as it contributed 66% to the total national GHG emissions expressed in CO_2 eq. in 2017, followed by CH_4 (16%) and N_2O (15%). HFCs, SF_6 and NF_3 amounted together to 4% of the total GHG emissions (excl. LULUCF) in Lithuania. GHG emissions trends by gas in CO_2 eq. are presented in the Figure 1-3 below and reflect the main tendencies of GHG level in general.

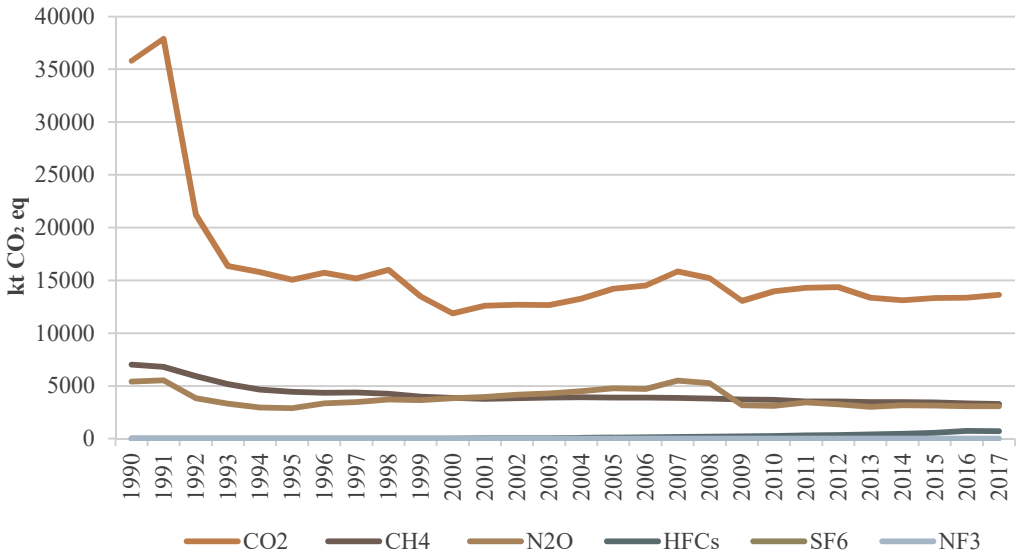

Figure 1-3. Trends of GHG emissions by gas kt CO_2 eq. (excl. LULUCF) 1990-2017

In 2017, the actual CO_2 emission (excl. LULUCF) was 62% lower than the emission in 1990. Comparing with 2016 CO_2 emissions increased by 14% including LULUCF and 2% excluding LULUCF. The largest source of CO_2 emissions is energy sector which contributes around 80% of all CO_2 emissions. Comparing with 2016 CO_2 emission from energy sector in 2017 have slightly decreased by 0.3%. CO_2 emission from the energy industries decreased by 13% and emissions from transport increased 5%.

Distribution of CO_2 emissions in 2017 by the main sectors and subsectors is shown in Figure 1-4.

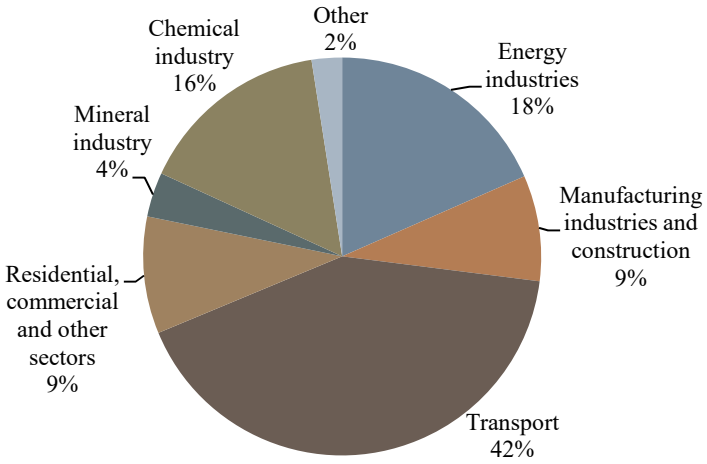

Figure 1-4. Distribution of CO_2 emissions by sector in 2017

Methane is the second most important GHG accounting for 16 % in the total national GHG emissions (excl. LULUCF). The largest sources of methane emissions in 2017 are: agriculture sector, which contribute 54% (enteric fermentation and manure management contributing with 47% and 7% respectively of the total national CH_4 emission (excl. LULUCF)), waste sector – 30% and fugitive emissions from oil and natural gas operations – 9% (Figure 1-5).

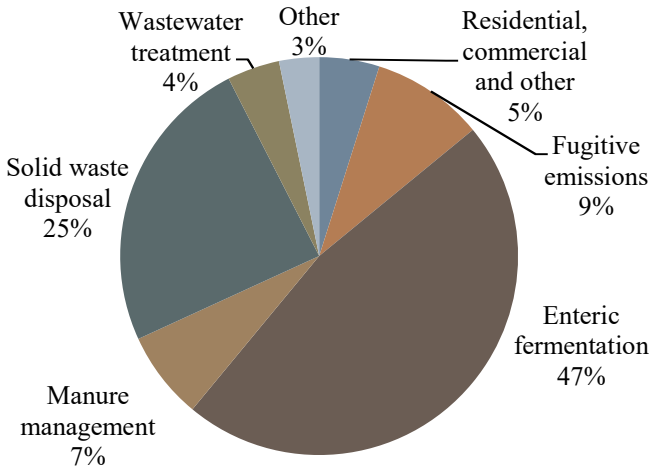

Figure 1-5. Distribution of CH_4 emissions by sector in 2017

Nitrous oxide is accounting for 15% in the total national GHG emissions (excl. LULUCF). Agriculture is the main source of N_2O emissions which contributed 84% to the total N_2O emissions in 2017. N_2O emissions from agriculture sector have decreased by 0.8% comparing with 2016.

The second significant source of N_2O emissions is nitric acid production. It contributes 8% to the total N_2O emissions. Figure 1-6 shows the distribution of N_2O emissions in 2017 by the main sectors and subsectors.

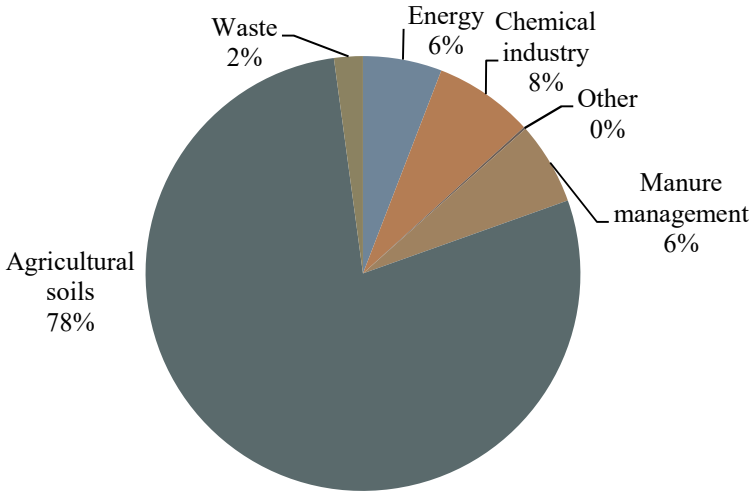

Figure 1-6 Distribution of N_2O emissions by sector in 2017

The F-gases contribute 4% to the total national GHG emissions in 2017. The emissions of F-gases have increased significantly during 1993-2016 period, but dropped in 2017. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications. With the adoption of Regulation (EU) No 517/2014 of the European Parliament and of the Council on Fluorinated Greenhouse Gases (F-gases regulation) the EU has set out restrictions to reduce HFCs emissions, and as a result of implementation of this regulation, HFCs emissions from these subcategories decreased in 2017. Figure 1-7 shows the trend of F-gases emissions during the period 1993-2017.

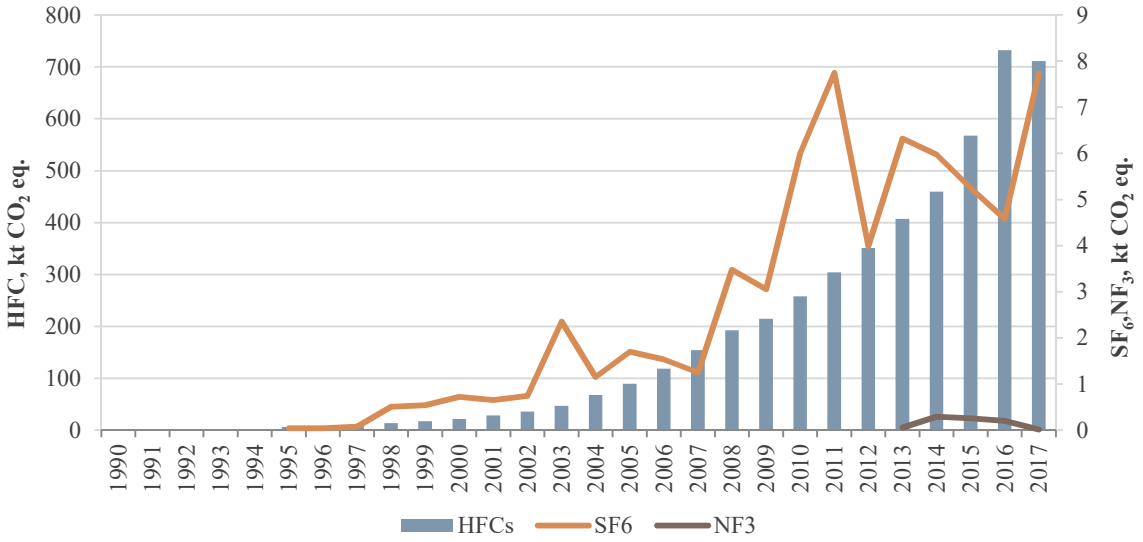

Figure 1-7. Emission trends for F-gases for the period 1993-2017 (kt CO_2 eq.)

1.1.3. Greenhouse gas emissions trends by sector

The trends of GHG emissions by sector expressed in CO_2 eq[1] are presented in Table 1-1.

The most significant source of GHG emissions in Lithuania is energy sector with 55% share of the total emissions in 2017. Agriculture is the second most significant source and accounted for 21% of the total emissions. Emissions from industrial processes and product use contributed 18% of the total GHG emissions, waste sector – 5%.

Table 1-1. Greenhouse gas emissions/removals by sector during the period 1990-2017, kt CO_2 eq.

GHG source and sink categories	Energy	IPPU	Agriculture	LULUCF	Waste	Total (including LULUCF)	Total (excluding LULUCF)
1990	33 149.6	4 481.8	9 039.9	-5 061.8	1 570.1	43 179.7	48 241.5
1991	35 221.5	4 514.1	8 915.7	-5 103.3	1 595.8	45 143.8	50 247.2
1992	19 923.5	2 668.8	6 807.1	-4 750.2	1 569.5	26 218.7	30 968.9
1993	16 058.3	1 738.4	5 494.5	-5 736.5	1 591.5	19 146.3	24 882.8
1994	15 094.2	1 935.3	4 846.3	-5 192.9	1 543.5	18 226.3	23 419.3
1995	14 117.8	2 222.7	4 491.1	-3 937.8	1 569.7	18 463.4	22 401.2
1996	14 601.1	2 613.0	4 669.4	1 272.6	1 570.1	24 726.1	23 453.5
1997	14 157.5	2 576.5	4 703.8	186.8	1 573.4	23 198.1	23 011.3
1998	14 848.8	2 984.1	4 564.1	-7 166.6	1 560.2	16 790.6	23 957.1
1999	12 442.7	2 919.7	4 247.2	-6 296.7	1 529.9	14 842.7	21 139.4
2000	10 910.7	3 075.2	4 078.7	-8 561.3	1 538.4	11 041.8	19 603.0
2001	11 548.3	3 322.6	3 911.6	-6 493.0	1 576.8	13 866.3	20 359.3
2002	11 629.5	3 495.2	4 058.4	-5 488.7	1 565.1	15 259.9	20 748.5

[1] IPCC Fourth Assessment Repot

GHG source and sink categories	Energy	IPPU	Agriculture	LULUCF	Waste	Total (including LULUCF)	Total (excluding LULUCF)
2003	11 618.2	3 578.0	4 144.0	-5 073.2	1 554.3	15 821.6	20 894.8
2004	12 281.8	3 767.5	4 182.8	-4 406.1	1 527.5	17 353.9	21 759.9
2005	13 164.3	4 107.8	4 206.6	-3 727.5	1 487.0	19 238.3	22 965.9
2006	13 232.2	4 366.4	4 199.7	-1 989.0	1 453.1	21 262.7	23 251.7
2007	13 473.1	6 143.6	4 343.5	-3 870.3	1 428.3	21 518.6	25 388.9
2008	13 351.9	5 473.5	4 238.7	-4 504.3	1 412.7	19 973.0	24 477.3
2009	12 168.8	2 292.8	4 318.8	-5 670.1	1 371.3	14 482.1	20 152.2
2010	13 152.6	2 237.3	4 274.9	-8 983.3	1 342.4	12 025.3	21 008.6
2011	12 292.6	3 717.4	4 302.3	-8 803.5	1 261.8	12 771.5	21 575.0
2012	12 329.3	3 566.9	4 378.8	-8 258.6	1 226.6	13 244.0	21 502.6
2013	11 709.7	3 001.6	4 351.0	-7 796.8	1 194.5	12 461.4	20 258.2
2014	11 327.8	3 187.5	4 562.1	-6 467.8	1 135.6	13 747.4	20 215.2
2015	11 288.4	3 510.3	4 600.1	-3 879.9	1 077.3	16 598.7	20 478.6
2016	11 629.6	3 343.9	4 479.1	-6 032.1	1 053.5	14 478.0	20 510.1
2017	11 599.4	3 638.2	4 402.9	-5 296.4	1 060.8	15 409.5	20 705.9
2017/1990, %	**-65.0**	**-18.8**	**-51.3**	**4.6**	**-32.4**	**-64.3**	**-57.1**

Energy

Energy sector is the most significant source of GHG emissions in Lithuania with 55% share of the total emissions (excl. LULUCF) in 2017. Emissions of total GHG from energy sector have decreased almost 3 times from 33,150 kt CO_2 eq. in 1990 to 11,599 kt CO_2 eq. in 2017 (Figure 1-8). Significant decrease of emissions was mainly due to economic slump in the period 1991-1995. During fast economic growth over the period 2000-2008 GHG emission in energy sector was increasing about 3 per annum. The global economic recession had impact on GHG reduction in energy sector by 9% in 2009. The closure of Ignalina NPP and GDP increase had impact on GHG increase by 8% in 2010.

During the period 1990-2017 the share of transport sector significantly increased. In 1990 transport sector accounted for 18% of total GHG emission in energy sector whereas in 2017 – 50%. Although efficiency of transport vehicles increased during this period, the growth of GHG share of transport sector was influenced by the rapid increase of the density of transport routes and the number of road vehicles as well as significant GHG reduction in other energy sub-sectors.

The increase of GHG emissions from fugitive sources is caused by the increase of CO_2 emissions from hydrogen production in oil refinery and by the increase of CH_4 emissions from natural gas distribution, reflecting the increase of the length of natural gas pipelines. In 2000-2016 GHG emissions from this subsector were increasing by average 4% per annum.

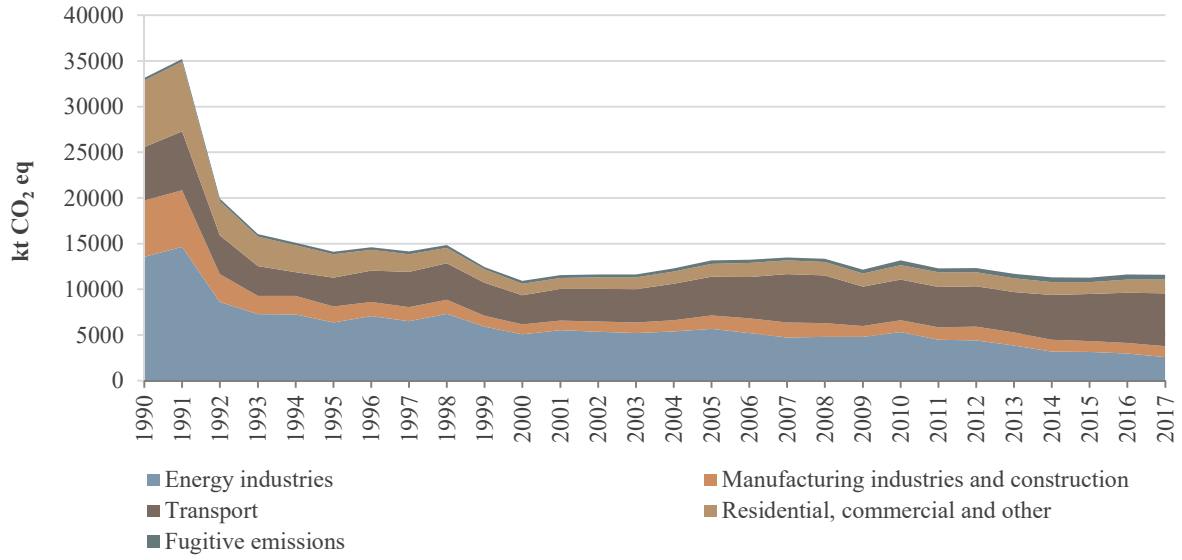

Figure 1-8. Trend of GHG emissions in energy sector during the period 1990-2017

Industrial Processes and Product Use

Emissions from industrial processes and product use (referred to as non-energy related ones) amount to 18% of the total emissions (excl. LULUCF) in 2017. Emissions from industrial processes and product use include CO_2, N_2O and F-gases (HFCs, SF_6 and NF_3) emissions. Emissions of total GHG from the industrial processes and product use sector have decreased from 4,482 kt CO_2 eq. in 1990 to 3,638 kt CO_2 eq. in 2017 (Figure 1-9).

CO_2 emissions from ammonia production contributed 16% to the total national CO_2 emissions (excl. LULUCF) in 2017. The lowest emission of CO_2 was in 1993 due to decrease of the ammonia production and the peak of CO_2 emissions were in 2007 when the ammonia production increased. Comparing with 2016 CO_2 emissions increased by 15% in 2017.

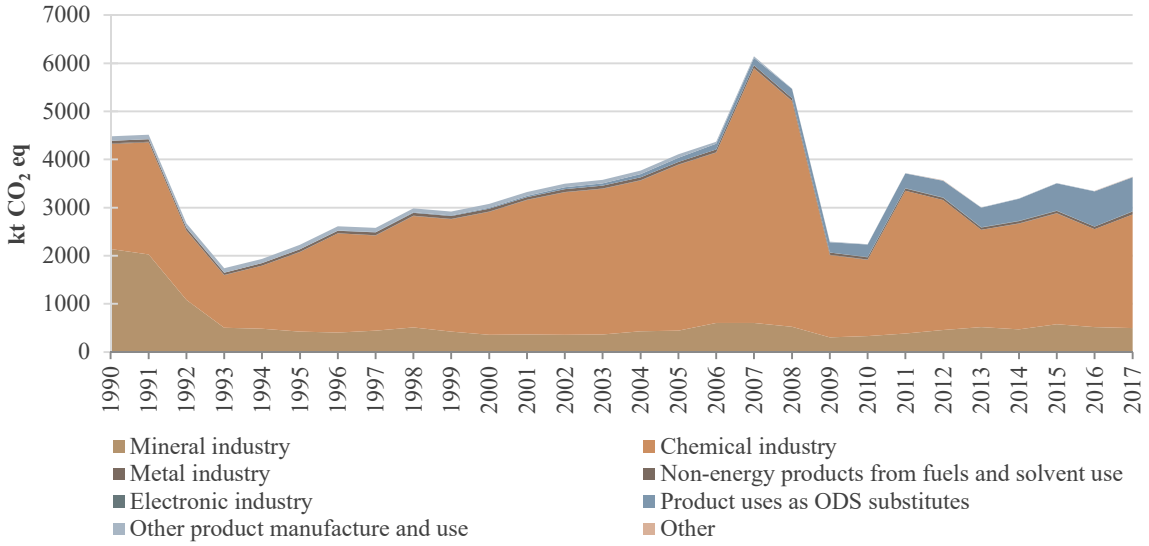

Figure 1-9. Trend of GHG emissions in industrial processes and product use sector during the period 1990-2017

Nitric acid production is the main source of N_2O emissions in industrial processes sector and accounts for 7% in the total national N_2O emissions (excl. LULUCF) in 2017. N_2O emissions had been

increasing since 1995 and reached its peak in 2007. After the installation of the secondary catalyst in nitric acid production enterprise in 2008 the emissions of N_2O dropped drastically till 2010 and started to increase because of the increase of production capacity. After 2011 emissions began to decrease because the project (Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant in Fertiliser Factory) of catalyst installation has been finished. Comparing with 2016 nitric acid production increased by 13% and N_2O emissions increased by 8%.

One of the main sources of GHG emissions in the industrial process and product use sector is the use of F-gases, which accounts for 20% in the total industrial process and product use sector emissions and for 4% in the total national emissions (excl. LULUCF) in 2017. Emissions from the consumption of F-gases were constantly increasing during 1993-2016 period, but dropped in 2017 (2%) as a result of F-gases regulation implementation.

Agriculture

Agriculture sector is the second most important source of GHG emissions in Lithuania contributing 21% to the total GHG emission (excl. LULUCF). Emissions of GHG from agriculture sector have decreased 2 times from 9,040 kt CO_2 eq. in 1990 to 4,403 kt CO_2 eq. in 2017 (Figure 1-10).

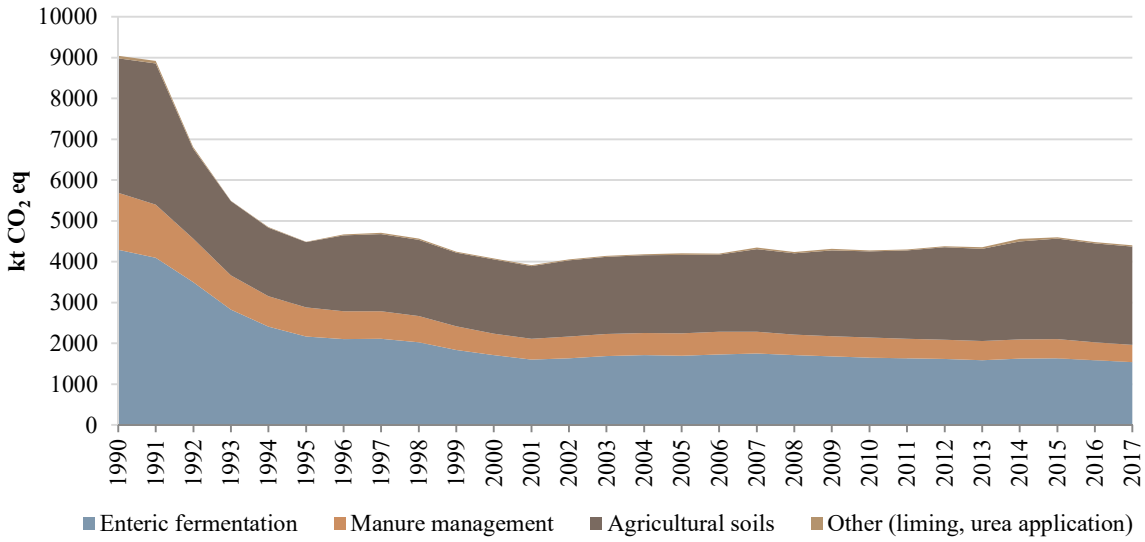

Figure 1-10. Trend of GHG emissions in agriculture sector during the period 1990-2017

Emissions from agriculture sector decreased substantially in the beginning of 1990s. The agriculture sector contributed 24% of the national GDP in 1992 and employed 19% of the labour force. Lithuania's agriculture, efficient according to the past soviet standards, produced a huge surplus that could not be consumed domestically. Lithuania was producing crops, developing livestock farming and food processing industry. Crops accounted for 1/3 and livestock for 2/3 of the total value of agricultural output. Lithuanian agricultural production was high enough to allow the export of about 50% of the total output.

Significant reforms were introduced in the early 1990s, particularly after the restoration of independence. The reform included the re-establishment of private ownership and management in the agriculture sector. Legislation defined dismemberment of the collective farms, but they did not definitively ensure their replacement by at least equally productive private farms or corporations. Agricultural production decreased by more than 50% from 1989 to 1994. The farms were broken into small holdings, averaging 8.8 ha in size, often not large enough to be economically viable.

Agriculture sector is the most significant source of the CH_4 and N_2O emissions accounting for 54% and 84% in the total CH_4 and N_2O emissions, respectively. The emissions of CH_4 and N_2O from agriculture sector decreased by 64% and 36% compared to the 1990, respectively. The reduction of CH_4 emissions is caused by the decrease in total number of livestock population.

The major part of the agricultural CH_4 emission originates from digestive processes. Enteric fermentation contributes 47%, manure management – 7% to the total national CH_4 emissions.

Agricultural soils are the most significant source of N_2O emissions accounting for 79% in the total national N_2O emissions.

LULUCF

The Land Use, Land-Use Change and Forestry (LULUCF) sector for 1990-2017 as a whole acted as a CO_2 sink except in 1996 and 1997 when emission constituted to 1,272.6 kt CO_2 eq. and 186.8 kt CO_2 eq. (Figure 1-11). That is explained by sudden spruce dieback after the invasion of bark beetles in a result of draughts. Spruce dieback caused huge losses in living trees volume in Lithuania's spruce stands and increased harvest rates, which had direct impact on biomass calculations in forest land and CO_2 balance in total of this sector.

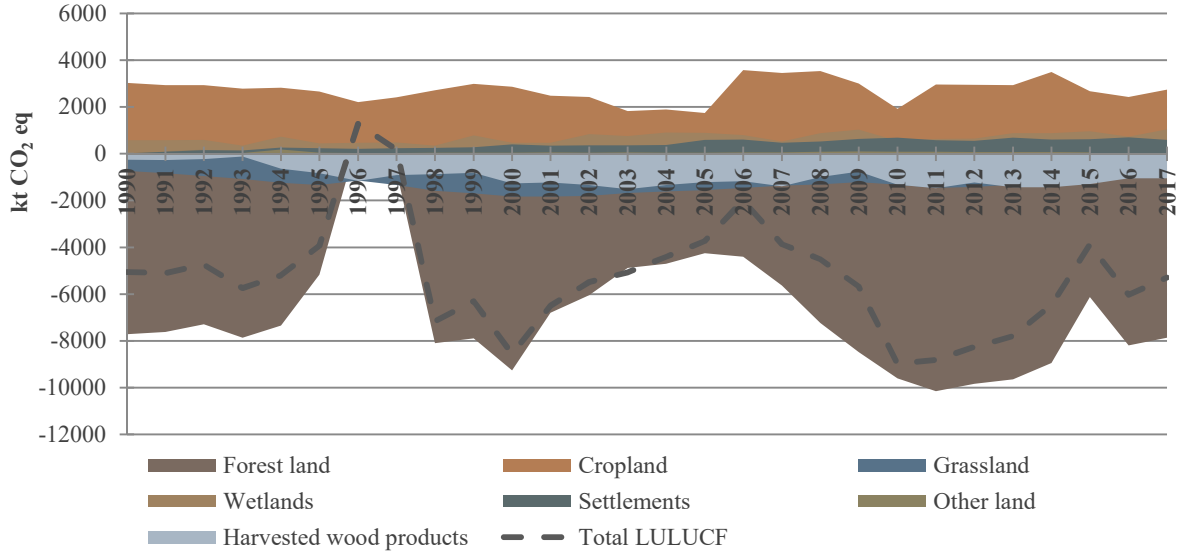

Figure 1-11. Total GHG emissions/removals from LULUCF sector for the period 1990-2017

Other fluctuations in forest land GHG removals (1998-2017) are also influenced by natural conditions – annual fluctuations in total growing stock volume are similar to observed growing stock increment changes in the period.[2] However, human activity in forest land, also has an impact on growing stock changes via intermediate and final felling. For example, lower removals from LULUCF sector in 2001-2006 and 2015 has been mainly caused by decreased mean annual volume change from forest land (from 7.2 million m^3 in 2000 to 5.8 million m^3 in 2001 and from 7.6 million m^3 in 2014 to 5.2 million m^3 in 2015). In addition to this, GHG removals are continuously increasing in harvested wood products due to slightly increasing forest use and increased production of long-life products

[2] Kulbokas, G., Jurevičienė, V., Kuliešis, A., Augustaitis, A., Petrauskas, E., Mikalajūnas, M., Vitas, A., Mozgeris, G., 2019. Fluctuations in gross volume increment estimated by the Lithuanian National Forest Inventory compared with annual variations in single tree increment. Baltic Forestry, Vol. 25.

(sawnwood category). Cropland and grassland also have significant impact in total GHG balance in LULUCF sector. Two opposite trends in GHG emissions/removals from both agricultural land use categories can be observed during reporting period. After the collapse of Soviet Union, restoration of private ownership of land has begun and collective farms were dismembered. However, this process does not always resulted in continuation of farming, which in turn resulted in abandonment of large cropland areas and thus in turn increase in grassland areas. Increase in grassland areas resulted in increasing GHG removals in grassland category. After Lithuania has joined EU and started to implement Common Agriculture Policy (CAP) with direct subsidies for farmers, conversions from grassland to cropland increased, which influenced increasing GHG emissions from cropland category due to the losses in biomass and soil carbon stock.

Total LULUCF sector GHG removals varies greatly during the reporting period, with on average GHG removals of 5.2 million tCO_2eq.

Waste

The waste sector accounted for 5% of the total GHG emissions in 2017 (excl. LULUCF). Emissions of the total GHG from waste sector have decreased from 1,577 kt CO_2 eq. in 1990 to 1,061 kt CO_2 eq. in 2017 (Figure 1-12).

Solid waste disposal on land including disposal of sewage sludge is the largest GHG emission source from waste sector. It contributed around 75% of the total GHG emission from waste sector in 2017 (73% excluding disposal of sewage sludge). GHG emissions occurring due to solid waste and sewage sludge disposal on land were increasing slightly from 1990 to 2003 and then started to decrease due to reduction of disposed waste, extraction of landfill gas, anaerobic digestion of sewage sludge.

Certain increase of emissions was observed from 2001 to 2003 and was caused mainly by disposal of large amounts of organic sugar production waste. In later years the producers managed to hand this waste over to farmers for use in agriculture and GHG emissions declined.

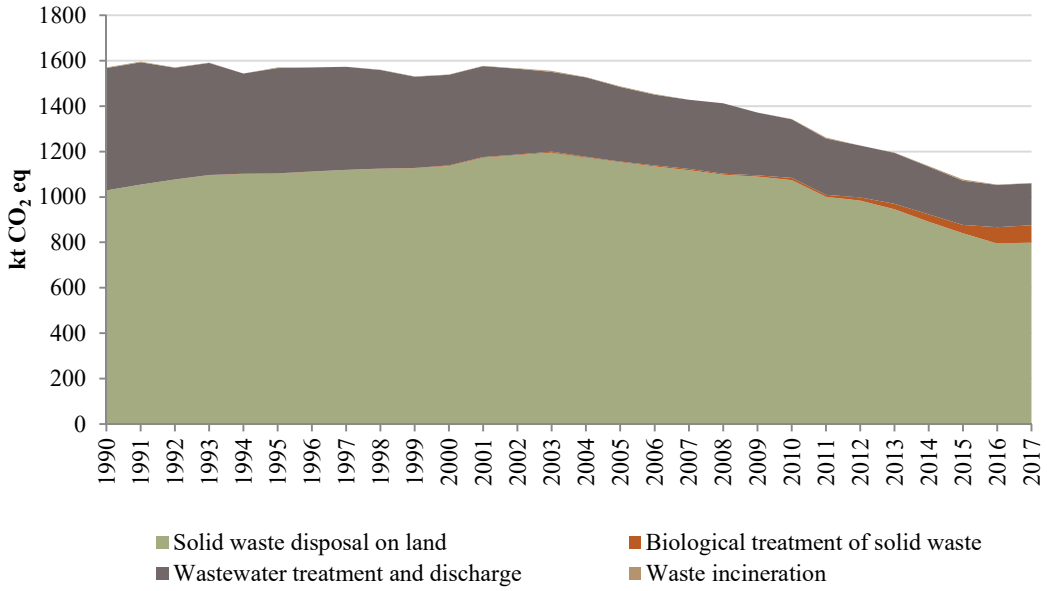

Figure 1-12. Trend of GHG emissions in waste sector during the period 1990-2017

Biological treatment of solid waste contributed around 7% of GHG emissions from waste sector in 2017. The biological treatment of waste has increased significantly since 1990 (0.02% of GHG

emissions from waste sector) and the amount of treated waste increased even more after the launch of the mechanical-biological treatment plants in 2016.

Wastewater treatment and discharge contributed around 17% of GHG emissions from waste sector in 2017. Wastewater in Lithuania is treated in aerobic treatment systems with minimum CH_4 generation. However, part of population still has no connection to public sewerage systems and emissions from sewage collected from septic tanks are significant.

KP-LULUCF

GHG removals and emissions resulting from forestry related activities (afforestation (A), reforestation (R) and deforestation (D)) are addressed by Article 3.3 of the Kyoto Protocol. Reporting under this article was mandatory during the first Kyoto Protocol commitment period (2008-2012) and shall be mandatory accounted and reported during the second commitment period. Article 3.4 includes the following activities: forest management, cropland management, grazing land management and revegetation. For the first commitment period Lithuania had chosen to ellect forest management (FM). Lithuania continues to account emissions and removals from FM activity as it is an obligatory activity in the second commitment period.

Net removals from Article 3.3 activities for the first commitment period were -212.9 kt CO_2 eq. in 2012. Second commitment period has started with total removals of -127.9 kt CO_2 eq. in 2013. Afforestation and reforestation resulted in net removals of -333.9 kt CO_2 eq. and deforestation – net emissions of 206 kt CO_2 eq., whereas in 2017 afforestation/reforestation rates were higher and deforestation – significantly lower (A/R – net removals of -407.9 kt CO_2 eq., D – net emissions of 23.9 kt CO_2 eq.), which resulted in total removals of -384 kt CO_2 eq. from A/R/D activities.

The area subjected to A/R was 52.88 thousand ha in 2017. There could be three periods distinguished in the time series of 1990-2017 describing the A/R trend line (Figure 1-13). The first time period of human induced afforestation/reforestation has started in 1990-2000 and is the consequence of the restoration of Lithuania's independency in 1990s. Forest expansion was the key priority among politicians therefore afforested and reforested areas constituted to more than 500 ha annually. After the spruce dieback which hit hard the Lithuanian forest in 1994, afforestation and reforestation rates were equal to forest regeneration after sanitary clear-cuttings. Another two huge increases in A/R area were recorded in 2001-2009 and 2010-2017. Increase in afforestation/reforestation activities in State Forest Enterprises since 2001 was the result of increased funding for such activities while increase of afforestation/reforestation since 2010 is mostly due to the introduction of EU support for such activities for private land owners.

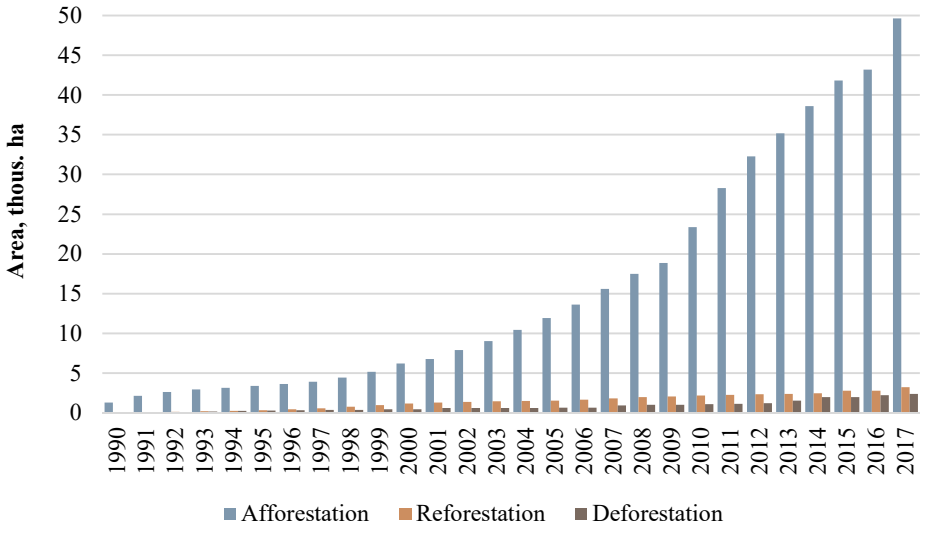

Figure 1-13. Cumulative area of afforestation, reforestation and deforestation, 1990-2017

In 2017, deforested area since 1st of January 1990 was 2 022.8 ha. Deforestation was mainly caused by the forest area conversions to settlements (road building, cities expansion, etc.), other lands (e.g. quarry's) and wetlands (e.g. flooding) land use categories.

Net removals from Article 3.4 activity forest management (FM) were -6 343.9 kt CO_2 eq. in 2017. The area subjected to FM was 2 139.3 thousand ha by the end of the first commitment period and 2 142.0 in the beginning of the second commitment period, expanding up to 2 155.4 thousand ha in 2017.

1.2. National systems in accordance with Article 5, paragraph 1, of the Kyoto Protocol

1.2.1. Institutional arrangements for greenhouse gas inventory preparation

Detailed institutional set up for GHG inventory preparation is presented in Lithuania's National Inventory Report 2019, Chapter 1.2.1. Basic elements are presented further in this chapter.

The main entities participating in GHG inventory preparation and submission process are:

- Ministry of Environment;
- Environmental Protection Agency;
- Permanent GHG inventory expert working group;
- State Forest Service;
- National Climate Change Committee;
- Data providers;
- External consultants.

The institutional set-up for GHG inventory report preparation and submission is given in Figure 1-14. Ministry of Environment of the Republic of Lithuania (MoE) is a National Focal Point to the UNFCCC. The Ministry of Environment is designated as a single national entity responsible for the national GHG inventory. It has overall responsibility for the National System of GHG inventory and is in charge of the legal, institutional, and procedural arrangements for the national system and the

strategic development of the national inventory. Within the ministry, the Climate Change Management Group administers this responsibility by supervising the national system. The Group will continue to supervise and coordinate the preparation of the National Inventory Report, including the final review of draft inventory reports.

The contact person in the MoE with overall responsibility for the national inventory is:

Ms. Jolanta Merkelienė
Chief Desk Officer, Climate Change Management Group
Tel.: +370 695 75667
Fax: +370 706 63663
E-mail: jolanta.merkeliene@am.lt

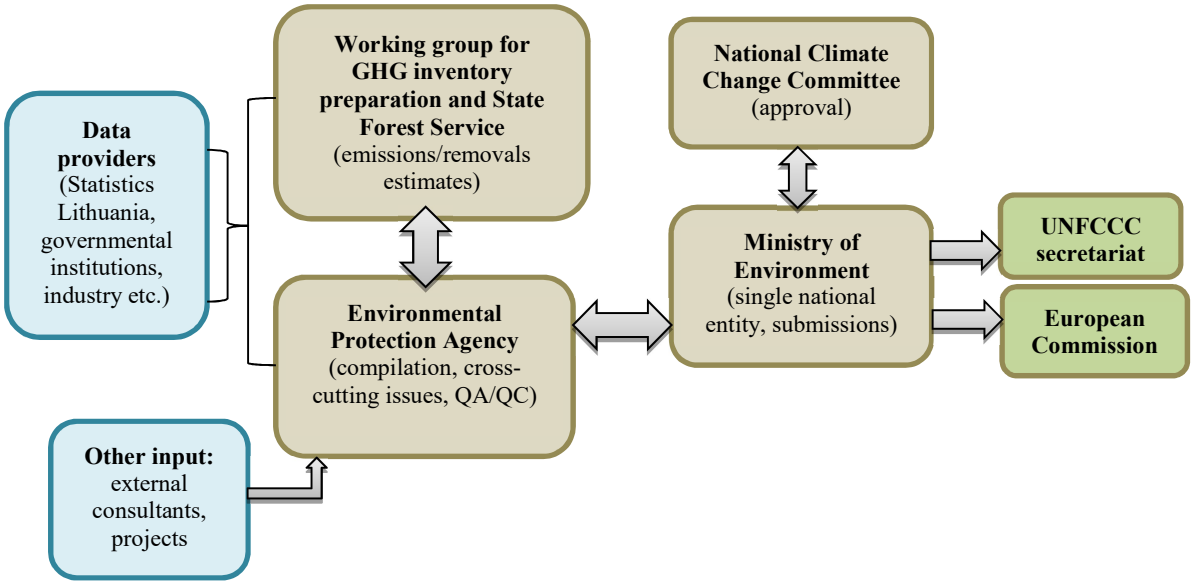

Figure 1-14. Institutional set-up for GHG inventory preparation

The **Lithuanian Environmental Protection Agency (EPA)** under the Ministry of Environment is assigned as an institution responsible for the GHG inventory compilation and QA/QC manager. In 2012 Climate change division was established within the EPA. The EPA responsibilities include: development and implementation of QA/QC plan and specific QA/QC procedures, collection of activity data and emission factors used to calculate emissions, collaboration with sectoral experts on the selection of best available methods complying with IPCC methodology, accomplishment of cross-cutting issues (key categories analysis, overall uncertainty assessment, analysis of GHG trends), establishment of GHG inventory database and archive, where GHG inventory submissions and all supporting reference material is stored and maintained etc.

Since 2014 submission personnel of EPA is also responsible for the calculation of emissions and preparation of NIR part of the industrial processes and products use sector and agricultural soils part of the agriculture sector.

The EPA is responsible for compilation of the final report based on the sectoral information provided by the experts/consultants – members of **Permanent expert working group** for GHG inventory preparation, which was established in 2012 by the Governmental Resolution No 683. It consists of experts from the Lithuanian Energy Institute, the Centre for Physical Sciences and Technology, the Institute of Animal Science of the Lithuanian University of Health Sciences, Centre for Environmental Policy, The State Forest Service and Aleksandras Stulginskis University. Composition of the Permanent expert working group for the preparation of GHG inventory is shown in Figure 1-15.

Members of the working group are responsible for determination of activity data and emission factors, calculation of emissions/removals on the basis of 2006 IPCC Guidelines, filling CRF tables for corresponding sectors, drafting relevant NIR sectorial chapters, application of sector specific QA/QC procedures.

External experts, independent specialists providing data for the GHG inventory, may also be involved during the inventory preparation process.

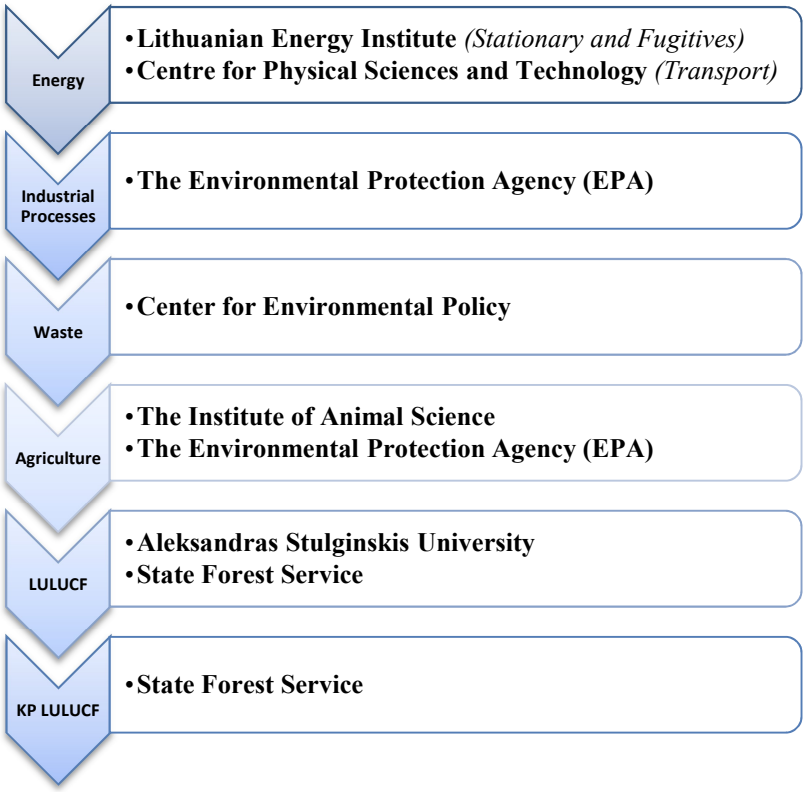

Figure 1-15. The composition of Permanent expert working group for preparation of GHG inventory in Lithuania

The **State Forest Service** under the Ministry of Environment in the GHG inventory preparation process is responsible for calculations of emissions and removals of LULUCF sector and Kyoto Protocol activities under Article 3 para. 3 and 4. The State Forest Service representative is also a member of Permanent working group for GHG inventory preparation. The State Forest Service inter alia compiles the National Forest Inventory (NFI) and the forest information system, carries out monitoring of the status of the Lithuanian forests, collects and manages statistical data etc.

Before final submission to UNFCCC secretariat and European Commission, reports are forwarded to the **National Climate Change Committee** for comments and final approval. National Climate Change Committee was established in 2001 in the first instance and periodically renewed (the latest in January 2015). It consists of experts from academia, government and non-governmental organizations (NGOs) and has an advisory role. The main objective of the Committee is to advise on the development and implementation of the national climate change management policy.

1.2.2. Greenhouse gas inventory preparation process, methodologies and data sources used

Work process of preparation and submission of National GHG inventory in Lithuania is organized by performing planned activities. The Figure 1-16 below shows a general overview of the GHG inventory preparation and submission process cycle.

Lithuania has to submit GHG inventory to the European Commission by 15th January and update estimates by 15th March annually. GHG inventory to the UNFCCC secretariat shall be submitted by 15th April annually.

This timeline shows only general activities overview and might be modified according to the reviews scheduled, planned projects, etc.

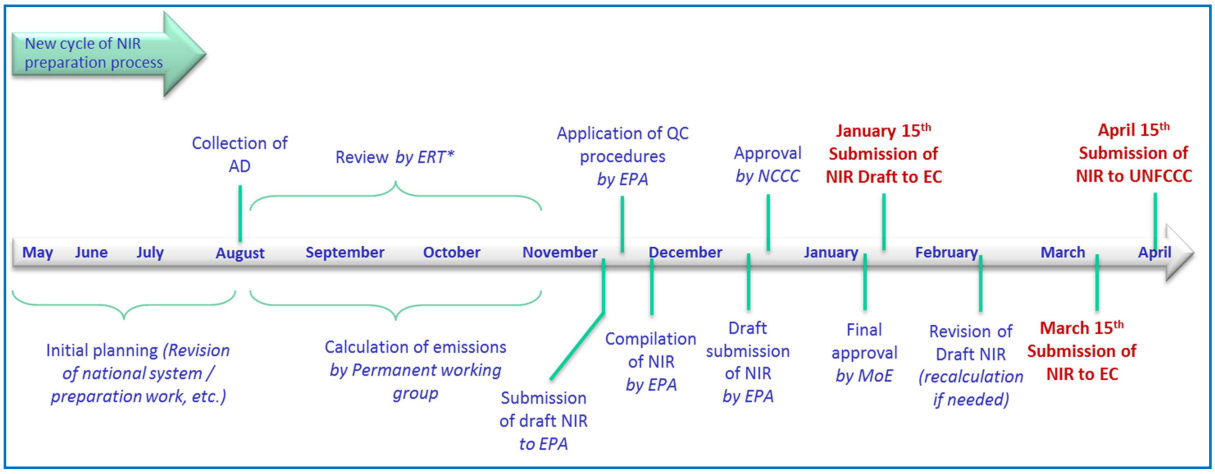

Figure 1-16. General timeline of GHG inventory preparation and submission process

One of the inventory preparation processes is data collection. This process starts with sending official requests to data providers (e.g. industrial companies) and collecting data from official statistical data sources. This process also involves application of QC procedures (conducted by EPA by providing documentation QC protocols) in order to collect all references and evaluation of uncertainty of activity data.

Activity data necessary for the calculation of GHG emissions is collected from published materials and official national and international databases. Not published data is gathered from relevant authorities (institutes, industry companies etc.) on the request of the EPA.

The main data providers for GHG inventory estimation are:

- Statistics Lithuania (Statistical Yearbooks of Lithuania, Sectorial Yearbooks on energy balance, agriculture, commodities, natural resources and environmental protection);
- The State Forest Service under the Ministry of Environment (NFI data, Lithuanian Statistical Yearbooks of Forestry);
- The Environmental Protection Agency (F-gases data, wastewater and waste data).

Table 1-2. Main data sources used in the GHG inventory

Sector	Main data sources
1.A Energy: Fuel Combustion	Energy Statistics database (Statistics Lithuania) EU ETS emission data

Sector	Main data sources
1.B Energy: Fugitive Emissions	Energy Statistics database (Statistics Lithuania) Lithuanian Geological Service Individual companies
2. Industrial Processes and Product Use	Individual production plants EU ETS emission data Industrial statistics database (Statistics Lithuania) F-gases database (EPA) Published literature
3. Agriculture	The Register of Agricultural Information and Rural Business Centre of Ministry of Agriculture Agricultural Statistics database (Statistics Lithuania) Regional Waste Management Centres Published literature International Fertilizer Association (IFA)
4. LULUCF/ KP-LULUCF	National Forest Inventory (NFI) Standwise Forest Inventory State Forest Cadaster Lithuanian Statistical Yearbook of Forestry National Paying Agency database on A/R areas Published literature
5. Waste	Waste database (EPA) Water and wastewater database (EPA) Regional Waste Management Centres Health Education and Disease Prevention Centre

Lithuania's GHG emission inventory includes all major emission sources identified by the 2006 IPPC Guidelines with some exceptions, which have a minor effect on the total GHG emissions (insignificant categories in terms of the overall level and trend in national emissions). All Lithuania's territory is covered by GHG inventory.

The GHG inventory is prepared in accordance with IPCC methodology:

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (*IPPC, 2006*);
- 2013 Supplement to the 2*006 IPCC* Guidelines for National Greenhouse Gas Inventories: Wetlands (*IPCC, 2014*);
- 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (*IPCC, 2014*).

GHG inventory is prepared also taking into account requirements, provided in Regulation (EU) No 525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC.

Simple equations that combine activity data with emission factors are used. Different sources in the transport, agriculture, waste and LULUCF sectors necessitate the use of more complicated equations and models. Advanced and country-specific approaches (Tier 2 and Tier 3 methods) are used wherever possible, as these are designed to produce more accurate emission estimates than the basic (Tier 1) methods.

The choice of methodological tier for the individual categories depends among other things on the significance of the source. The key categories analysis for the GHG inventory is performed according to the 2006 IPCC Guidelines (Approach 1 and Approach 2 level and trend assessment of the key categories) by EPA annually. The analysis covers all of the sources and sinks of the inventory. The Approach 2 methodology makes use of category-specific uncertainty analysis. The categories

identified by Approach 2 that are different from categories identified by Approach 1 are treated as key categories.

The level of disaggregation used for the key category analysis is performed by taking into account country-specific issues, specifically, in energy and agriculture sectors key categories are broken down into sub-source categories in order to reflect the level at which the EFs were applied and in order to focus efforts towards methodological improvements on these most significant sub-source categories.

Approach 1 key category (level assessment) with a highest contribution to national total emission in 2017 and 1990 was 4.A.1 Forest land remaining forest land - carbon stock change in biomass (CO_2). Its contribution to national total was 20% in 2017 and 11% in the base year. The second most important source of GHG emissions in 2017 was 1.A.3.b Road transportation accounting for 15% of the total emissions whereas in the base year it was 1.AA.1.a Public electricity and heat production – Liquid fuel (CO_2) accounting for 10% of the total emissions. Results of the Approach 1 and Approach 2 Level and Trend key categories analysis are provided in Annex II.

Inventory estimates are periodically recalculated. This occurs for a number of reasons, including revisions in key external data sources and revisions of data due to improvements in the estimation methodology or the inclusion of additional sources, input from the QA/QC activities and recommendations from international review process. Recalculations are conducted in accordance with the 2006 IPCC methodology and are reported in NIR of each sector. To ensure the accuracy of the estimates and to maintain consistency of the series through time, recalculations of past emissions estimates are undertaken for all previous years to view the actual difference of recalculation performed.

1.2.3. Quality assurance and quality control

Quality assurance and quality control (QA/QC) is an integral part of the inventory process. The quality requirements set for the annual inventories – transparency, consistency, comparability, completeness, accuracy – are fulfilled by implementing the QA/QC procedures. The outcomes of the QA/QC may result in a reassessment of inventory or category uncertainty estimates and to subsequent improvements in the estimates of emissions and removals.

Lithuanian Environmental Protection Agency has the responsibility for co-ordinating the quality assurance and quality control (QA/QC) process of the greenhouse gas inventory.

As a GHG inventory compiler and QA/QC manager EPA performs general QC procedures which involve check of all the input data, assumptions and data criteria, references provided, emission calculations, units and conversion, consistency between source categories, aggregation and transcription. Besides of general check EPA fills in the checklist for primary data check and QC protocols which record all the corrective actions taken. General control procedures also involve QC of documentation and archiving system. The data providers, sectoral experts are also responsible for the quality of their own inventory calculations and for implementing and documenting the QA/QC procedures. The QC procedures used in Lithuania's greenhouse gas inventory comply with the 2006 IPCC Guidelines.

Category-specific QC checks, including technical reviews of the source categories, activity data, emission factors and methods, are applied on a case-by-case basis by focusing on key categories and on categories where significant methodological and data revisions have taken place.

A QA/QC plan is a fundamental element of a QA/QC system. The Ministry of Environment and the Environment Protection Agency are responsible for the development and update of QA/QC plan. The

last update of QA/QC plan was performed in 2018. The quality objectives of the QA/QC plan and its application are an essential requirement in the GHG inventory and submission processes in order to ensure and improve the inventory principles: transparency, consistency, comparability, completeness, accuracy, timeliness and confidence in the national emissions and removals estimates for the purposes of meeting Lithuania's reporting commitments under the UNFCCC and the Kyoto protocol.

The aim of Quality Assurance (QA) procedures is to review the complete GHG inventory by the third party which is not directly involved in preparation of inventory to assess its quality i.e. assure that best available data and methods are used. Review for QA can be applied either for the whole inventory either for a certain sector. QA procedures for Lithuania's GHG inventory are be applied by performing scheduled international review (UNFCCC review, EU review) or performing national QA procedures.

More detailed information about Lithuanian GHG inventory QA/QC system is provided in the Chapter 1.2.3 of Lithuania's National Inventory Report 2019.

1.2.4. Changes to the national inventory arrangements since the latest biennial report

Since the submission of Lithuania' Third Biennial Report, no changes have been made to the GHG inventory arrangements and the national system under Article 5, paragraph 1, of the Kyoto Protocol.

REFERENCES

2006 IPCC Guidelines for National Greenhouse Gas Inventories https://www.ipcc-nggip.iges.or.jp/public/2006gl/

Lithuania's National Inventory report 2019 https://unfccc.int/documents/194960

Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (OL 2013 L 165, p. 13) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0525&from=EN

Report of the individual review of the annual submission of Lithuania submitted in 2016, FCCC/ARR/2016/LTU, 6 March 2017: http://unfccc.int/resource/docs/2017/arr/ltu.pdf

Report of the technical review of the Third biennial report of Lithuania (FCCC/TRR.3/LTU) https://unfccc.int/documents/180565

2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol https://www.ipcc-nggip.iges.or.jp/public/kpsg/index.html

Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention, Decision 24/CP.19 http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf

2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands https://www.ipcc-nggip.iges.or.jp/public/wetlands/index.html

Photo: www.gamtosknyga.lt

QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGET

2. QUANTIFIED ECONOMY WIDE EMISSION REDUCTION TARGET

The climate change policy in Lithuania is based on the EU climate change policy. Lithuania's emission reduction target for the years 2013-2020 is part of the joint target of the EU. The EU quantified economy-wide emission reduction target is implemented through the EU Climate and Energy Package 2020. This chapter explains Lithuania's 2020 emission reduction target under the UNFCCC.

2.1. Quantified economy-wide emission reduction target jointly with the European Union

Lithuania – a Party of the Convention and Kyoto Protocol – together with the other EU's Member States has committed to a quantified economy-wide emission reduction target of 20% by 2020, below 1990 level. The EU had also committed to raising this target to a 30% emission reduction by 2020 compared with 1990 levels, provided that other developed countries also commit to achieving comparable emission reductions, and that developing countries contribute adequately, according to their responsibilities and respective capabilities. This offer was reiterated in the submission to the UNFCCC by the EU-28 and Iceland on 30 April 2014.

Information on the EU quantified economy-wide emission reduction target has been presented to the UNFCCC and is contained in the "Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention" (FCCC/SB/2011/INF.1/Rev.1) and document FCCC/AWGLCA/2012/MISC.1. No individual target is set for Lithuania in the documents mentioned previously as 20% target will be reached jointly by the EU. Key assumptions and conditions related to the EU's target (e. g. sectors, base year, coverage of gases etc.) are included in the document FCCC/AWGLCA/2012/MISC.1. The summary information of the EU's target assumptions and parameters is given in the Table 2-1 below.

Table 2-1. Key assumptions and parameters of the EU-28 target

Parameters	**Target**
Base Year	1990
Target Year	2020
Emission Reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Global Warming Potential	4th AR
Sectors Covered	All IPCC sources and sectors, as measured by the full annual inventory and international aviation to the extent it is included in the EU ETS.
LULUCF	Accounted under KP, reported in EU inventories under the Convention. Assumed to produce net removals
Use of international credits (JI and CDM)	Subject to quantitative and qualitative limits
Other	Conditional offer to move to a 30% reduction by 2020 compared to 1990 levels as part of a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

The EU Directive of the GHG Emissions Trading System (Directive 2003/87/EC and respective amendments) and the Effort Sharing Decision (Decision No 406/2009/EC) are the main EU legal acts that lay down provisions for the implementation of the target. A joint quantified economy-wide emission reduction target of 20% is calculated, providing that in 2020 emissions from sectors covered by the EU ETS will be 21% lower than in 2005. As the common EU climate policy objectives shall be divided in accordance with the capacities of the Member States and their development. In 2013 the European Commission by the Commission Decisions 2013/162/EU and 2013/634/EU adopted the national annual limits denominated in annual emission allocations (AEAs), which have been transferred into binding quantified annual reduction targets for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (OJ L 90, p. 106) (hereinafter – ESD). With this decision the national emission targets for 2020 have been set based on Member States' GDP per capita and emission level 2005 (Figure 2-1).

The Commission Implementing Decision 2013/634/EU adjusts these annual emission allocations taking into account the changes in coverage of the EU ETS from 2013 onwards. In 2017, the AEAs of the EU Member States were further adjusted to take into account changes introduced by the implementation of the 2006 IPCC guidelines for national GHG inventories on the emissions levels in the inventory as these guidelines were applied in inventory reporting after the AEAs under the ESD were agreed upon (adjusted only AEAs for years 2017 to 2020).

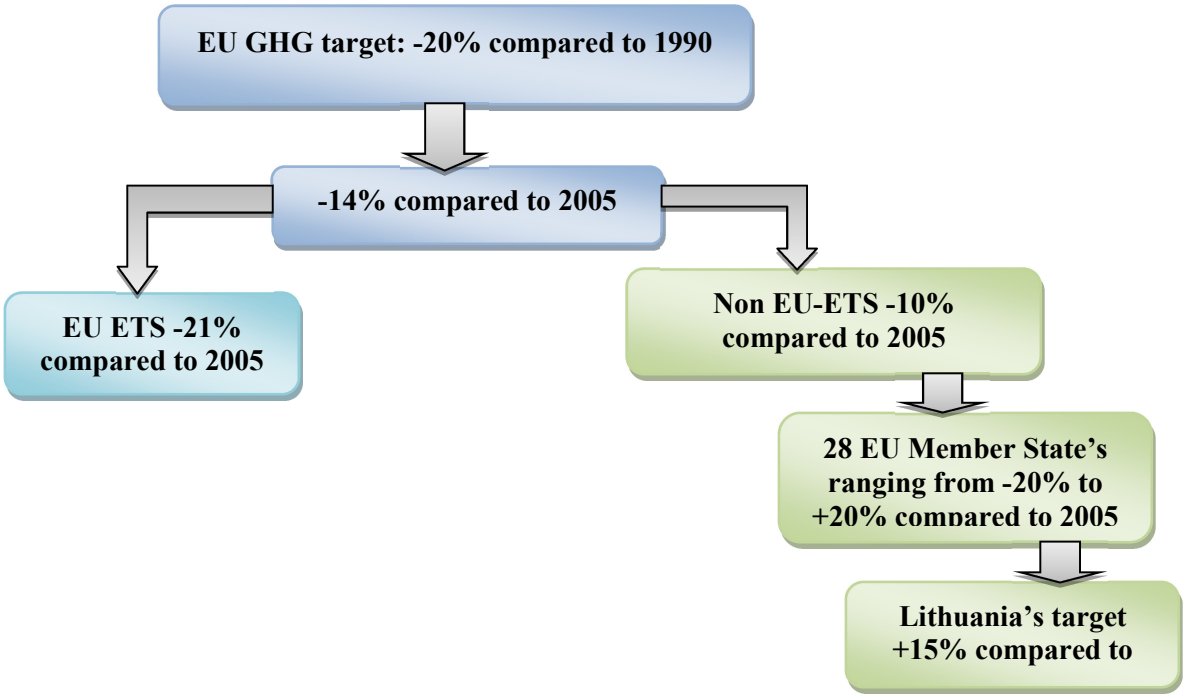

Figure 2-1. GHG emission 2020 target in ETS and ESD separation scheme under the EU legislation (Lithuania's example)

Under the revised EU ETS Directive (Directive 2009/29/EC), a single ETS cap covers the EU Member States and three participating non-EU countries (Norway, Iceland and Liechtenstein), and there are no further individual caps for Lithuania. Allowances allocated in the EU ETS from 2013 to 2020 decrease by 1.74 % annually, starting from the average level of allowances issued by Member States for the second trading period (2008-2012). For further additional information on recent changes in the EU ETS see Chapter 3.

In case of Lithuania about 90 stationary installations (larger than 20 MW combustion plants and chemical industry) and aircraft operators which are participating in the EU ETS jointly with the analogical operators from the other EU Member States will have to cut GHG emissions by 21% compared to 2005, and in the sectors which are not participating in the EU ETS (transport, agriculture, waste management, small industry and district heating companies, households, services and other sectors) the GHG emissions must not exceed annual emission allocations (kt CO_2 eq.) and to achieve, that GHG emissions in 2020 will not increase by more than 15% compared to 2005.

Generally, over eight years GHG emissions must not exceed 112,643,919 kt CO_2 eq. Lithuania's binding ESD annual emission allocations (AEAs) for 2013-2020 are provided in table 2-2.

Table 2-2. Lithuania's ESD annual emission allocations 2013-2020 and actual ESD emissions, tonnes CO_2 eq.

	2013	2014	2015	2016	2017	2018	2019	2020
ESD annual emission allocations*	12.936.664	13.297.646	13.658.629	14.019.611	14.125.626	14.497.103	14.868.581	15.240.059
Actual ESD emissions	12.449.462	12.922.268	13.250.961	13.921.700	14.132.498	-	-	-

*AEAs including adjustments in Commission Implementing Decision 2013/634/EU and Commission Decision (EU) 2017/1471

The ESD allows Member States to make use of flexibility provisions for meeting their annual targets, with certain limitations. The overachievement in a given year can be carried over to subsequent years, or be transferred to other Member States, up to 2020.[3] There is no intention to use credits from market-based mechanisms for the compliance with ESD 2020 target.

In Lithuania total emissions have decreased by 9.8% between 2005 and 2017 based on data of National GHG inventory report 2019. According to 2020 "with existing measures" (WEM) projections, Lithuania is on track to reach its 2020 ESD target. Lithuania as a Member State with a positive limit under Annex II of ESD over the years 2013-2016 was in compliance with AEAs targets and based on the Lithuanian GHG emissions projections there will be no shortage of the AEAs during remaining years of the commitment period. In case of shortage of AEAs, as it is in 2017, Lithuania primarily plans to use a possibility to cover the lacking part of the AEAs with the banked surplus of AEAs from previous years.

In addition, the EU Climate and Energy Package also requires Lithuania to increase its use of renewable energy sources (hereinafter – RES) to 23% of final energy consumption by 2020 and the share of RES of final energy consumption in transport involves not only biofuels but also electricity to 10% by 2020.

The quantified economy-wide emission reduction target for Lithuania is provided in Annex the CTF Table 2.

2.2. Other emission reduction targets

In addition to the EU target under the Convention, the EU also committed to a legally binding quantified emission limitation reduction commitment for the second commitment period of the **Kyoto Protocol** (2013-2020). In Table 2-3 all relevant GHG reduction targets for the EU and their key facts are displayed in an overview. On the left, the table includes the international commitments under the

[3] More information is available in https://ec.europa.eu/clima/policies/effort/framework_en

Kyoto Protocol and the UNFCCC. On the right, the EU commitments under the **Climate and Energy Package** are included.

Lithuania signed and ratified the **Paris Agreement** in 2016. Under the Paris Agreement Lithuania jointly with the EU and its Member States took a binding target of at least a 40% domestic reduction in economy wide GHG emissions by 2030 compared to 1990, by implementing the EU legal acts for the EU climate and energy policy targets till 2030, mainly through the EU emission trading system (EU ETS) and Efforts Sharing Regulation, as well as Clean Energy Package legislation. Moreover, cooperating with the EU Member States and other countries, Lithuania will promote the development of a low-carbon and climate-resilient economy in order jointly to reduce GHG emissions by 80-90% by 2050 and achieve climate neutrality in the second half of this century. The target will be delivered implementing the EU legal acts on 2030 climate and energy targets by all economy sectors, with the reductions in the EU ETS and non-ETS sectors amounting to 43% and 30% respectively by 2030 compared to 2005.

Table 2-3. Overview of GHG reduction targets for the EU

	International commitments			EU domestic legislation	
	Kyoto Protocol		UNFCCC	Climate and Energy Package	
				EU ETS	ESD
Target year of period	First commitment period (2008-2012)	Second commitment period (2013-2020)	2020	2013-2020	2013-2020
Emission reduction target	-8%	-20%	-20%	-21% compared to 2005 for ETS emissions	Annual targets by MS. In 2020 -10% compared to 2005 for non-ETS emissions
Further targets	-	-	Conditional target of -30% if other Parties take on adequate commitments	According to **Renewable Energy Directive** Lithuania has undertaken to increase the RES share in the final national energy consumption up to 23% by 2020. In 2018, the share RES in the total energy balance of the country accounted for 25.03%. According to the **Energy Efficiency Action Plan for 2017-2019** to increase energy efficiency by 1.5% annually until 2020, the target is to achieve savings of 740 ktoe of the total final energy consumption until 2020.	
Base year	1990 KP Flexibility rules (Art 3(5)) regarding F-Gases and Economies in Transition	1990, but subject to flexibility rules. 1995 or 2000 may be used as the base year for NF_3	1990	1990 for overall emission reduction target; 2005 for renewable energy and energy efficiency target; as well as for targets broken down into ETS and non-ETS emissions	
LULUCF	Included ARD and other activities if elected	Includes ARD and forest management, other activities if elected (new accounting rules)	Excluded	Excluded	
Aviation	Domestic aviation included. International aviation excluded	Domestic aviation included. International aviation excluded	Aviation in the scope of the EU ETS included. In practice total aviation emissions considered	Domestic and international aviation included, as in the scope of EU ETS	Aviation generally excluded, some domestic aviation included(operators below ETS de minimis thresholds)
Use of international credits	Use of KP flexible mechanisms subject to KP rules	Use of KP flexible mechanisms subject to KP rules	Subject to quantitative and qualitative limits	Subject to quantitative and qualitative limits	Subject to quantitative and qualitative limits
Carry-over of units from preceding periods	Not applicable	Subject to KP rules including those agreed in the Doha Amendment	Not applicable	EU ETS allowances can be banked into subsequent ETS trading periods since the second trading period	No carry-over from previous period
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6[4]	
Sectors included	Annex A of KP (Energy, IPPU, agriculture, waste), LULUCF according to KP accounting rules for CP1	Annex A of KP (Energy, IPPU, agriculture, waste), LULUCF according to KP accounting rules for CP2	Energy, IPPU, agriculture, waste, aviation in the scope of the EU ETS	Power & heat generation, energy-intensive industry sectors, aviation (Annex 1 of ETS directive)	Transport (except aviation), buildings, non-ETS industry, agriculture (except forestry) and waste
GWPs used	IPCC 2nd AR	IPCC 4th AR	IPCC 4th AR	IPCC 4th AR	

[4] In its third trading period, the EU ETS only covers the gases CO_2, N_2O, CF_4 and C_2F_6.

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Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009D0406&from=EN

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PROGRESS IN ACHIEVEMENT OF QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGET

3. PROGRESS IN ACHIEVEMENT OF QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGETS

3.1. Background for the information provided

In this chapter, we provide information on Lithuania's mitigation actions, including the policies and measures implemented and newly planned since the Seventh National Communication and Third Biennial report. In 2018-2019 Lithuanian institutions focused on the implementation of the 2030 Energy and climate targets. As a result in December of 2019 the Lithuania's National Energy and Climate plan (NECP) for the period 2021 -2030 (implementing Regulation on the Governance of the Energy Union and climate action (part of the Clean Energy for all Europeans package) adopted on 24 December 2018) was adopted. NECP document includes new as well as the already implemented measures and policies which were adopted to achieve 2020 economy-wide emission reduction target and continue to be implemented. Thus, in this submission of BR, we present renewed information on the policies and measures and their effects. The methods of the estimation of effects differ in separate sectors. The expert groups of different areas trough discussions determined the ex-ante effect of planned measures. These experts presented the Ministry of Environment their estimated sectoral parameters and predictions, and the Environment Protection Agency estimated the GHG mitigation effects according to the IPCC 2006 guidelines. As for the evaluation of fiscal measures, the external experts were involved, mostly they analysed the other countries experiences and adjusted to Lithuania. Additionally, planned measures were discussed with various stakeholder groups. All the additional measures were incorporated in the GHG projection scenario "with additional measures".

The information on the existing and planned mitigation actions and progress in attaining the goal under the Convention, where available, is included in CTF Tables 3 and 4.

Removals in the LULUCF sector are not included in the EU target under the Convention and reported in CTF Table 4 and CTF Table 4(a) as "not applicable" (NA). Mitigation actions in the LULUCF sector are described in Chapter 3.4.5 and presented in CTF Table 3.

3.2. Mitigation actions and progress towards Lithuania's QEERT

3.2.1. Climate change management policy in Lithuania

The main goals of climate policy are to ensure Lithuania's contribution to climate change mitigation, ensuring balance of environmental, social and economic interests and to promote Lithuania's ability to adapt to climate change and its impacts.

In accordance with the Kyoto Protocol Lithuania has undertaken to reduce its GHG emissions by 8% below 1990 level during the first commitment period 2008–2012 and successfully implemented achieving 56% GHG reduction, while GDP increased by 25%. In 2012 Lithuania together with the other EU Member States and Iceland undertook 20/30% GHG emissions reduction below 1990 level commitment for the second Kyoto Protocol period from 2013 till 2020. The Doha Amendment of the Kyoto Protocol was ratified by the Parliament (Seimas) on 20 October 2015.

On 7 July 2009 the Seimas of the Republic of Lithuania adopted the Law on Financial Instruments for Climate Change Management. This Law stipulates the rights, duties and liabilities of the persons engaged

in the economic activities resulting in GHG emissions as well as the sphere of competence of state institutions/authorities and bodies.

On 16 September 2009 the Government of the Republic of Lithuania by its Resolution No 1247 approved the updated National Strategy for Sustainable Development. In order to reach the objectives set forth in the strategy, implementation plan was prepared. Environment protection and climate change topics are under consideration in this Strategy.

On 15 May 2012 the Parliament of the Republic of Lithuania with its Resolution No XI-2015 adopted Lithuania's Progress Strategy "*Lithuania 2030*". This Strategy underlines the need for incentives for business to invest in green technologies, products and services. The main challenges and tasks in the period 2014–2020 may appear in the increase of energy efficiency and use of renewable energy sources (hereinafter – RES) in final energy consumption by creating and introducing low carbon technologies in industry, agriculture and transport sectors. It is indicated that stronger cross-sectorial cooperation between research and industry is needed as well as international cooperation on joint climate change adaptation and risk prevention and management. The **National Progress Programme for 2014–2020** was approved by the Government Resolution No 1482 of 28 November 2012 for the implementation of this Strategy.

The main national strategy for climate change management, elaborated and approved in November 2012, is the **Strategy for the National Climate Change Management Policy** until 2050 (currently is being updated), which sets legally binding short-term (until 2020), indicative mid-term (till 2030 and till 2040) and long-term (until 2050) adaptation and mitigation targets and objectives. Looking on the long term, Lithuania has committed to contribute to the EU milestones to reduce GHG emissions by 2030 – 40%, by 2040 – 60% and by 2050 – 80% compared to 1990 level. Legally binding mitigation targets and objectives are set in the following Lithuania's economy sectors: energy, industry, transport, agriculture, households, environmental protection and rational use of national resources, spatial planning, health care, science, education and provision of information to the public, international co-operation. It also defines policies and measures necessary for Lithuania to meet its Kyoto Protocol second commitment period target. The updated strategy was approved by Resolution No. 1326 of the Government of the Republic of Lithuania on the 30th of December 2019 and was forwarded to the Parliament of the Republic of Lithuania for the final approval[5].

Inter-institutional action plan on the implementation of the Goals and Objectives for 2013–2020 of the Strategy was approved on 23 April 2013 by the Government Resolution No 366 and it is annually updated. It contains provisions related to moving to a competitive low carbon economy and foresees measures for climate change adaptation and mitigation in Lithuania for the years 2013–2016. The Action Plan consists of general provisions, targets, objectives, measures, financial resources, implementing institutions, assessment criteria and values. Following the Strategic planning methodology approved by the Government, the plan is prepared for the three years period and is updated annually by adding one more year. Besides that, ministries and other governmental institutions are obliged to mainstream the goals and objectives into sectorial policies and plans as set forth by the Strategy, to establish implementation measures and to ensure close inter-institutional cooperation while developing the strategies, their implementation plans and programmes of individual sectors of economy.

To comply with annual GHG emission reduction targets in non-EU ETS sectors, quantitative annual GHG emission reduction targets in kt CO_2 eq. were determined for transport, agriculture, waste

[5] The long-term strategy project (Lithuanian language): https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/2749ea732b1311ea8f0dfdc2b5879561?positionInSearchResults=0&searchModelUUID=65e10e2b-6499-4bcc-aa5b-86376ab84f16.

management, non-ETS industries and other sectors are set as assessment criteria in the Action Plan. The results of the measures implemented in accordance with the Inter-institutional Action plan will form the basis for the update of the Strategy.

Since 2010 a **Special Program for Climate Change** has been developed as it was determined in the Law on Financial Instruments for Climate Change Management. The Program aims to develop an additional funding for climate change management measures. The Program funds are kept in a separate account of the State Treasury. Income and expenses of the Program are planned in the State budget according to the special principles of the funding program. The Program funds are used for increase energy efficiency, use of RES and implementation of the measures of inter-institutional Action Plan on the Implementation of the Goals and Objectives for 2013–2020 of the Strategy for the National Climate Change Management Policy.

The **National Climate Change Committee** has been established for advisory purposes on the development of the Lithuanian climate change policy and coordination of its implementation. The Committee includes 21 representatives of ministries, municipal authorities, research and study, industrial and non-governmental organizations.

The **National Energy Strategy,** approved of by the Parliament (Seimas) of the Republic of Lithuania in 2007 was repealed with new **National Energy Independence Strategy (NEIS)**, adopted on 26 June 2012 by the Decree No XI-2133 of the Parliament of the Republic of Lithuania (*amended in 2018*). The main goal of the Strategy is to ensure Lithuania's energy independence by strengthening Lithuanian's energy security and competitiveness.

The following main programmes and plans are prepared, setting the particular measures for the implementation of energy sector targets: District Heating Development Program, the Energy Efficiency Action Plan, and the National Renewable Energy Resources Development Strategy.

Renewed **NEIS** on 21st of June in 2018 sets the energy goals of Lithuania and the directions of their implementation until 2030, and sets the energy development guidelines until 2050. The main strategic directions of the Lithuanian energy policy development are energy security, competitiveness, green energy development and innovations. The Strategy reflects the vision of the Lithuanian energy sector – to provide reliable, renewable and environmentally friendly energy to the residents of the country for the most favourable price.

Lithuania has developed a **National Energy and Climate Action Plan 2021-2030** in line with the requirements of the Energy Union Governance Regulation. This Plan has been prepared based on and integrating the provisions, objectives, tasks of the Lithuanian national legislation, international obligations, strategies, and other planning documents, as well as measures being implemented and planned to be implemented.

The key strategic documents integrated into the NEIS (2018) and the National Climate Change Management Policy Strategy (2012 and updated in 2019) and the National Air Pollution Reduction Plan adopted (2019). Some of the strategies are still being drafted, some are still in the process of being developed, so their intended content is mirrored, where possible, with planned (un]approved) policies and measures.

In parallel to the preparation of the National Energy and Climate Action Plan the **National Progress Programme** (NPP) was updated The purpose of NPP drafting is to create a basic (umbrella) medium-term planning document setting out the country's strategic development goals and objectives, revealing what changes will be sought in all areas of state activity over the next ten years to ensure long-term economic and social progress. For the consistency between these two strategic planning documents, the

target values of the NPP assessment indicators correlate with the goals set in the National Plan. For each economic sector contributing to the anthropogenic impact of climate change, NPP has specific GHG reduction targets for 2030. The following objectives and/or tasks set for the energy sector in the NPP: To increase the competitiveness of the energy sector; To connect the Lithuanian natural gas system with the EU natural gas system and access to the international LNG market; To link the Lithuanian power system with the Continental European power system for synchronous operation; Ensure the adequacy of the Lithuanian electricity market and electricity system by increasing the share of domestic electricity production; To reduce energy poverty among the population; To ensure good environmental quality and sustainability of the use of natural resources, mitigate Lithuania's impact on climate change and increase its resilience to its influence.

3.3. The GHG emissions trading system in Lithuania

The EU ETS is a key climate policy instrument that has been implemented in the EU to achieve its objectives of reducing GHG emissions in a cost-effective manner since 2005. From 2013 the EU ETS covers certain activities that emit CO_2, N_2O and PFCs.

EU ETS is established by the Directive 2003/87/EC under which each operator carrying activities under the Directives scope participates each year in a so called “compliance cycle”. This yearly cycle includes monitoring GHG emissions, verifying them and reporting to the competent authority. After the reporting is complete each installation is obligated to surrender EU ETS allowances equal in amount to the emitted GHG in tonnes during the reporting year.

EU ETS allowances are given for free to the operators which are deemed to be exposed to carbon leakage to third countries. However, this allocation is reduced each year to encourage operators to plan for the shortage of allowances and reduce their GHG emissions by modernising their installations. Since 2013 the main principle of allocation is auctions and operators receive just limited amount free allowances and the rest needed amount are obligated to purchase from other operators or auctions of allowances.

Since 2005, Lithuania takes part in EU Emissions Trading System. Aviation has been included in the EU ETS since 2012, and monitored since 2010. Installations under scope of the EU ETS are required to have a GHG emissions permit, issued by the Environmental Protection Agency in accordance with Order of the Minister of Environment No. D1-231 approved on 29 April 2004 (latest amendments in Order No. D1-169 adopted on 26 February 2015). These permits must be updated if changes to the functioning of the installation occur.

In 2018, 86 installations and 1 aircraft operator from Lithuania carried out activities that fall under the scope of the EU ETS (Fig. 4-2). Most of these installations are small district heating units.

According to Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions (MRR) all 86 installations are divided into 3 categories:

- 75 installations fall under category A (installations that emit less than 50 kt CO_2 eq. per year or low emitters (less than 25 kt CO_2 eq. per year));
- 8 installations fall under category B (installations that emit more than 50 kt CO_2 eq., but less than 500 kt CO_2 eq. per year);
- 3 installations fall in category C (installations emitted > 500 kt CO_2 eq.).

In total Lithuanian EU ETS operators emit about 29% (comparing National GHG inventory report data and EU ETS data for year 2017) of total national greenhouse gas emissions. The majority of GHG is emitted from 3 installations that carry out production of ammonia and nitric acid, petroleum refining and cement production. All operators of stationary installations and aircraft operators in the EU ETS are

required to monitor and report their annual emissions in accordance with the MRR. Reported emissions are also affected by obligations under the Accreditation and Verification Regulation (AVR) and must be verified by independent 3rd party verifiers that are accredited by the National accreditation bodies. Any verifier accredited by the EU Member State National accreditation body (NAB) may carry out verification in any EU Member State. In case of Lithuania, all verifications are carried out by verifiers that are accredited by foreign NABs. There are no verifiers accredited by the Lithuanian NAB.

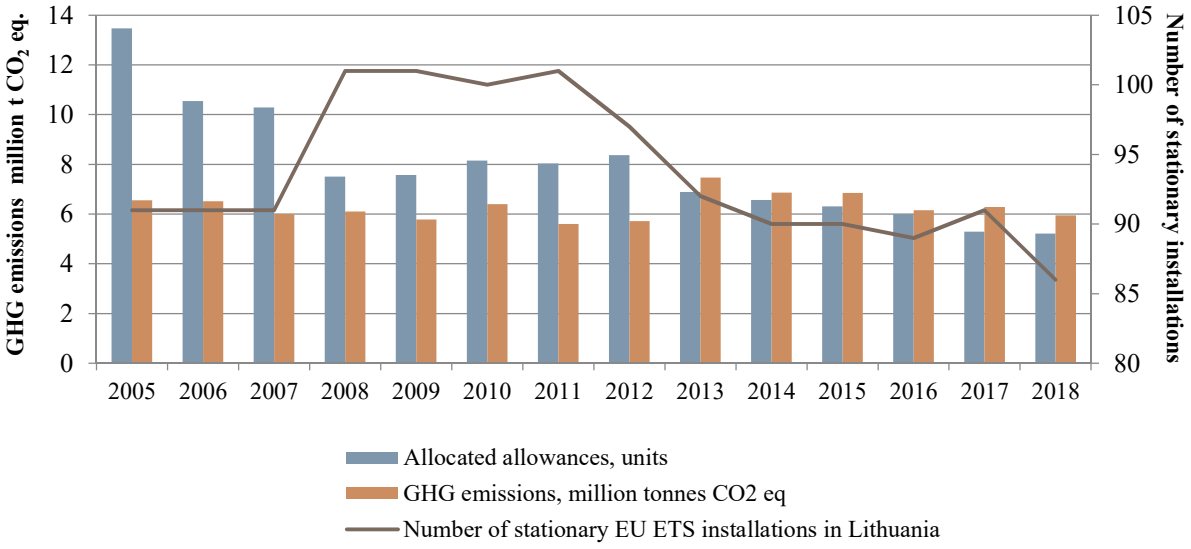


Figure 3-1. Trends of EU ETS in Lithuania

Note: The figure shows an increase of EU ETS GHG emissions in 2013. This is due to increase in the scope of activities that fall under the EU ETS directive (since 2013 non-combustive CO_2 emissions from ammonia production and N_2O emissions from nitric acid production started to be included in EU ETS)

During the first (2005-2007) and second (2008-2012) EU ETS trading periods, emission allowances were allocated on a national level according to EU wide rules. Since the beginning of the third (2013-2020) trading period the allocation was changed and this means that approximately half of the allowances are expected to be auctioned, with this proportion continually rising throughout the trading period. Furthermore, it was decided to decrease the EU ETS total emissions cap by 1.74% yearly so that the target of 21% of GHG reduction by 2020 in EU ETS would be achieved (compared to 2005 GHG emission level).

Revision of the EU ETS – phase 4 (2021-2030)

In March 2018 the European Parliament and Council amended Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments after 2020. The annual reduction in the number of allowances of the EU quota will be reduced from the current 1.74% linear reduction factor to 2.2% in order to provide the emissions reductions and thus deliver the underlying environmental objective. It is determined further strengthening the EU ETS by temporarily doubling the rate at which allowances are placed in the Market Stability Reserve (MSR) from 2019. This change would allow the MSR to reduce the existing market oversupply of allowances faster.

Since European leaders have agreed to continue free allocation after 2021, the necessary changes to update the relevant rules are also proposed. This includes updated benchmarks to reflect technological progress where necessary, criteria for the future composition of the carbon leakage list and procedures to reflect changes in production.

Several low carbon funding mechanisms are proposed, in particular an Innovation Fund (to support demonstration of innovative renewable energy and low-carbon innovation in industry, as well as carbon capture, use and storage) and a Modernisation Fund (modernising the energy systems of EU Member States with lower GDP).

3.4. Sectoral policies and measures

There are several directions of climate policy where appropriate measures are made to achieve overall goals. In Lithuania, climate policy is integrated with the decision-making processes in energy, transport, agriculture, waste, forestry and land-use sectors and territorial planning. All the EU Policies and measures related with GHG mitigation and their expected effects are presented in CTF table 3. The main policies and measures in different sectors are described in the table below.

Table 3-1. Climate change policy directions

Climate policy sectors	Goals of sectorial policies related to climate change	Sectoral policy planning documents
ENERGY	- To increase energy efficiency	National Energy Independence Strategy Energy efficiency law Heat Economy Law Energy Efficiency Action Plan Multi-apartment Building Renovation (Modernization) Programme Public Building Renovation Programme
	- To increase the share of renewable energy sources (RES) in the balance of energy sources - To increase the share of district heating from RES - To promote of the RES use in industry sector	National Energy Independence Strategy National Renewable Energy Resources Development Strategy National Renewable Energy Resources Programme for 2016-2020. Multi-apartment Building Renovation (Modernization) Programme
	- To reduce relative consumption of thermal energy per unit of the used dwelling area by up to 30% by 2020	Multi-apartment Building Renovation (Modernization) Programme
	- To implement energy saving technologies	Law on Energy from Renewable Sources
	- To renovate public buildings	Programme of Public building renovation The Programme on Heat industry development in 2015-2021 Program for Increasing the Energy Efficiency of Public Buildings
TRANSPORT	- To promote of RES use in transport sector	The National Programme on the Development of Transport and Communications Law on Energy from Renewable Sources
	- To increase the share of RES (biofuels and electricity) not less than 10% in all modes of transport in comparison with the final consumption of energy in the transport sector	Law on Energy from Renewable Sources
		The Order No 3-100 of the Minister of Transport and Communications of the Republic of Lithuania On the

Climate policy sectors	Goals of sectorial policies related to climate change	Sectoral policy planning documents
	- To promote clean and energy-efficient road transport vehicles.	adoption of the energy efficiency and environmental protection requirements for the purchasing of road vehicles and setting mandatory cases.
	- To promote the use of bicycles and development of bicycle track's infrastructure	National Programme on the Development of Transport and Communications for 2014-2022
	- To improve road infrastructure	National Programme on the Development of Transport and Communications for 2014-2022
INDUSTRY	- To increase energy-efficiency in industrial process	The Programme for investment incentives and industry development for 2014-2020
	- To prevent emissions of pollutants and GHG	IPPC permits and Pollution permits
	- To ensure a more cost-efficient contribution to achieving the EU's climate objectives by discouraging the use of F-gases	Regulation (EU) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006
	- To promote the environmental management system in the manufacturing sectors	The Order No D1-973 of the Minister of Environment on the green procurement implementation measures for 2012-2015
	- To reduce energy use in manufacturing industry	Recommendations on the main Lithuania's Republic energy strategic directions
AGRICULTURE	- To ensure environmental requirements for manure management	The Order No D1-367/3D-342 of Ministers of Environment and Agriculture on environmental requirements for manure management
	- To set requirements pursuant to Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources	The Program for Minimization of Water Pollution Caused by Agriculture activities
	- To introduce Good Agricultural Practice	Lithuania's Rural Development Programme 2014-2020
	- To improve the status of ground and surface water bodies, to achieve and maintain good environmental status of the Baltic Sea, to reduce the risk of floods, to provide quality public drinking water supply and sanitation services and to reduce pollution by waste water.	National Water Area Development Programme 2017-2023
	- To minimize water pollution caused by agriculture activities	The Program for Minimization of Water Pollution Caused by Agriculture activities, adopted on 8th June 2012 by the Order No D1-490/3D-39 of Ministers of Environment and Agriculture.
FORESTRY	- To implement long-term forest economy policy	The National Forest Area Development Program 2012-2020
	- To increase forest area by 3% until 2020	Lithuania's Rural Development Programme 2014-2020 The National Forest Area Development Program 2012-2020

Climate policy sectors	Goals of sectorial policies related to climate change	Sectoral policy planning documents
WASTE	- To implement recycling	National Waste Management Plan for 2014-2020 Circular economy package
	- To ensure that biodegradable municipal waste compose 35% until 2020, (compared with the amount in 2000)	National Waste Management Plan for 2014-2020 Circular economy package
	- To increase biogas extraction	National Waste Management Plan for 2014-2020

Number of measures has been implemented, adopted and planned to fulfill policy goals mentioned above.

The following chapters provide a description of measure according to these directions of action, as well as implemented additions.

3.4.1. Energy

The general objective of Lithuania's energy policy is to ensure energy security at competitive prices with the lowest possible environmental impacts. Energy sector is a key sector for the overall functioning of the economy as it provides an important input and service to the other sectors of the economy. Lithuania is also obligated to progressively increase the use of renewable energy resources (RES) in the production of electricity and heating and to reduce energy consumption. The focus is on implementation of the strategic projects aimed to achieve energy independence including ensuring sufficient local power generation capacities to cover domestic demand (estimated at 12-14 TWh in 2020).

The Law on Energy (2002, with later amendments) is the main law, setting the functions and obligations in the energy sector. Different energy sub-sectors are regulated by the following sectoral laws: the Law on Electricity (2000, with later amendments), the Law on Heat Sector (2003, with later amendments), the Law on Natural Gas (2000, with later amendments), the Law on Nuclear Energy (1996, with later amendments), the Law on the Nuclear Power Plant (regulates the implementation of the new NPP) (2007, with later amendments), the Law on Construction (1996, with later amendments), the Law on Energy from Renewable Sources (2011, with later amendments) and the Law on Energy Efficiency Improvement (2016).

Renewable Energy Sources

The development of RES will follow the EU and national strategic documents and legislation. The main RES development policies and measures are enshrined in the revised NEIS and the Law on Renewable Energy of the Republic of Lithuania, and separately for each sector.

In the revised **NEIS** the main strategic goals are to increase the share of electricity production from RES in the final electricity consumption up to 30% in 2020, 45% in 2030 and 80% in 2050:

– By 2020, the share of RES in the final electricity consumption will grow to 30% and will constitute no less than 3TWh. From the perspective of the technology development trends, it is estimated that electricity produced from wind will become the main source of RES energy and by 2020 might reach up to 44%, biomass – up to 26%, hydropower – up to 19%, energy produced in solar power plants – up to 6%, and biogas – up to 5% of all RES-generated electricity consumed.

- A lot of attention will be paid to the production of decentralized electricity from RES. The number of electricity consumers who can generate electricity for their own needs will be gradually increased. By 2020, after creating a favourable investment environment, there will be at least 34 thousand electricity consumers using a prosumer scheme.

- By 2030, no less than 45% of electrical power consumed in Lithuania will be produced from RES and will constitute no less than 7 TWh. With technology development trends in mind, it is estimated that the majority of electricity – no less than 53% – could come from wind power, 22% – from solar energy, 16% from biofuel energy produced in highly efficient co-generation power plants, and 8% – from hydropower. Biogas could generate about 1% of electrical power.

- By 2050, electricity generated from RES will constitute no less than 100% of power consumed in Lithuania, and the amount of energy produced from RES will be no less than 18 TWh.

To maximize the share of RES for district heating consumers, households with independent heating and non-household consumers with independent heating:

- Up until 2020, RES consumption will continue to increase as compared to district heat consumption and in independent heating in households.

- The share of DHS RES (including waste) will be 70% by 2020 and 90% by 2030. The development of high-efficiency biofuel CHP plants will continue, non-recyclable municipal waste non-hazardous industrial waste that have energy value will be effectively used for energy production.

- After creating a favourable regulatory environment, households with independent heating will gradually switch to clean, zero GHG technologies and the share of RES in households will reach 70% by 2020 and 80% by 2030. GHG producing technologies will be replaced by clean, clean-air technologies that do not impair the quality of air.

The main objective of **National Renewable Energy Resources Development Strategy,** adopted on 21 June 2010 by the Government Resolution No 789 of the Republic of Lithuania, is to meet the demand of electricity in the best way in the sector of electricity, heating and transport by increase of the share of RES in the final energy balance and to reduce the import of fossil fuel and in this way to increase the energy security, energy independence and to contribute to the international efforts to reduce the emissions of GHG. This strategy foresees the minimum RES trajectory ensuring that Lithuania meets the objective of 23% of RES in the final energy consumption in 2020. The goals of this strategy is now incorporated in the revised NEIS.

The **Law on Energy from Renewable Sources** adopted on 12 May 2011 by the Parliament of the Republic of Lithuania, and amended in 2018. The Law was adopted to ensure the balanced development of the RES. This Law establishes the tasks for separate energy sectors in order to reach the common goal of 23% of RES in the final consumption of energy by 2020.

The key support instruments for RES production are feed-in tariffs, also support scheme consisting of several support measures like:

- reservation of the capacity and transfer of energy grids or systems for connection of renewable energy installations;
- discount of the costs of connection of renewable energy installations to energy grids or systems;
- priority of transmission of energy from renewable sources;

- support for production and processing of agricultural commodities, namely, raw materials for the production of biofuels, biofuels for transport, bio lubricants and bio oils;
- support of investments in renewable energy technologies;
- purchase of energy from renewable sources.

After adoption of this Law, a mixed support measures model was chosen, where producers of small power plants has the fixed rate of the price and larger producers had to participate in an auction where they compete for quotas and for lowest desired fixed tariff price. Electricity produced from wind, solar, hydropower, biogas and biomass power plants with installed capacity not exceeding 30 kW was purchased at the fixed price (feed-in tariffs) which is determined by the national regulatory authority. However, in order to avoid a significant distortion of the market and reduce financial burden on consumers in 2013 the important amendments of the Law have been made, for example:

- The power of RES plant, for which the simplified requirements are applied, has been reduced from 30 kW to 10 kW.
- The frequency of feed-in tariff review for all types of renewable sources has been changed from one time per year up to four times per year.
- The rules for promotion have been changed. Feed-in tariff has been applied from the production permit date, not development permit.

In comparison from 2012 to 2014, feed in tariffs depending on the installed capacity have decreased:

- wind power – 21-24%
- solar – 56-62%
- biomass – 38-40%.

In December 2014, the Parliament of the Republic of Lithuania approved the amendments on Law allowing net-metering system application for small solar power plants (residential <10kW budget and public institutions <50 kW) to promote solar energy use in households.

After the amendment of Law in 2018 the main goal was set to reach no less than 38% in 2025 of the energy production from RES, compared to gross national final energy consumption, by increasing the use of the newest and most effective RES utilization technologies and enhancing energy efficiency. Additionally, a new support model to promote RES in electricity production was established –as a technology neutral (produced from sun, wind, biogas, or biomass) auctions. Auction participants competing for the possibility to get a premium to the market price. The support is funded from the budget for Services of General Interest.

The **Lithuanian Law on Heat Economy** was adopted in 2003 by the Parliament (Seimas) of the Republic of Lithuania and later amendments. The objective of this legal act is to reduce the unfavourable effect of heat energy on the environment by promoting combined heat and power generation, the heat generation from biofuels and RES.

Implementation of described legal documents and measures following them, Lithuania reached 23% target before 2020 and exceeded it already in 2014, when the share of RES in total final energy consumption was 23.66%. Lithuania transferred part of the surplus to Luxembourg and became the first EU Member State to sign a cooperation agreement on the transfer of statistical quotas for RES.

In 2018, the share of RES in total final energy consumption was 25.03% or 24.21%, when taking into account the statistical transmission of energy to Luxembourg. These results were mainly determined by the share of RES in the heat sector, which accounted for 45.25%. The share of RES in electricity production was 18.41%, and in the transport sector – 4.33% (Fig 3-2).

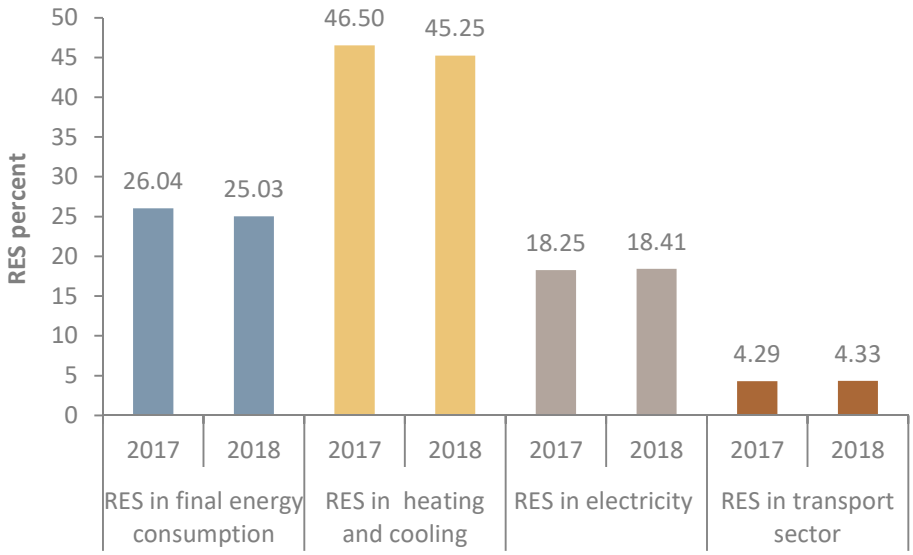


Figure 3-2. RES share in final energy consumption

Lithuania's intended 2030 RES target of 45% in final energy consumption is planned to be achieved through neutral auctioning of incentive quota allocations and the widespread deployment of low-power renewable energy facilities owned by private energy users and communities. In order to successfully integrate larger amounts of renewable energy and a large number of electricity-generating customers, it is envisaged to invest in smart energy systems, including transmission, distribution and storage infrastructure, and in increasing the necessary balancing capacity.

Below the brief descriptions of energy efficiency existing and planned measures:

✓ ***Electricity***

RES1. Support scheme for electricity generated from RES (auctions) renewable energy is not yet able to compete in the market, consequently, the production of energy from RES is encouraged and will continue to be within the limits of the country's economically and technically acceptable RES development, focusing on active participation of RES producers in market conditions or until RES production reaches market price. The support scheme currently approved in Lithuania includes the following support measures:

- Electricity generated from RES price premium;
- Priority transmission of electricity generated from RES;
- exemption from liability for the balancing of generated electric energy and (or) power generation capacity reservation during the promotion period for electricity producers, operating power plants less than 500 kW.

The specified promotional measures are only applicable when participating in a technology neutral auction and after winning it with the lowest price offer. The producer who has won the auction receives support measures for a period of 12 years.

The first auction to meet the 2030 target began on 2 September 2019, distributing 0.3 TWh of electricity. The auction is scheduled to end in March 2020, however, the result of this auction is expected to be visible in 2023.

The auctions will be organized according to the approved schedule until the interim target of 5 TWh annual electricity production from RES-E in the year 2525 will be achieved (2.2 TWh of RES electricity is already produced in 2018). If this goal is achieved before 2025, with the construction of power plants without support, auctioning will be stopped and the need for further support will be assessed. A technological, economic and social evaluation of RES technology development and support scheme will be carried out at least every 5 years to determine the effectiveness of the support scheme in Lithuania and its continued need.

RES2. Financial support for producing consumers (prosumers) In 2015, a scheme for electricity prosumers was created, to encourage electricity consumers active participation in the market. By 2030, we aim to have 30% of prosumers, compared to the total number of electricity consumers.

To ensure that the electricity generating scheme is available to all electricity prosumers, the EU Structural Funds and the National Climate Change Program are funding the purchase of the power plants. As of 2019, support of 323 EUR per kW to producing users provided. Total by 2023 it is planned to invest more than 16 million EUR from EU funds, with four invitations scheduled during this period.

RES3. Promotion of highly efficient cogeneration In 2016, Vilnius Cogeneration Power Plant received 190 million Eur loan from the European Investment Bank (EIB), backed by the European Fund for Strategic Investments (EFSI) – a vital element of the Investment Plan for Europe. Vilnius cogeneration power plant will produce about 0.3 TWh of electricity. The total electrical capacity of the power plant will be about 92 MW. The boiler will only use municipal waste leftover from sorting and recycling. The other two biofuel boilers, three times larger than the waste boiler, will use biomass.

Kaunas CHP plant was not designed to support. A high-efficiency waste-to-energy CHP plant will be installed, with an electric capacity of about 24 MW. Municipal waste remaining after sorting, non-hazardous industrial waste and sludge from water treatment plants will be used. Such capacities will allow to produce about 170 GWh of electricity per year.

RES4. Financial support for investments into small-capacity power plants Support is being prepared for investments in low-power stand-alone power plants, with priority given to power plants under construction by renewable energy partnerships. The support will be awarded based on a competitive tendering procedure from revenue arising after the statistical transfer of energy between the Republic of Lithuania and Luxembourg and/or the other Member States, planning that the first competition will be organized in 2020.

RES5. RES development in the Baltic Sea In 2018, the research started to evaluate necessary development and operation of RES-based power plants in the Baltic Sea and to determine the installed capacity of these power plants. By 2021, it is a plan to decide on the territories of the Baltic Sea where it is appropriate to organise a tender. Until the beginning of 2022, it is a plan to hold a bid for development and commissioning. After estimating the duration of the tendering procedures and the construction of the power plants, planned that electricity production would start after 2028.

RES6. RES for industry LT+ support for additional RES capacities Installing renewable energy generation capacity, developing and deploying new renewable energy technologies in industrial companies to meet their energy needs, and to enable the supply of surplus energy to other industrial enterprises or the transmission to centralized energy networks. The amount of funding for a project depends on the size of the company and how eligible costs are determined:

- 80% of the eligible expenses for a very small, small enterprise;
- 60% of eligible expenses for large enterprises (intensity is subject to the provisions of the EU Block Exemption Regulation).

Given the ambitious RES targets, this measure is planned to be continued after 2020. It is planned that 70 % of the funds will be allocated to the development of RES in the electricity sector, the remaining 30 % - in the heat sector.

RES7. Use of RES in public and residential buildings Promoting RES (solar, wind, geothermal energy, biofuels or other) use in public and residential (various social groups) buildings with Climate Change Program funding.

RES8. Financing solutions for installation and storage of power generation from RES, including producing consumers, RES communities EU support is planned to support the deployment of low-power electricity generation from RES owned by generating consumers, energy communities, businesses or individual energy consumers. The need for EU support funds and possible measures in this area, the need for funds and the results of their achievement are currently being assessed.

RES9. RES integration into networks The total increase in RES power is projected to be 1944.5 MW in 2021-2030. Such an increase will require measures to integrate new generators safely and reliably into electricity transmission and distribution networks.

Additional support measures contributing to the development of RES-E:

- RES-E exemption from excise duty. This provision applies to both electricity produced in Lithuania and imported electricity.

- Guarantees of origin RES-E. Guarantees of origin are issued to RES-E manufacturers. Guarantees of origin shall be issued and the RES-E producers who have won the auction and receive electricity price premium.

- RES purchase and sale contracts. RES producers are entitled to sell electricity to final customers under renewable electricity purchase and sale contracts without an independent electricity supplier's license. Such producers will still have to meet the requirements of an independent electricity supplier.

✓ ***Transport***

RES10. Obligatory addition of biofuels into mineral fuels Fuel sales points shall sell following the requirements of Lithuanian and European standards:

- petrol containing 10% or more by weight of biofuels (optional for A98 petrol);
- diesel containing at least 7% t biofuels (from 10 April to 10 November);
- Arctic grade 1 and 2 diesel can be biofuel-free in winter;
- during the transition period (10-20 November and 10 March to 10 April), the diesel content must be at least 5% (with a tolerance of minus 0.5%) biofuels.

RES11. Exemption from excise duty on biofuels Biofuel and biofuel blends complying with the requirements of the Law on Excise Duties and the standards EN 14214 and CEN / TS 15293 approved by the European Committee for Standardization shall be subject to an excise duty reduction proportional to the percentage of biological origin admixture in the biofuel and fuel mixture.

RES12. Support for II generation biofuels through obligatory addition into fuels By reducing operating costs for manufacturers and ensuring product competitiveness on the market, it is expected that additional quantities of second generation biodiesel will be generated. The aim is that in 2030 half of the total consumption of biodiesel would be the of raw materials from II generation. Various tariff measures

would be applied to compensate producers for the price difference. The price of the measure is calculated taking into account the subsidy per 1 liter – 0.55 EUR.

RES13 Support for biomethane and II generation bioethanol production (equipment and factories) It is expected that the incentive will be used to install facilities for the production of 2nd generation liquid biofuels from the straw which currently has the highest potential. A contribution of 2nd generation bioethanol to the fuel mixture of about 6.45 ktoe can be expected.

Funding is also planned for the installation and capacity increase of biomethane gas production facilities, including biogas treatment equipment. To meet the country's needs, it is necessary that by 2030 production of biomethane gas annually reach 81.5 ktoe. The one-time grant to production facilities could amount around 73%.

RES14. Support for purchasing buses running on biomethane In order to ensure that the biomethane gas produced (81.5 kTNE) is consumed in the transport sector, the purchase of gas-fueled public transport vehicles is encouraged. In order to be consumed all the methane produced in quantity, it should be ensured that the cities be running at least 680 natural gas-powered buses, which each year must go at least 65 000 kilometers. In this case, there is a need to adjust public procurement legislation, and to include the requirement that, when purchasing public transport services, municipalities make it compulsory for the service provider to carry passengers by buses equipped with biomethane gas. One natural gas bus is approximately 20 % more expensive compared to a diesel-powered bus. The measure would compensate for the price difference.

RES15. Subsidy for biofuel producers (reducing price differences) The purpose of the subsidy would be to align the prices of compressed natural gas and compressed biomethane gas, thereby making the product attractive to the end user. The measure applies without taking into account the costs of setting up production capacity. The volume of the measure is 92.72 million EUR m^3 of biomethane gas.

- ✓ ***Heat***

RES16. Installing additional RES capacities for heating Improvement of incentive regulation enabling heat supply companies to raise funds for modernization. The nominal thermal capacity of the replaced equipment is 600 MW.

RES17. To promote the use of biofuels for the production of heat in district heating systems Improvement of incentive regulation enabling heat supply companies to raise funds for modernization. Additional production capacity of RES - 70 MW.

RES18. Promote the use of RES in CHP heat generation by evaluating the use of solar technologies, heat pumps and heat storage in CHP systems. The nominal heat power of newly installed equipment is planned to reach – 200 MW

RES19. To assess the current situation and prospects for the decentralised sector's heat supply. Preparation of study and adoption of appropriate legislation to create a favourable regulatory environment for the gradual transition of individually heated households/housing to clean or low greenhouse gas technologies or to the CHP system.

RES20. Review existing requirements for reserve heat generation capacity and reserve fuel reserves. Natural gas heat suppliers paying the security component would not accumulate additional reserve fuel reserves.

RES21. Promotion of low-power biofuel cogeneration. The planned installed capacity: 5MW electric and 20 MW thermal capacity. Tatally produced 0.03TWh of electricity per year.

RES23. Promoting improvement of efficiency of heat transmission network, including modernisation of relevant equipment To renew and / or modernize the heat transmission network and its equipment / elements.

RES24. Analyse the potential of the cooling sector in Lithuania Evaluate the current situation in the cooling sector, perform a prospective analysis and set guidelines for the most rational solutions for cooling; create a map of the national territory, which reflected in the existing district heating and cooling local supply needs, including district heating and cooling network infrastructure.

RES25. Promote the use of renewables and waste heat in district heating

- New biomass incinerators in district heating. In 2017, the share of RES in the district heating sector in Lithuania was already 68.7%, and in the heating and cooling sector – more than 46%. In some municipalities, coal and gas oils still used, and this measure aims at converting their heating plants into RES.

- Promote the use of RES in district heating (using solar technology, heat pumps and / or heat storage) Heat pumps are already being used in other countries and have proved their worth in energy efficiency. Because the period is 2021-2030, no specific technology is bound. The deployment of the most cost-effective solution will be supported.

- Promote the use of waste heat from industrial, waste or cooling energy sources in the district heating sector. Promote the use of waste heat from industrial, waste or cooling energy sources in the district heating sector. In Lithuania, the heat generated by chemical processes in production companies has potential about 3 TWh per year, and it could be partly used in the district heating sector. Full utilization is not possible because some industrial sites are too remote from heat consumers. The priority in the heat sector is to capture, store and efficiently use environmental and residual energy emitted into the air by power plants, industrial sites and buildings. Waste heat from the thermal power plants can be used to heat buildings.

RES26. Modernization of heat accounting system By 2027, according to the EU Internal Market Directive (2009/72/EC) and its amendment (2016/0380 (COD)) and in the case of a positive cost-benefit analysis, all heat meters must be replaced by remote reading.

Energy efficiency

Lithuania aims to continuously and consistently increase its energy efficiency, introduce innovative and less energy consuming technologies, increase consumer education and change its behavior. The greatest potential for energy efficiency improvements in terms of the cost-effectiveness of efficiency measures lies in the industrial, building and transport sectors.

In pursuit of the energy efficiency improvement objectives, set in the **NEIS**, aim will be to:

- to ensure the implementation of the EU requirements for Lithuania in the field of energy efficiency improvement by 2020, with a total savings of 11.67 TWh (primary and final energy savings), and the financing of the fulfillment of these requirements.
- by 2030, ensure that primary and final energy intensity is 1.5 times lower in 2030 than in 2017;
- by 2050, ensure that primary and final energy intensity is about 2.4 times lower than in 2017.

Priorities:

- to promote integrated renovation of multi-apartment and public buildings (prioritizing renovation in quarters) and to save about 2.6–3 TWh of energy in the renovated multi-apartment and public buildings by 2020 and 5–6 TWh by 2030 (by adding up savings in each year).
- Rapidly develop low-energy and energy efficiency industries install and acquire new and environmentally friendly technologies and equipment.

On the 3rd of November of 2016 the **Law on Energy Efficiency** with amendments of related energy laws was adopted. This law establishes the energy efficiency of state management, regulation and supervision of the legal framework. The purpose of this law – to ensure that all Lithuanian economic sectors of energy consumption savings in line with Lithuania's EU legislation enshrined in energy efficiency obligations, and efficient production, distribution and use of energy. Based on this Law the mandatory energy savings for Lithuania have been set at 11.674 TWh of final energy (implementing Directive No. 2012/27/ES). This amount is equal to the sum of the amounts of energy savings achieved each year from 1 January 2014 to 1 January 2020.

Energy Efficiency Action Plan for 2017-2019 approved by Order No 1-181 of 7 July 2017 of the Minister of Energy of the Republic of Lithuania. The Action Plan describes energy efficiency improvement policies:

- taxes on fuel;
- renovation of apartment buildings;
- increasing the energy efficiency of public buildings;
- energy audits in industry;
- agreements with energy suppliers on consumer education and counseling;
- agreements with energy companies on energy saving;
- replacement of boilers in households.

Multi-apartment Building Renovation (Modernization) Programme approved by the Government of the Republic of Lithuania Resolution No 1213 of 23 September 2004, later amendments in 2015. In 2009 essential adjustments of the Programme were adopted which have changed the financing rules. However, in 2012 Programme of Modernization of Multi-apartment Buildings was changed again, this time enhancing implementation of actual modernisation projects. More detailed information is available in the National Reform Programme 2014.

The main aim of the Programme is to reduce thermal energy use in multi-apartment buildings, built before 1993, at least by 20% by the end of 2020, i.e. estimated annual energy consumption in these buildings by the end of 2020 should be reduced at least by 1 000 GWh/year, and reduce GHG emissions by 230 kt CO_2 eq/year, compared with 2005.

Programme of Public building renovation approved in November 2014 by the Government of the Republic of Lithuania Resolution No 1328. The 2020 target set in this Programme is to renovate area of 700 000 m^2 of the public buildings by saving 60 GWh of the annual primary energy and to reduce GHG emissions by 14 kt CO_2.

It is planned to renovate public buildings by reaching C class of building energy performance. In this Programme it is defined that the total area of public houses which are owned by the state and municipalities is 14.8 million m^2 (approximately 35% of non-residential buildings), for the heating all these building approximately 2 300 GWh of heat energy is used.

The **Programme on Heat industry development in 2015-2021** adopted in 2015. The Programme determines trends of heat industry development and modernisation, technical solutions and energy mix for the production of the heat, demand and potential for higher efficiency cogeneration, investments and time frames. In Lithuanian cities, approximately 72% of residential space is heated via centralized heating systems. It is forecasted that 5% will be reduced consumption of centralized heat by 2021 compared with 2014 due to energy efficiency improvement in public and multi-apartment buildings.

Based on the current statistical information of all measures from 2014 to 2017 the total energy savings expected to reach 7.49 TWh by 2020. The amount of energy savings under the energy efficiency improvement programs / measures is presented in Table 3-2.

Table 3-2. Total energy savings in 2014 – 2017 period, GWh.

Measure	2014-2017 measures implemented savings, GWh
Multi-apartment renovation (modernization)	2624,15
Excise and taxes on fuel	2059,19
Renovation of public buildings	520,9
Education of energy consumers and advisory agreements	41,86
Energy saving agreements with energy companies	1169,77
Energy saving measures implemented according to Climate Change and Lithuanian Environmental Protection investment fund programs	1076,84
Total:	**7492,71**

It is also important to note the improved Lithuanian energy productivity indicator (gross energy efficiency indicator), which shows the country's energy efficiency and allows the decoupling of the country's energy consumption. In 2017 the value of Lithuanian indicator reached 4.8 EUR / kgne (the EU average is 8.3EUR / kgne).

Below the brief descriptions of energy efficiency existing and planned measures:

EE1. Higher excise and taxes for fuel consumption In order to increase energy efficiency in the transport sector, Lithuania has introduced higher excise duties and VAT rates on fuel, ie petrol, liquefied natural gas and diesel. In Lithuania, fuel is subject to 21% VAT, 6% higher than the EU15 minimum. Higher excise duty on petrol is 21% (+0.08 EUR / l) and on LPG 243% (+0.18 EUR / l). Taken together, the impact of higher taxes and excise duties is 14.7% higher for petrol, 5.2% for diesel and 64.7% for LPG due to higher taxes and excise duties than in the EU. Taking into account the amount of fuel sold in Lithuania (petrol, diesel and LNG) and the elasticity of demand, as well as the experience of other countries (Sweden, Spain, Germany and Estonia) in calculating the impact higher taxes and excise duties on fuel, are projected to save 6 TWh in 2030.

EE2. Renovation of multi-apartment buildings Lithuania will continue to give priority to the renovation of apartment buildings, seek to reduce heating costs for consumers and improve living conditions in apartment buildings. The multi-apartment building renovation program will continue and nearly 500 apartment blocks will be renovated every year, saving 100 GWh each. Preference will be given to multi-apartment buildings constructed in accordance with the technical standards of the Building Regulation in force before 1993. After the refurbishment of the building, it should reach class C and save 40% of the energy used in the building. It is planned that by the end of 2030 about 5,000 apartment buildings will be renovated and 5.5 TWh of energy will be saved.

EE3. Renovation of public buildings The current Public Buildings Energy Efficiency Program plans to set targets for state-owned public buildings by 2030. It is planned that by 2030 about 510 000 m2 of central government public buildings and about 450 000 m^2 of municipal public buildings will be renovated. Under current law, public buildings are required to achieve a minimum class C after renovation. It will save about 10 GWh of energy each year and in total will save about 0.55 TWh of energy.

EE4. Consumer education and consulting (by energy suppliers) The provisions in the Energy Efficiency Law concerning agreements with energy suppliers on consumer education and advice will continue beyond 2020. Under this Law, energy suppliers obliged to sign contracts with the Ministry of Energy of the Republic of Lithuania regarding consumer education and consultation. Newly established energy suppliers must sign agreements with the ministry within six months from the beginning of their activity. With this measure is expected to save 3 TWh of energy and change consumer behaviour.

EE5. Services of Public Interest privilege for industrial companies implementing energy efficiency measures The largest Lithuanian companies will receive compensation for energy efficiency improvements. It is planned that energy efficiency measures implemented every year will save about 100 GWh of energy and 5.5 TWh of energy by 2030.

EE6. Agreements with energy companies on energy saving Pursuant to the Energy Efficiency Improvement Act, electricity and gas transmission system and distribution network operators, with at least 1/2 vote of state control, are committed to the Ministry of Energy to announce energy saving agreements. Other energy companies also have to conclude energy saving agreements with the Ministry of Energy. The energy savings of energy companies will be determined in proportion to the final energy supplied to consumers over the last few years. Energy companies are required to save energy according to the energy levels specified in the energy savings agreements (by themselves or through others) by applying economically viable energy efficiency improvement measures in end-users' facilities (facilities, equipment, transport). The measure is expected to save about 100 GWh annually and save about 5.5 TWh by 2030.

EE7. Changing boilers into more efficient technologies Households are expected to install 50,000 biofuel boilers by 2030, with other heat-efficient energy efficiency measures that will save at least 200 GWh per year or 11 TWh. It is planned to renew 5,000 household boilers each year. The compensation up to 50% of the cost associated with the replacement of old boiler will be provided for households not connected to the district heating system.

EE8. Modernisation of heating and water systems in apartment buildings A financial measure that will encourage building owners to upgrade old elevator-type substations to a newer contour-type substation. It is planned to reimburse up to 30% of the investment costs and to upgrade about 250 substations each year. This would save about 10 GWh of energy per year, or 0.55 TWh by 2030.

EE9. Energy efficiency improvements in non-industrial businesses In order to increase the energy efficiency of business enterprises, Lithuania has planned a financial instrument that will encourage enterprises to implement the energy efficiency improvement measures specified in the energy audit. It is planned to provide a subsidy for the energy savings achieved and to save about 100 GWh of energy per year and almost 5.5 TWh by 2030.

EE10. Financial support for renovation of single-family houses Financial incentive for individual homeowners to renovate individual homes. There are plans to renovate 1,000 individual homes each year and save 13.5 GWh of energy. Up to 30% of the investment costs will be reimbursed. Total energy savings up to 2030 equals 0.742 TWh.

EE11. Modernisation of street lighting systems Financial support for the modernization of street lighting systems. The target is to replace and upgrade about 25% of all luminaires in Lithuania or about 65,000 luminaires by 2030. Renewal of one luminaire is expected to save about 250 kWh of electricity per year and to achieve a total savings of about 0.11 TWh by 2030.

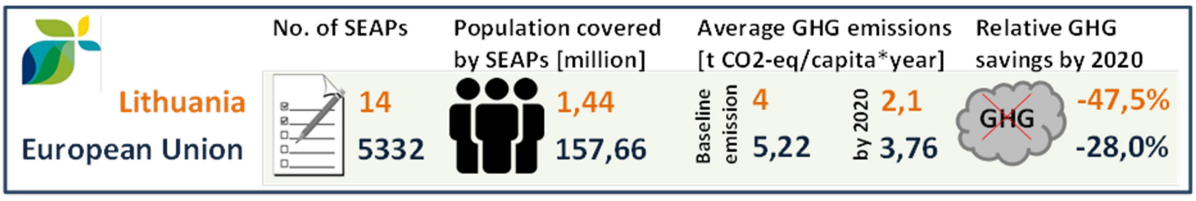
Other information and initiatives

Energy related projects

Aiming to shift investments towards a low carbon economy Lithuania promotes cooperation between public, private sector and financial institutions. This cooperation has proved as a valid alternative source of finance for investments in low carbon solutions. As an example of **greening finance for sustainable business** is project implemented by Lietuvos Energija (currently "Ignitis"). In 2018 Lithuanian's national energy company, which is one of the largest state-owned energy groups in the Baltics, in cooperation with the European Bank for Reconstruction and Development, has successfully issued 300 million EUR **green bonds**. This was the biggest ever issued green bond emission (for a duration of 10 years) in all Central and Eastern EU states, and yet the issue was oversubscribed 5 times, resulting in 1.4 billion EUR offered from investors. Not only has Lithuania's company managed to get finances at a record low rates for investments in renewable energy, energy efficiency, clean transportation and pollution prevention and control including waste-to-energy. Also, Lithuania has learned a valuable lesson that there many possibilities for green investment projects based on public private and finance institutions partnership in Central and Eastern Europe.

The Covenant of Mayors

By 2016, in the context of the Covenant of Mayors, the sustainable energy action plans delivered by 14 Lithuanian municipalities had been assessed. Overall, these municipalities cover more than 1.4 million inhabitants. All together, these municipalities committed to reduce by 2020 the GHG emissions by 47.5% (as compared to 1990 baseline).



(source: JRC 2016. Notes: SEAP=sustainable energy action plan, GHG=greenhouse gas emissions)

Regional cooperation in energy sector

Lithuania is part of **the Baltic Energy Market Interconnection Plan (BEMIP).** BEMIP's main objectives are to develop an internal and regional energy market between the EU Member States in the Baltic Sea region and integrating it fully into the EU's energy markets thus increasing security of supplies. BEMIP projects have been part of the European Economic Recovery Plan (EERP) and the Trans-European Energy Networks Programme. BEMIP projects have also been funded through the EU's structural funds, including the European Regional Development Fund (ERDF) and the Cohesion Fund (CF). Many infrastructure projects are supported through CEF co-funding amounting to EUR 534.3 million. In the framework of the societal challenge for secure, clean and efficient energy of the Horizon 2020 programme, EUR 16.9 million is allocated to participants from the Baltics to stimulate research and innovation in this field.

The implementation of the Paris Agreement and the EU climate and energy targets till 2030 are being periodically discussed in different comities of the Baltic Assembly, which is represented by members of Parliament of Estonia, Latvia and Lithuania, Summits of Prime Ministers, the Baltic Environmental Councils and senior officials group meetings as well as the forums for the implementation **of the European Union Strategy for the Baltic Sea Region (EUSBSR)**.

Also, Baltic States cooperate actively on the energy issues, in particular related to common projects of electricity generation, synchronization and operation of electricity market in the framework **of the Baltic Council of Ministers of Senior Officials on Energy.**

3.4.2. Transport

The National Renewable Energy Resources Development Strategy sets the target to increase the use of renewable energy resources in transport sector from 4.3% in 2008 to 10% in 2020. A part of raw materials (mainly rape seeds and triticale) for biofuels production is compensated under the Lithuanian state aid scheme.

Lithuania started production of biofuel in 2004 and made about 4 kt of biodiesel that year and has made considerable progress in developing biofuel production. In 2013 the volumes of biofuel production increased to 141 kt. About 117 kt of biodiesel and 24 kt of bioethanol were produced that year. Respectively, about 365 thous. tonnes of rape seeds and about 83 thous. tonnes of triticale were used in the production of biofuel in 2014, Lithuanian producers produced 105.9 kt of biodiesel and 9.7 kt of bioethanol.

Gross final consumption of electricity produced from renewable energy sources in the transport sector in 2013 the consumption – 60.1 ktoe, in 2014 – 61 ktoe and in 2015 – 69 ktoe. The main legal documents related to the promotion of biofuels and climate change mitigation actions in the transport sector are listed below.

The National Programme on the Development of Transport and Communications for 2014-2022 was adopted on 15 December 2014 by the Resolution No 1443 of Government of the Republic of Lithuania (latest amendment in 2017) and replaced Long-term (until 2025) Strategy of Lithuanian Transport System Development, adopted on 5 June 2005 by the Government Resolution No 692 of the Republic of Lithuania. The Programme is medium-term strategic planning document setting out the strategic goal, the objectives and tasks aimed at reaching the goal, their evaluation criteria and the institutions implementing the Programme. The Programme contains an analysis of the development prospects of the transport and communications sector, namely, transport (road, railway, maritime, inland waterways and air), logistics and post. The areas of information society development and electronic communications, including their objectives and tasks, are analysed in 'Lithuania's Digital Agenda' – the Programme on the Information Society Development in 2014-2020 approved by Resolution of the Government of the Republic of Lithuania No 244 of 12 March 2014 'On approval of the Programme on the Information Society Development in 2014-2020 'Lithuania's Digital Agenda'. The Programme emphasises the horizontal priorities in the area of transport and communications including the multimodality of transport, integrated urban transport, application of intelligent transport systems to all modes of transport, traffic safety and security, increase in energy efficiency in the transport sector, and development of environmentally-friendly transport. In the Programme it is foreseen 15-16 thous. electric cars (around 6 thous. in 2020) by 2025 in Lithuania.

The strategic goal of the Programme is to create a sustainable, environmentally-friendly and competitive national transport and communications system with a high value-added creation potential. Upon attainment of the strategic goal, the transport and communications system would ensure a high-quality, efficient, uninterrupted and sustainable mobility of members of the public and goods' transportation as well as high-quality logistics and postal services. There are 5 objectives of the Programme:

- Increase mobility of goods and passengers, improve the corridors of the core network of the EU Trans-European Transport Networks as well as their connections with national and local transport networks, and increase the efficiency of multimodal transport.
- By means of the active transport policy measures, increase competitiveness of the transport sector and improve the transport and logistic service quality.

- Promote sustainability of the local (urban and suburban) transport system.
- Increase energy efficiency in transport and reduce the adverse impact of transport on the environment.
- Improve traffic safety and security.

In 2017 the Program was updated transposing the requirements of the Directive 2014/94/EU on the deployment of alternative fuels infrastructure.

The Program identifies the main goals for the development of alternative fuel infrastructure:

- it is planned to install 28 public electric charging access points (high power near the road network of the "Trans-European Transport Network" (hereinafter – TEN-T) and 100 public electric vehicle charging access points (urban and suburban agglomerations with more than 25 thousand inhabitants) until 2020;
- it is planned to install 1 refueling point for liquefied natural gas in inland waters and in port of Klaipėda;
- 1 LNG refuelling point accessible to the public for heavy-duty vehicles shall be put in place in Kaunas along the TEN-T Core Network by 2025;
- it is planned to install 1 liquefied natural gas distribution system for supplying LNG fuel refueling points until 2025;
- it is planned to install 9 publicly available refueling points for compressed natural gas in Vilnius, Kaunas, Klaipėda, Šiauliai, Panevėžys, Telšiai, Ukmergė, Marijampolė, Elektrėnai;
- it is planned to install 10 publicly available compressed natural gas refueling points on the automobile roads of the "TEN-T core network" near the E85 and E67 roads until 2025.

The Law on Energy from Renewable Sources adopted also establishes the common promotion system on the enhancement of the use of RES in the transport to increase the share of energy from renewable sources in all modes of transport at least up to 10% as compared with the final energy consumption in the transport sector. In 2017 **the Law** was **amendment to** transpose the requirements of the ILUC directive (EU) 2015/1513 and setting the requirements that the share of energy from biofuels produced from cereal and other starch-rich crops, sugars and oil crops and from crops grown as main crops primarily for energy purposes on agricultural land shall be no more than 7% of the final consumption of energy in transport and a reference value for advanced biofuels target at least 0.5% in energy content of the share of energy from renewable sources in all forms of transport in 2020.

In 2011 the Minister of Transport and Communications of the Republic of Lithuania order No 3-100 on the **energy efficiency and environmental protection requirements for the purchasing of road vehicles and setting the cases when the ones are mandatory** was adopted and amendment in 2017.

This legal act implements and transposes to national legislation the European Parliament and Council Directive 2009/33/EC of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles, and Directive 2006/32/EC on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.

The Order of the Ministers of Environment, Social Security and Labour, and Transport and Communications **on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations** was adopted in 2000 and revised in 2016 by Order No D1-350/A1-250/3-171(1.5 E) implementing European Parliament and Council Directive 94/63/EC of 20 December 1994 on the control of VOC emissions resulting from the storage of petrol and its distribution from terminals to service stations. This act determining

limitations for emissions of VOC from modern equipment of petrol storage, distribution and transportation.

The **Connecting Europe Facility (CEF)** contributes to the goals of the Energy Union. Regarding Lithuanian participation to the CEF – Transport programme 2014-2016, the current Lithuanian action portfolio comprises 12 signed grant agreements, allocating 368.8 million EUR of actual CEF Transport Funding to Lithuanian beneficiaries. The transport mode which receives the highest share of funding is rail (84% of actual funding). Lithuania has a considerable rail portfolio under the CEF programme. Apart from the involvement in a multinational study for the Rail Freight Corridor "North Sea – Baltic", the focus is definitely on the Rail Baltic line, the most significant and strategic Global Project of the North Sea-Baltic Corridor.

First municipalities had prepared and confirmed **City sustainable mobility plans (CSMP)**, in which stated necessity to develop public, engineless and ecological transport, also infrastructure applied for people with special needs. The objectives of cleantech in transport sector of Lithuania are implementing basic objectives of White book – to reduce twice the number of cars which uses fuel by 2030, to avoid them totally by 2050 and to achieve zero pollution from transport in the biggest urban centres by 2030.

The Order No 3-108(1.5E) of the Minister of Transport and Communications of the Republic of Lithuania on the approval of **Guidance for the development of sustainable mobility plans in cities,** adopted on 13 March 2015, which provide guidance for the municipalities exceeding 25 thousand inhabitants to develop sustainable mobility plans in cities. 18 municipalities have developed sustainable urban mobility plans containing GHG emission reduction measures in transport.

Stimulation of bio-fuel production and consumption

In Lithuania annual fuel consumption amounts to 200-250 kt of gasoline and 1.0 to 1.2 million tonnes of diesel per year. Lithuania produces two types of biofuel: biodiesel and bioethanol. The main feed stocks for biodiesel and bioethanol production are rape seed and rye. The association of biofuel producers consists of 6 members the main producer of biodiesel is "Rapsoila" and producing bioethanol – "Kurana". [6] The latter company, in 2019 started to produce the second generation biofuels and plans to produce 1.2 thousand cubic meters of second-generation bioethanol from by-products, and eventually increase its production capacity to 5,000 cubic meters.

Table 3-3. Bio-fuel production and consumption

Year		2005	2013	2014	2015	2016	2017	2018
Production, kt	Biodiesel	7	89.2	119.7	117.6	103.1	118.2	154.2
	Bioethanol	6.6	27.1	15.1	17.4	14.1	13.4	17.1
	Total	**13.6**	**144.4**	**134.8**	**135.0**	**117.2**	**131.6**	**171.3**
Consumption, kt	Biodiesel	3.2	58.6	65.1	65.4	56.7	69.7	79
	Bioethanol	0.9	10.4	10.5	15.0	9.9	12.8	12.4
	Total	**4.1**	**69.0**	**75.6**	**80.4**	**66.6**	**69.7**	**79**
Bio-fuel share in total fuel consumption (%)		1.1	4.6	4.2	3.2	2.2		4.3

Biofuel production in Lithuania started in 2002 and has expanded continuously since then. A reduction of prices for regular fuels in 2014 made biofuels less competitive. In addition, there is still only a small number of bio-fuel using vehicles in the country. The harsh winter conditions and very low temperatures in Lithuania make use of high ethanol blends dangerous to car engines. A third reason is market limitations. Lithuanian blending companies can purchase bio-components from other

[6] The official website: http://www.biodegalai.lt/

EU producers who offer more competitive prices. Therefore, local producers are finding it a challenge to sell their higher cost bio-fuels.

Lithuania, as a member of the EU, has implemented EU law on biofuels with a number of regulations. The basic requirements are two EU directives: Renewable Energy Directive (RED) (2009/28/EC) and Fuel Quality Directive (2009/30/EC).

The efficient implementation of GHG emissions reduction targets in maritime (shipping) sector can be achieved only with international instrument developed under IMO.

The efficient implementation of GHG emissions reduction targets in civil aviation sector can be achieved only with a proper functioning of global market-based measure getting agreement in ICAO. Information about steps taken to promote or implement any decisions by ICAO and IMO to limit or reduce associated emissions is provided in Chapter 4.8.

Regional cooperation

Rail Baltica is a project to link Finland, Estonia, Latvia, Lithuania and Poland with a standard gauge rail line, providing passenger and freight service between the countries and improving rail connections between Central and Northern Europe. It envisages a continuous rail link from Tallinn (Estonia), to Warsaw (Poland), via Riga (Latvia) and Kaunas (Lithuania). It will bypass the Kaliningrad Oblast (Russia) and Hrodna (Belarus), which have historically hosted two Poland-Lithuania rail routes. Rail Baltica is one of the priority projects of the EU: Trans-European Transport Network*s* (TEN-T). The constructions are planned to be finished by 2030.

Below the brief descriptions of transport existing and planned measures:

T1. Renewal of public transport fleet, both within city and intercity Renewal of the public urban vehicle fleet with alternative fuel vehicles. Also, the installation of alternative fuels (LNG and electricity infrastructure) as stationary stops in bus fleet areas.

T2. Electrification of railways/ Renewal of railway infrastructure, electrification and development. Renewal of the railway infrastructure – 814 km of railway will be electrified and transport 70% of the freight carried by train.

T3. Implementation of measure stipulated in the plans of sustainable mobility in the cities. Implementation of measures in the Sustainable Urban Mobility Plans (SUMP) that will promote walking, cycling, public transport and the use of alternative fuels. It is estimated that the implementation of all SUMPs will require 2.2 billion, some of which are expected to be funded by EU structural funds in 2021-2027.

T4/RES12-15 Promotion to use RES in transport sector This measure is identical to measures consisting of two parts and is aimed at:

- Promote the use of sustainable biofuels made from non-food and feed crops (II generation). Increase the use of biomethane from agricultural and non-municipal waste through regulatory measures on gas suppliers. As a result, the share of II generation biofuels in overall consumption will reach 0.2% in 2022.

- Promote the market for guarantees of origin for biogas to reach 100% biogas producers registered in the register of guarantees of origin by 2030.

T5. The goal for the EU White Book is absence of polluting cars in the cities by 2050 As a result, by 2050 cities will have to eliminated polluting cars. This requires the development of a long-term plan for the develop a long-term promotion of the use of electric cars and charging infrastructure, with objectives and measures.

T6. Development and promotion of economical and environmentally-friendly driving skills Reduced fuel use due to changes in driving skills that are being changed through economical and green driving training, education, advertisements, etc. Social advertising and other measures will affect 5% of the population of drivers and are predicted that reduce fuel consumption by 3.7%

T7. Promoting acquisition of low emission vehicles A financial incentive will be offered to 4.8% of the deals. Of these, 50 % will use it, while the efficiency of newly purchased cars will improve by 42 %. The amount of financial support is 1000 EUR.

T8. E-tolling implementation in the field of freight transportation The tax is expected to encourage the replacement of 60 lorries and an average of 5.5 buses per year from non-Euro standards to Euro standards.

T9. Introduction of incentives to use combined freight transport (instead of intermodal transportation by land) Encourage intermodal unit carriers to opt for combined transport rather than land transport for intermodal units. By 2030, 5% of freight will be shifted to combined transport. They reduce GHG emissions by 19% compared to road transport alone.

T10. Limitation of transport with ICE into defined city zones It is planned to create low-emission areas in cities, which will limit the traffic of both diesel and gasoline-powered vehicles. Passenger cars will decline by 5 % throughout the period.

T11. Creation of a sustainable mobility fund The Fund is the primary and indispensable tool for other measures. The fund raises funds from targeted pollution taxes and is designed to promote less polluting transport (incentives for installing electric car charging accesses, purchasing zero-emission cars, zero-emission TP parking, social dissemination and habit-forming).

T12. Renewal of transport fleet by using green public procurement for transport Expected change in the legal framework to increase the use of clean vehicles and reduce the number of conventional fuel vehicles to meet the minimum public procurement targets for non-polluting cars (categories M1, M2 and N1) by 2025 compared to the total number of fleets, must be at least 60%, the number of non-polluting heavy vehicles (N2 and N3) in relation to the total number of fleets must be at least 8% and the number of non-polluting buses (category M3) - 80%; by 2030, the proportion of clean passenger cars (categories M1, M2 and N1) in green procurements compared to the total number of fleets must be 100%, and the number of clean heavy duty vehicles (categories N2 and N3) at least 16%, non-polluting buses (category M3) should be 100% of the total number of fleets.

T13. Promotion of the use of electric cars and development of their charging infrastructure The aim is to have 10 % of M1 annual sales (registered and re-registered passenger cars) in 2025, and 50 % in 2030 facilitating, subsidizing and increasing the availability of charging infrastructure for electric vehicles by:

- Purchase discount for pure electric vehicles (fixed amount – EUR 4 thousand for new electric vehicle, EUR 2 thousand - for used electric vehicle under 5 years);
- Semi-public and private recharging / installation access charges for conventional electric cars (fixed amount up to 22 kW up to 250 EUR);
- Relief for the purchase / installation of public high-power electric vehicle charging access points in problematic / commercially unattractive locations along national roads and in cities (fixed amount up to 50 kW – 5,000 thousand EUR, up to 100 kW – 10,000 EUR);
- Obligation to provide electric vehicle charging access points for new buildings or parking (at least 2 access points per 10 parking spaces);

- Obligation to provide EV charging access points for newly built or refurbished gas station network stations near public highways.

T14. Construction of new freight ships and barges This measure would shift part of the freight from polluting road transport to less polluting inland waterways. The funding offered is up to 30 % (up to 50 % for LNG ships or self-propelled barges), and the rest is own funds. It is estimated that 54.5 million tonne-kilometres will be shifted from road to inland waterway transport.

T15. Construction of new passenger ships It is assumed that modern waterborne transport will contribute to GHG savings through the construction of new vessels and barges and the development of waterway passenger transport. Increased passenger traffic by water (0.6 million passenger kilometers) will reduce passenger traffic by road accordingly.

T16. Replacement of the existing inland water freight ships, passenger, fishing and other inland water ships power plants, renewal of other mechanisms related to their replacement A significant part of inland waterway power plants used in Lithuania is polluting. This measure would involve the conversion of existing power plants into less polluting or to LNG, electricity, a renewable energy source driven ones.

T17. Development and / or upgrading of inland waterway infrastructure, including ports and marinas Currently, there are only a few places suitable for cargo service in Lithuania from Kaunas to Klaipėda, which need to be further expanded or reconstructed. Above Kaunas to the state border with Belarus, the infrastructure suitable for transportation of goods is scarce and needs to be developed. The measure would allow the development of cargo shipping on the Kaunas-Klaipeda route, as well as open up the development of cargo shipping on the Kaunas-Grodno route, including intermediate points on these routes

T18. Development and implementation of a tax credit system The development and application of a system of tax incentives for inland waterway transport would in practice encourage carriers to develop their freight and passenger transport business, which would significantly improve the possibilities for reducing air pollution. This initiative can significantly reduce land freight transport, encourage passenger transport, improving mobility opportunities for less polluting transport, and promoting the introduction of advanced, low-emission technologies into inland waterway transport.

T19 Support for LNG truck acquisition Provide subsidies to business companies to offset vehicle acquisition costs. It is planned to provide a one-off non-refundable flat rate subsidy; Preliminary estimate: 15,000 EUR per truck, around 1,000 vehicles per year would be subsidized.

T20. Yearly car pollution tax Increases in environmental taxes, as well as an annual car tax, depending on the level of emissions, have been shown to encourage car switching to less polluting cars. Over the course of the year, 5% of newly purchased petrol and diesel cars will be replaced by zero emissions.

T21. Differentiation of vehicle registration (Re-registration) fee by level of pollution Pollution-related registration / re-registration taxes on new and used cars will reduce CO_2 emissions by 3.5% a year, encouraging the purchase of less polluting vehicles.

T22. Marking of vehicles by pollution level CO_2 labelling of vehicles will allow more efficient implementation of other emission measurement measures and ensure rapid identification of the vehicle group. Vehicles would be marked with special stickers indicating the group to which they belong, and the data would be entered in the database with the vehicle's registration plates. Newly registered vehicles would be marked at the time of vehicle registration, and already registered vehicles would be subject to compulsory roadworthiness tests.

T23. Development of LNG distribution system Installation of Liquefied Natural Gas (LNG) Distribution System for LNG Refueling Points 2 LNG Stations, the installation of which will be supported by 50% reimbursement of installation costs. One-stop LNG sales are projected to reach 792 tonnes per year.

T24. Reduction of traffic jams:

- by applying traffic organisation solutions Changes in traffic organization through traffic planning tools (traffic distribution, traffic restriction during rush hours) and / or the introduction of smart traffic technology (smart traffic lights, crossings, etc.) would help to reduce congestion and fuel consumption. 35% of all vehicles in Lithuania are driven in three biggest cities and it is assumed that 50% of the them stands in congestion, this way they use 1.8 times more fuel.
- by applying territory planning solutions Preparation of recommendations for municipalities that will contribute to efficient traffic management, including spatial planning decisions (optimal arrangement of public transport stops, development of commercial areas according to traffic volume, etc.).
- by promoting the flexible working hours and remote work Educating and informing employers and employees about flexible working hours (teleworking, start and end of flexible working hours, extra days off, etc.) allows you to reduce commuting to and from work.

T25. Abolition of pollution tax privilege for persons engaged in individual activity To abolish the tax privilege for pollution caused by mobile sources applicable to persons engaged in individual activities under the Law of Personal Income Tax and using private vehicles in their activities.

T26. Reduced VAT tariff for acquisition of new N1 electric cars By 2025, electric vehicles are planned to account for at least 30% of annual N1 (light commercial vehicle) purchase transactions (first time registration and re-registration of new and used cars); 100% from 2030 onwards. Starting in 2030, N1 class cars with internal combustion engines will not be registered.

T27. Obligation for taxi and transportation companies to forward orders received by phone/app to drivers of zero emission vehicles first The obligation for taxi and other carrier companies to direct their orders received by phone/gadget to drivers of zero-emission vehicles. Taxi and shuttle companies forward orders (by phone/gadget) to companies (their operators/administrators) first to drivers of zero-emission vehicles, then to others; at airports, buses and train stations, zero-emission taxis have priority in waiting queues. The measure will result in the conversion of 2 % of taxis and carriers into zero emission vehicles.

T28. Preparation of a comprehensive study of capital (Vilnius) city public transport (to optimise public transport lines, to adapt them to zero emission public transport) and implementation To optimize public transport lines and adapt them to zero-emission public transport, a complex study of Vilnius city public transport network and fleet will be prepared. It is planned to investigate all transport lines to ensure fast and convenient communication between the expanding city and its access points; provide for the development of trolley lines and reduce the use of diesel buses at the center. A study of other alternative zero-emission passenger transport in urban areas has also been carried out and the most suitable vehicles and infrastructures have been proposed for the development of the necessary infrastructure. The study will be implemented in 2023-2030. The strategy-based optimization will reduce bus emissions by 12.64%.

T29. Behaviour change to reduce fuel consumption through informing the public, formation of habits and pilot projects Changing people's behaviour, their habits through education and opinion-forming (training, publicity, presentations, advertising, promotion, etc. in kindergartens, schools,

universities, residents, public, municipal and private companies and organizations, etc.). Impact factor: 5% of the affected population reduce their fuel consumption by 3.7% due to the measures.

T30. Improvement of public transport availability and its use

- Refinement / introduction of transport routes to meet the changing needs of society, with a view to reducing the number of vehicles in the city;
- Step-by-step introduction of free public transport (reimbursement of tickets) to regulate urban traffic (free public transport for primary school children, then for school pupils, followed by students and seniors).

3.4.3. Industrial Processes

The policies and measures in industry sector are based on a few main principles which are required to reach environmental targets. Firstly, the amount of its waste should be reduced, the production more sustainable, natural and energy resources used efficiently. Secondary, raw materials should be processed, the multi-use packaging and materials produced and utilized, waste (especially hazardous) securely managed, and equipment needed for environmental protection should be manufactured.

The Programme for investment incentives and industry development for 2014-2020 was approved on 17 of September 2014 by the Resolution No 986 of the Government of the Republic of Lithuania. In this programme an objective to encourage enterprises to use recourses and energy more efficiently as well as use of RES is set. It is planned to implement energy efficiency measures and to reduce energy use in manufacturing industry from 222.9 (in 2012) to 182.9 (in 2020) kg of oil equivalent (for creation of 1000 EUR value added). Additionally, Ministry of Innovation and Economy of the Republic of Lithuania prepared a study on "The potential of energy use efficiency increase in industry enterprises and determination of measures which encourage the use of different types of energy" in 2015. The aim of this study was to identify measures and main drives which encourage increasing energy efficiency in industry and to use different types of energy as well as help to identify the main implementation mechanisms and provide recommendations how to implement the proposed measures. Implementation of the Programme is financed from the EU structural funds.

The Directive 2010/75/EU of the European Parliament and of the Council of 24th November 2010 on industrial emissions (integrated pollution prevention and control) and the Directive 2008/1/EC of the European Parliament and of the Council of the 15th January 2008 concerning integrated pollution prevention and control (IPPC) are transposed into the national legislation.

Industrial enterprises, exceeding 50 MW must apply for the IPPC permit and enterprises below 50 MW must apply for the Pollution Permit in order to ensure pollution prevention and to incentivise transfer to cleaner technologies protecting the quality of environment. Natural resources must be used rationally and sparingly, energy use must be efficient, monitoring and control must be performed for the substances and raw materials, fuel and energy consumption in the processes of production. Less hazardous materials are promoted to use in the process of industrial activities.

The term "best available techniques" includes both the technology used and the way in which the installation is designed and maintained. The presented techniques are developed in the scale that allows implementation under economically and technically viable conditions and the techniques are most effective in achieving a high general level of protection of the environment as whole.

The ISO 14000 family of standards provides practical tools for companies and organizations of all kinds looking to manage their environmental responsibilities. ISO 14001:2015 and its supporting standards such as ISO 14006:2011 focus on environmental systems to achieve this. The other ISO 14000 standards focus on specific approaches such as audits, communications, labelling and life cycle analysis, as well as environmental challenges such as climate change. GHG emissions permits issued for the installations participating in the EU ETS are consistent part of the IPCC permits or Pollution permits.

On 1st of January 2015 Regulation (EU) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006 was adopted. The main goals of the new Regulation is to ensure a more cost-efficient contribution to achieving the EU's climate objectives by discouraging the use of F-gases with a high impact on the climate in favour of energy-efficient and safe alternatives, and further improving the containment and end-of-life

treatment of products and equipment that contain F-gases; help to bring about a consensus on an international agreement to phase down hydrofluorocarbons (HFCs), the most relevant group of F-gases, under the Montreal Protocol.

It is aimed at cutting total EU emissions from F-gases by two thirds by 2030 compared to 2014 levels. It prohibits the placing of F-gases on the market in certain circumstances where alternatives are available. During 2018-2020, quotas for legally placing HFCs on the EU market were reduced to 63% of 2015 levels.

The Ministry of Environment has updated the existing national legislation in the area of fluorinated greenhouse gases ensuring the implementation of the requirements of the Regulation (EU) No 517/2014:

The Order No D1-897 of the Minister of Environment the Republic of Lithuania ensuring the implementation of the requirements of the containment, use, recovery and destruction of the fluorinated greenhouse gases was adopted on 12 December 2016. This order defines the functions of the national authorities ensuring the implementation of the requirements of the new Regulation (EU) No 517/2014;

The Order No D1-372 of the Minister of Environment establishes the Rules on the issuance of Certificates for the companies handling fluorinated greenhouse gases;

The Order No D1-668 of the Minister of Environment establishing the training and attestation system for the employees engaged in the activities with the fluorinated greenhouse gases was prepared with the view to amend and updated the existing national legislation in this area in order to comply with the requirements on the new Regulation (EU) No 517/2014, adopted on 20 October 2016.

The Order No D1-12 of the Minister of Environment establishing the procedures for reporting on fluorinated greenhouse gases and ozone depleting substances, data collection and management, accounting of equipment and systems which contain these gases or materials was adopted on 10 January 2010 and was amended in 2016.

The amendment to the Administrative Infringement Code establishing more stringent responsibilities for the breach of the requirements of handling fluorinated greenhouse gases was adopted in 2016.

In July 2017, the EU and its Member States committed to ratifying the Kigali Amendment to the Montreal Protocol, it came into force on 1 January 2019 and is a significant step forward in implementing the Paris Agreement by limiting the global production and use of hydro fluorocarbons (HFCs). Science suggests that an ambitious phase-down of HFCs alone could prevent up to 0.5°C of global warming by the end of the century.

The Order No D1-973 of the Minister of Environment on the green procurement implementation measures for 2012-2015 adopted on 14 December 2011 and later amendments promoting the environmental management system in the manufacturing sectors as well as the strengthening ability of enterprises to organise green procurements.

The Order No 620 of the Minister of Environment of 5 December 2002 (with later amendments in 2014) on limitation of emissions of volatile organic compounds (hereinafter – VOC) was adopted. The aim of this order is to reduce the direct and indirect impact of VOC emissions (released by paints, solvents, adhesives and other products) on environment, usually on the ambient air, and the potential risk on human health, by providing measures and procedures to be implemented in the activities referred to by this document, in case the activity exceeds the solvent consumption level prescribed in this normative document.

Below the brief descriptions of industrial processes existing and planned measures:

P1. AB "Akmenės cementas" introduction of alternative fuel and technology change

The company plans to increase the combustion capacity of alternative fuels by replacing up to 90 % of fossil fuels (coal) as an alternative. It is planned that in the first stage the company will install equipment for burning the dried sewage sludge. According to calculations, the company will burn 20 kt of dried sewage sludge per year which will replace about 5 % of fossil fuels. In the second phase, the company plans to install a „bypass" system, which will allow burning not only used tires, dried sewage sludge but also other high-calorific waste such as solid recovered fuel, wood waste. The use of alternative fuels will increase by 30 %. The system is scheduled to be launched in 2024. The installation of a combustion chamber is envisaged by 2027 in the third stage. It is expected to replace 90 % of coal consumption.

P2. Implementation of F-gas Regulation/ Implementation of Kigali Amendment. Implementing Regulation on fluorinated greenhouse gases the emissions of F-gases will decrease by two thirds by 2030 compared to 2014 level. The regulation aims to reduce by 2/3 overall EU emissions of fluorinated gases by 2030 compared to the 2014 level. The Regulation prohibits the use of fluorinated greenhouse gases with a GWP>2500, prohibits to supply of the new equipment filled with high GWP containing HFCs to the market and gradually phase-out of the quota method for such gases.

Kigali Amendment to the Montreal Protocol by limiting the use of hydrofluorocarbons (HFCs) are already in place and will be enforced implementing F-gas Regulation and national acts.

P3/EE5. PSO privilege for industrial enterprises. A support mechanism to fund energy efficiency measures in the industrial enterprises. Enterprises will receive compensation (subsidies) for the implementation of energy efficiency measures. It is planned that energy efficiency measures will be implemented every year and about 100 GWh of energy will be saved. 5.5 TWh of energy saved by 2030.

P4. Investment and innovation incentives. Current corporate tax incentives for investment and innovation: promoting entrepreneurship – from 1 January 2018 a one-year income tax holiday for start-ups, exempt from corporation tax in the first year of operation;

Incentives for innovation focused on companies that develop the latest technology in their operations and then use them to generate revenue for their operation:

1) triple deduction of R&D costs - it is allowed to deduct the expenditure three times form the income (normally only once);

2) faster depreciation of assets used in R&D activities - allowed write-down on the acquisition cost of fixed assets used in R&D activities within a two-year period (usually within 3 to 8 years),

3) reduced tax rate for commercialization of R&D – from 2018 an additional bonus for R&D investing companies – reduced profit taxes by 5% for the commercialization of R&D inventions.

P5/RES6. RES for industry LT+ support for additional RES capacities/ Reduce the use of coal, coke and lignite. Aims to reduce intensity of energy consumption in industrial companies by increasing generation and consumption of RES. The measure will affect fuel combustion in industry and construction (not participating in EU ETS system). The share of renewable energy sources in the industry: 70%. electricity and 30% heat.

The measure appointed for industry not participating in EU ETS system. As coal is the most polluting fuel in terms of GHG emissions, it is proposed to cut the subsidy from 2024.

P6. Reduce F-gas use in the business enterprises (companies). The objective of this measure is to promote (motivate) business enterprises to acquire new or replace old equipment with using other technological alternatives or use small GWP gas. When providing financial support prioritize those applicants who plan to purchase refrigerant equipment with lower GWP. Other countries' practice assumes that this measure can reduce emissions by 30%.

P7. Promotion of replacement of pollutant technologies with greener technologies. This measure is a tool for industry participating in ETS system. It will partially allocate funds for the projects with replacement pollutant technologies with greener technologies. According to the best practices it is projected to reduce GHG by 22%.

P8. Implementation and promotion of modern and innovation technologies This measure is for small and medium-sized enterprises. The measure aims to reduce the negative effects of climate change and the greenhouse effect, and plans investments in assets (equipment, technology) that will reduce the negative environmental impact of economic activities, promote industrial symbiosis and ensure a continuing environmental effect. On average, the introduction of technological eco-innovations could reduce emissions by about 20%.

Implementation of modern technologies, adapting existing and developing new production capacities to produce new and existing products. The funding will encourage companies to invest in the acquisition and installation of new production technology lines, modernization of existing production technology lines, and installation of engineering networks.

P9. Implementation and promotion of non-technological eco-innovation/ Encouraging investment in product / packaging / service design solutions The objective of the measure is to encourage micro, small and medium-sized enterprises (SMEs) to implement non-technological eco-innovations tackling environmental problems. It is planned to implement environmental management systems in accordance with the requirements of international standards. Perform technological and/or environmental audits of the production process, eco-design, eco-labelling. One company implementing non-technological eco-innovations could reduce GHG emissions about 38 tCO_2eq.

Encouraging companies to invest in product/service design solutions to increase the attractiveness of a company's products or services, jointly with demand and productivity of the company. Financial support for projects to develop innovative packaging designs to reduce waste in the industry.

P10. Promoting traditional industrial transformation and the digitization of industry. Encourage the transformation of traditional industry through the deployment of innovative technologies for industrial innovativeness and for the growth of the economy. The measure includes nanotechnologies, microelectronics and nanoelectronics, among them semiconductor electronics, new materials, biotechnology and photonics. These technologies include flexible production systems and digital technologies. Technology improvements are expected to reduce GHG emissions by 20%.

Industrial SMEs technological audit to assess the opportunities and perspectives for digitizing manufacturing processes in industrial SMEs, deployment of manufacturing process equipment with integrated digitization technologies for industrial SMEs, based on the recommendations of the technology audit performed.

P11. Increasing energy efficiency in companies. In order to increase the energy efficiency of business enterprises, Lithuania has planned a financial instrument that will encourage companies to implement energy efficiency measures specified in the energy audit. It is planned to subsidize the achieved energy savings and to save about 100 GWh annually and almost 5.5 TWh of energy by 2030.

3.4.4. Agriculture

More than half of Lithuania's land is suitable for agriculture. Forests occupy about 33.5% of our land area, 5.8% by wetlands, 4.8% is settlements.

The long-term goal for the agricultural sector set out in the Sustainable Development Strategy is to create a cost-effective, and competitive industry based on environmentally friendly farming. Agriculture sector should develop ecological farms, produce high quality certified agriculture and food products that conserve natural resources. The main long-term challenges for the agricultural sector are:

- intensify the production of organic crop and livestock products, achieve a certified ecological production area of at least 10% of all farmland by 2020;

- to promote the efficient development of biofuel production: biofuels should replace at least 15% of the fuel used for transport.

In 2014 **Lithuania's Rural Development Programme 2014-2020** (hereinafter – RDP) was prepared by the Ministry of Agriculture of the Republic of Lithuania (MoA) in cooperation with the Ministry of Environment in fulfilment mission and objectives laid down in the Articles 3 and 4 of the European Parliament and the Council Regulation (EC) Nr. 1305/2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005. To achieve the objectives of rural development the main target of the RDP 2014-2020 is promoting the growth of agriculture sector based on innovative technologies, that is more territorially and environmentally balanced, climate-friendly and resilient and competitive as well as innovative. The achievement of this goal will contribute to the Europe 2020 strategy for smart, sustainable and inclusive growth. Therefore, all three objectives of the EAFRD will be implemented: (a) fostering the competitiveness of agriculture; (b) ensuring the sustainable management of natural resources, and climate action; (c) achieving a balanced territorial development of rural economies and communities including the creation and maintenance of employment. Based on the analysis of the Lithuanian agricultural conditions and problems identified, measures will be implemented in all six Union priorities for rural development of the EAFRD and 16 out of 18 thematic areas. Also, to implement the EU strategy properly on the Forestry topic, the improvement of forestry economic value and forest areas expansion has been chosen. The total program budget is 1.978 billion EUR. 36% of all funds allocated for climate change mitigation (this amount includes the previous programming period). The main targets of the program are switching to organic farming (25,000 ha), keeping ecological farming areas (110,000 ha). The Programme 2014-2020 has been formally adopted by the European Commission on 13 February 2015. It outlines Lithuania's priorities for using 1.9 billion EUR of public money that is available for the period 2014-2020 (1.6 billion EUR from the EU budget and 0.3 billion EUR of national funding). More than 120 million EUR was allocated for the forestry sector. The main objectives are the modernization and improvement of the economic performance of small and medium-sized farms (nearly 8 000 farms will be supported), the preservation of biodiversity (11% of farmland), better management of soil (8% of farmland), the promotion of organic farming, the creation of new jobs (nearly 2,000) and the development of rural areas and businesses. Almost 150 000 people trained and professional skills upgraded. They include farmers, land managers, food industry actors, forest holders and the staff of rural SMEs. They will also be encouraged to diversify their activities.

Trend two, which includes ecological farming (in 2012 a total of 2,594 certified ecological farms accounted for 163.3 thousand ha and covered 5.7% of agricultural land, and in 2015 it increased up to 209.6 thousand ha), land afforestation, and improvement of the condition of risky water bodies was

assigned nearly 0.3 billion EUR. Manure utilization and utilization for the production of biogas enables to solve problems related to the negative environmental impact of production activities. Livestock and poultry manure can produce about 50 million m^3 of biogas. Total financial assistance of 45 million EUR from Programme 2014-2020 is planned. Using this support could be built about 30 biogas plants with a total electric power of about 20 MW. In 2017, there are already operating eight biogas plants and planned to build 14 biogas plants until 2020, using financial support from Programme 2014-2020.

Most of the sectoral agricultural programs will be renewed in 2020, with livestock and crop development expected by 2027.

The National Forest Area Development Program 2012-2020 approved on 23 May 2012 by Resolution No 569 of the Government of the Republic of Lithuania. The goal of the Programme is to implement long-term forest economy policy that would be coherent with other sectorial policies, would be based on country specific traditions, the EU regulations, international conventions, resolutions, treaties, programmes, and to set goals and tasks for forestry sector development up to 2020. The Programme sets a strategic goal on forestry development, other forestry goals, and tasks to achieve the set goals, evaluation criteria. In the Annex the implementation evaluation criteria for the years 2011, 2015 and 2020 are set. The Programme is sought to increase forest coverage of the country up to 34.2% by 2020 by afforestation of abandoned lands and lands that are not suitable to be used for agricultural activities, and to encourage people financially to plant forests in private and state-owned lands, to develop forest regeneration on a genetic-ecological basis with selectively valuable and qualitative forest increasing matter. In 2011 the Forest Law was amended by tightening the procedure of forest land transformation. Forest land may be transformed into farming land or other type of land only in exceptional cases. In addition to that new compensation system was created, which ensures obligation to plant new forest on non-forest land as a compensation for the forest land plot transformed into the other land use. This regulation serves not only as additional guarantee to prevent decrease of forest land area, but also creates conditions for increase of forest coverage. In the period 2007-2013 with a financial support from Rural Development Program 2007-2013 the area of 17.2 thousand ha was afforested and additional 3.6 thousand ha were afforested in 2014.

National **Water Area Development Programme 2017-2023** approved on 1 February 2017 by Resolution No 88 of the Government of the Republic of Lithuania. The main goals of the Programme are: to improve status of ground and surface water bodies, to achieve and maintain good environmental status of the Baltic Sea, to reduce the risk of the floods, to provide quality public drinking water supply and sanitation services and to reduce pollution by waste water.

Action plan for the implementation of the Program was approved on 5 May 2017 by the Order No D1-375/3D-312 of Minister of Environment and the Minister of Agriculture of the Republic of Lithuania.

Implementation of the Council Directive of 12 December 1991 concerning **the protection of waters against pollution caused by nitrates from agricultural sources** (91/676/EEC) with the latest amendment by the Regulation (EC) No 1137/2008 of the European Parliament and the Council of 22 October 2008 (further – Nitrates Directive) is primarily directed towards the minimization of the water pollution with nitrates. Activities are supported for the establishment of modern manure silos and other measures which enable the control against manure penetration into the surroundings. Replacement of manure handling systems from thick or dry silos to liquid silos may lead to a reduction in emission of nitrogen compounds to atmosphere by up to 20 times. The country took an obligation that the Nitrates Directive would be implemented in two phases. The implementing Nitrates Directive legal documents are:

- The Order No D1-367/3D-342 of Ministers of Environment and Agriculture on **Environmental Requirements for Manure Management** adopted on 14 July 2005 with later amendments sets requirements pursuant to Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agriculture activities, particularly the environmental requirements on the use of manure for croplands fertilization. Additionally, the farm, keeping animals are required to store manure and slurry in storage vessels which comply with environmental requirements. In order to reduce GHG emissions, also there are established requirements for slurry storage covering and slurry speeding technology by the Order No D1-367/3D-342.
- By the Order No D1-490/3D-39 of Ministers of Environment and Agriculture the **Program for Minimization of Water Pollution Caused by Agriculture activities** was adopted on 8 June 2012. The Oder sets requirements pursuant to Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources.

Below the brief descriptions of agriculture planned measures:

A1. Realisation of the recommendations of the Code of Good Agricultural Practices The Code of Good Agricultural Practice aims to reduce negative impacts on soil, water, air and climate and will inform farmers about innovation.

A2. Provision of one-off compensations to farms for long-term obligations related to climate change mitigation Increase areas for environmentally friendly actions. Expand crop areas that do not use mineral N fertilizers. An area of 60,000 ha uses 30% less mineral N fertilizer.

A3. Sharing knowledge with farmers about environmentally friendly activities Improve farmers' knowledge on how to use advanced agricultural technologies and farming solutions to reduce GHG emissions.

A4. Investment support for implementation of climate-friendly farming methods in cattle farms (investment into energy-saving and GHG emission reducing equipment and technologies) The investments are directed to more energy efficient and GHG emissions reducing technologies and equipment. The aim is to increase the efficiency of mineral fertilization of plants (according to actual plant needs and ensuring all qualitative soil parameters) and to apply slurry acidification, slurry insertion in soil. Planned results are: 300 thous. m^3 of pigs and 350 thous. m^3 of cattle manure and slurry are used to produce biogas; 300 thous. m^3 of slurry used to fertilize fields by direct application to the soil; encouraging the introduction of slurry acidification technologies.

A5. Provision of compensations to farms for long-term obligations related to climate change mitigation The aim is to increase the areas under environmentally friendly actions, such as extending crop areas that do not use mineral N fertilizers. It is planned that after implementation of this measure the use of mineral fertilizers will be discontinued in the area of 60 thousand ha.

A6. Improvement of mandatory requirements for the use of slurry and manure It is planned to change the requirements for the application of slurry and manure when it is applied in the fields. Requiring that manure spread within 4 hours must be applied to the ground. This would make it possible to reduce the use of mineral nitrogen fertilizers and the amount of GHG produced from manure. The measure is expected to affect 1 million ha.

A7. Promotion to replace a component of the animal fodder to reduce emissions of methane and nitrogen compounds To inform farmers about the impact of certain feed composition changes on GHG emissions while maintaining productivity: changing pig feed, reduce methane emissions from cattle by modifying the composition of feed for cattle, to inform livestock farmers of the possibilities

of diversifying their feed composition by improving the quality of their feed and, at the same time, the productivity of their livestock (for example, converting common wheat, barley straw to maize, millet, etc.), by reducing the amount of carbohydrates and replacing them with unsaturated fats in the feed, incorporate nitrogen-containing slow-digesting nitrogen compounds into the feed, reduce the amount of protein in the feed for dairy cows, and avoid over-feeding.

A8. Balanced use of mineral fertilizers Establish a system of balanced fertilization to reduce the use of mineral fertilizers and to increase use efficiency (per unit of yield or per hectare of crop): to set a requirement for the farm to provide data on the use of mineral fertilizers on the farm (by active substance); o develop a methodology for the preparation of fertilization plans to calculate the optimum fertilization by crop and to require farms to prepare mineral and organic fertilizer plans. The use of mineral N fertilizers on agricultural land is expected to decrease by 15%.

A9. Promotion of environmentally friendly and sustainable farming methods Promote good and sustainable farming practices. To make farmers aware of the implementation of eco-schemes through direct support measures under the CAP Strategic Plan and other policy instruments This measure includes field days, information campaigns on soil-friendly technologies; fertilize according to the real need of the plants by postponing spring fertilization; to carry out local (precision) fertilization and the opportunities and benefits of reducing the use of mineral fertilizers.

A10. Informing farmers about possibilities to reduce GHG emissions at the farm level Provide advice to farmers on energy efficiency, livestock or crop technologies to identify and advise on how to reduce GHG emissions from the production process of a specific farm.

A11. Encourage breeding more productive, resistant to diseases and climate animals To inform farmers about the possibilities to breed or purchase more climate-friendly and productive livestock breeds (especially dairy cows). It is also important to educate farmers about the need to consult veterinarians on a timely basis, prevent animal health issues, keep animals clean, and so on.

A12. Review of fuel norms and allotted excise-free fuel quantity Reduced excise-free fuel consumption would save 20% of fuel consumption.

A13. Promoting use of non-arable technology It is planned that in the end of the 2021 – 2030 period, 650,000 thousand ha will be used for non-arable technology, which will reduce fuel consumption by 40%.

A14. Waiver of environmentally detrimental tax privileges applied to transport used in agriculture All non-road mobile machinery, including agricultural machinery, is subject to stricter tariffs for their fuel and pollutant emissions.

A15. Increase of air pollution taxes Increase of environmental pollution tax on livestock and poultry enterprises.

A16. Reduction of the use of fossil fuel in agriculture, forestry and fishery Choosing the right implements according to the power of the tractor and applying the principles of eco-driving. The reduction in fuel consumption due to the introduction of the measure over the entire period will be 5.7%.

3.4.5. Land use, Land use Change and Forestry

In the land use, land-use change and forestry (hereinafter – LULUCF) sector, one of the main factor influencing the CO2 absorption is the forest expansion. National Forest Area Development Program 2012-2020 approved by Resolution No 569 of the Government of the Republic of Lithuania on 23 May 2012, sets a strategic goal on forestry development, other forestry goals, and tasks to achieve the set goals, evaluation criteria. In the Annex, the implementation evaluation criteria for the years 2011, 2015 and 2020 are set. The Programme is sought to increase forest coverage of the country up to 34.2% by 2020 by afforestation of abandoned lands and lands that are not suitable to be used for agricultural activities and to encourage people financially to plant forests in private and state-owned areas, to develop forest regeneration on a genetic-ecological basis with selectively valuable and qualitative forest increasing matter.

In 2011 the Forest Law was amended by tightening the procedure of forest land transformation. Forest land may be transformed into farming land or another type of land only in exceptional cases. In addition to that new compensation system was created, which ensures obligation to plant a new forest on non-forest land as a compensation for the forest land plot transformed into the other land use. This regulation serves not only as additional guarantee to prevent the decrease of forest land area but also creates conditions for the increase of forest coverage.

The main legal act regulating forest management is the Law No XI-1830 on Forests adopted by the Parliament (Seimas) of the Republic of Lithuania in 2011. By the amendments of this legal act the new measures were introduced, that creates legal conditions for better preserving of forests and forest land in cases of land-use change from the forestry to other use, in particular: the number of instances when it is allowed to change forest land into any other land is narrowed and prescribed precisely.

The compensatory afforestation in all cases of changing forest land into any other land was established under the National Forest Area Development Program 2012-2020.

The estimation of policy and measures effect on GHG emissions mitigation in LULUCF sector effect is related to the National Forest Area Development Program 2012-2020 where the target to increase the forest area by 3% by 2020 is set.

Table 3-4. The mitigation measures in LULUCF sector to minimize GHG emissions in forestry sector

Name of measure	Description	Year of implementation	Implementing entity
Restoration of forestry potential and introduction of prevention actions	Fires and natural disasters pose a significant threat to forest ecosystems. Each year in Lithuania between 100 and 750 ha of forest is burned. Lithuania's Rural Development Programme 2014-2020 provides investment support for restoration of forest damaged by fires and other natural disasters including pests and diseases, as well as support for implementation of forest fire prevention measures.	2014-2020	Ministry of Environment
Afforestation and restoration of damaged forest	To reduce atmospheric pollution originated from agricultural activities and contribute to climate change mitigation as well as to reduce the area of the abandoned land, the afforestation of these lands and the restoration of damaged forests is supported. In the inter-institutional Action Plan on the implementation of the Goals and Objectives for	2014-2020	Ministry of Environment

Name of measure	Description	Year of implementation	Implementing entity
	2013-2020 of the Strategy for the National Climate Change Management Policy the measure is set to plant new economically valuable and productive as well as biological resistant forests in abandoned lands in the state's possession.		
Afforestation	Afforestation actions are supported by Lithuania's Rural Development Programme 2014-2020. 53 million EUR allocated for new commitments under the sub-measure „Afforestation" for the programming period 2014-2020. Planned that forest land in 2020 reach 34.2%.	2014-2020	Ministry of Agriculture

EU LULUCF Regulation 2018/841 for the period 2021-2030

Under EU legislation adopted in May 2018, EU Member States have to ensure that GHG emissions from LULUCF are offset by at least an equivalent removal of CO_2 from the atmosphere in the period 2021 to 2030. The new LULUCF regulation sets out Member States' commitments on LULUCF that contribute to meeting the GHG emission reduction target at least 40% to compare with 1990 of the Union for the period from 2021 to 2030, as well as the rules for the accounting of emissions and removals from LULUCF and checking the compliance of Member States with these commitments. It is planned that this regulation will incentivise more climate-friendly land use and help farmers to develop climate-smart agriculture practices and support foresters through greater visibility for the climate benefits of wood products, which can store carbon sequestered from the atmosphere and substitute for emission-intensive materials.

Brief description of existing and planned policies and measures in LULUCF sector

L1 and L2 It is expected to increase forest land area up to 35% of the total country area according to the suggestions (not precisely determined in any of the strategic planning documents). National Forestry Development Programme for 2021-2020 sets the goal to increase forest coverage by 3% until 2020. It was estimated that afforestation of the poorly fertile soils to increase forest coverage could increase LULUCF sector GHG removals by 1,680 kt CO_2eq. in 2020. However, a successful increase in forest land area mostly depends on support from national programs for afforestation of abandoned lands and Rural Development Program, therefore the aim to increase forest coverage to 35% is unsecured. An additional measure to increase forest land coverage could be to afforest and reforest areas in abandoned land or land not suitable for agricultural purposes. The need to identify steps reducing GHG emissions and increasing absorption potential of the LULUCF sector included in the Action Plan for the implementation of the Government Work Programme in the period of 2017-2020. Application of additional measures could increase GHG removals in the LULUCF sector approximately up to 1,050 ktCO_2eq. in 2035.

L3. Afforestation and restoration of damaged forests. It is planned to provide support for afforestation, reforestation and restoration. Over the period 2021-2030, it is expected to plant 8 thousand ha of new forests annually or to preserve self-sustaining areas of trees.

L4. To promote the use of biomass for energy. Additional production of wood-based biofuels from wood chips.

L5. To restore wetlands in arable peatlands and protect their "green bedding" (perennial grass cover). Identify areas of former wetlands where it is appropriate to restore wetlands by naming the effectiveness of such wetlands in absorbing GHG. Promote the restoration of drained wetlands

(wetlands) by ceasing arable farming, restoring adequate water levels and maintaining ecosystems through sustainable economic activities. About 2% of wetlands are planned to be restored by 2030, which is 8,023 ha of wetland areas with organic soils.

L6. To evaluate the possibilities and potential results of growing perennial plants in the agriculture land. Identify criteria and areas of farmland where it is expedient to expand perennial crop production, the range of perennial crops to be cultivated, the purpose of such crops, and assess the economic-ecosystem benefits for agricultural production.

L7. To promote the perennial crops (ie trees and shrubs). Promote the cultivation of perennial crops on farms through the CAP strategic plan and other incentives. 7,143 ha of arable land will be converted into grassland for the entire 2021-2030 period.

L8. To grow grasslands in organic soils and promote their sustainable use. To promote the restoration, conservation and regular maintenance of "green bedding" (perennial grass cover) of organic soils by reducing the extent of organic soil ploughing. Use the resulting products according to the principles of bio-economy and circular economy. It is planned that 8,023 ha will be restored, i.e. 7.6%

L9. To include in the accounting system abandoned land with self-grown trees as forest land (no human planted). Reimbursement of expenses for landowners of unused lands which was overgrown with trees, needed officially managed documents to assign this land area into a forest.

L10. Transformation of stands and scrubs. Through the application of the financial incentives will aim to re-establishing low absorption potential stands and scrubs to create sustainable forest ecosystems and enhance forest absorption potential. It is planned that 1,500 ha/year will be converted.

L11. Promotion of green bedding in the agricultural land/ To promote landscape gardening elements in the cultivated fields/Promote the optimised use of grasslands and pasture. Encourage farms to plant green bedding in the sides of fields and gardens, promoting intercropping and intermediate crops to cover soils as long as possible with plants, and planting green grass in "buffer" strips near water bodies. It is planned to plant about 400 ha per year.

Prioritise CAP measures to stimulate farms, plant landscapes elements (hedges and other plants) with high GHG absorption capacity at the edges of cultivated fields. It is planned to plant about 200 ha per year.

Prioritise CAP measures to promote livestock farming: extend grazing to reduce manure production in barns, maintain meadows and pastures without mowing, and develop extensive grasslands that will weigh on increasing livestock density, promoting grass productivity in less fertile regions. It is planned to plant about 400 ha per year.

L12. Provision of one-off compensatory support to farms for short-term commitments (ECO scheme of "experimental" impact) related to climate change mitigation. By 2030 it is planned that an area of 650,000 ha land will be cultivated non-arable technology.

L13. Protection of organic soils. It is planned that at least in 1,000 ha of organic soils will not be drained.

L14. Promoting Green Public Procurement. Establish additional environmental criteria for public procurement to encourage the use of wood and wood products in the construction sector.

L15. Identify national indicators for GHG emissions/carbon stocks changes. Establish national GHG emission/carbon stock change indicators to fine-tune GHG emissions/absorption accounting and identify the most appropriate GHG reduction and absorption measures in the LULUCF sector.

L16. Encourage intermediate cultivation of crops. Encourage farmers to adopt intermediate crop production practices. The RDP investment measures aim to give priority to agricultural entities that produce intermediate crops from 15% of the arable land, increasing payments according to the area of the intermediate crop.

3.4.6. Waste management

The National Waste Management Plan for 2014-2020 approved by Resolution No 519 of the Government Republic of Lithuania. One of the National Waste Management Plan's for 2014–2020 objective is to minimise GHG emissions in the waste sector. By 2020, the reuse and recycling of waste materials such as paper, metal, plastic and glass from households, and from other sources where waste streams are similar to those from households shall be increased to a minimum of 50% by weight of overall waste. Also, recycling and another recovery of municipal waste shall be increased to a minimum of 65% by weight of the total amount of municipal waste. By 2020, municipal biodegradable waste disposed of in landfills shall make up no more than 35% of municipal biodegradable waste generated in 2000. This Plan is scheduled to be updated in the middle of 2020 and will cover 2021–2027.

In the light of the on-going review of the recycling targets and landfill restrictions for municipal waste – 65% recycling target for 2030 and possible upwards review of the goals by 2025 and a landfill restriction to 10% for 2030 – the Commission services consider that the optimal incineration capacity in a country is 20-25% of municipal waste generated. Incineration capacity over this is likely to further hinder Lithuania from meeting the 50% recycling target in 2020 and the future increase of that target level.

EU structural and investment funds are an essential source of funding for improved waste management system in Lithuania. In 2007–2013 190 million EUR were invested into waste management projects, including construction of 1 regional mechanical and nine mechanical sorting and biological waste treatment facilities, remediation of 341 old landfills/dumpsites, construction of numerous bulky waste collection and green waste composting sites, extension of separate waste collection system (210,000 containers for recyclable and biodegradable waste).

In the 2014-2020 period, it was planned to invest 87.2 EUR million into following measures: to support further development of the separate collection of waste, to modernise the capacities for waste preparation for recycling, reuse or another recovery (sorting lines, other equipment), and to modernise the waste management information system and monitoring.

Several new biogas plants were constructed in wastewater treatment plants. In 2013 first waste incineration plant in Lithuania has started operation with energy recovery. Non-energy waste incineration accounts for only 0.1% of total GHG emissions in the waste sector. Similar amounts of waste incineration are expected to remain in the future. Also, to improve the efficiency of heat and energy use, the use of indigenous and renewable resources in thermal power plants and the reduction of CO_2 emissions will be more efficient in the period 2019-2020. The cogeneration plants will be built in Vilnius and Kaunas, which will use 360 tons of biomass and municipal waste per year, which will make up 30%. of all municipal waste.

The main legal acts and programs of the Republic of Lithuania regulating waste management activities include the Law on Waste Management, Law on Management of Packaging and Packaging Waste, the Law on Taxes for Environment Pollution, the Rules on Waste Management, the National Waste Prevention Programme and the National Waste Management Plan for 2014-2020. Management

of wastewater and sludge is regulated by the Law on Potable Water Supply and Wastewater Handling and the Development strategy of Potable Water supply and wastewater handling.

Implementation of the Circular Economy Action Package has been a step in progressing the EU's efforts to reduce emissions from waste. The Package provides a transparent, systematic approach that focusses on several priority issues, including plastics, food waste, critical raw materials and construction and demolition and delineates actions, commitments and timetables. Implementation of the EU's circular economy action package has been vital in progressing efforts to reduce emissions from waste. It provides a clear, systematic and holistic approach that focuses on many priority issues, including plastics, food waste, critical raw materials, and construction and demolition. It sets out clear actions, commitments and timetables. The Commission has adopted a raft of legislative proposals on areas such as waste, packaging, landfill, end-of-life vehicles, batteries and accumulators, and waste electrical and electronic equipment. They include stricter targets, such as recycling 65% of municipal waste and 75% of packaging waste by 2030 and reducing landfill to 10% of municipal waste by 2030. Lithuania is seeking to minimise the amount of landfilled waste: 65% of municipal waste planned to recycled or composted, 30% - incinerated in cogeneration power plants, 5% – disposed of in the landfills by 2030.

The industrial development Programme emphasises the aim of encouraging companies to work together on the principles of industrial symbiosis in the region, allowing for the saving of raw materials and the reduction of waste generated. It is envisaged that, when measures are taken, the production and other economic waste of the plants recycled and otherwise used should be multiplied by 90% (2012) to 92% (2020).

The state waste prevention program covers all waste streams, but priority is given to reducing the generation of packaging, electrical and electronic equipment, biodegradable waste, hazardous and construction waste. It is these designated priority waste streams that have the most significant negative impact on the environment and public health and/or generate substantial amounts compared to other waste streams.

The implementation of the State waste prevention program will reduce the growth of waste generated, the negative environmental and public health impacts of waste, the levels of harmful substances in materials and products. The principal objective of reducing the growth of emerging and unused waste, the rational use of natural resources and materials, and reducing the risk of adverse impacts of waste on public health and the environment will be met.

Lithuania is taking steps towards the concept of "recycle, repair and reuse" and avoiding waste at all stages of the value chain with its EU circular economy package. In the waste management sector, existing policies aimed at reducing the amount of municipal waste going to landfills and recycling. New landfills complying with EU environmental requirements have been set up for the disposal of solid waste, mechanical-biological treatment facilities for biodegradable waste, wastewater treatment projects and waste incineration capacity are being developed. Landfill gas is used for power generation or other purposes.

Below the brief descriptions of waste management sector existing and planned measures

W1. To reduce the waste quantity in landfills. To increase municipal waste recycling by at least 65% of the total waste by 2020. Municipal biodegradable waste disposed of in landfills should not exceed 35% of municipal biodegradable waste compared to 2000. To use methane (CH_4) gas from landfills for the energy generation. To incinerate waste in CHP plants.

W2. Creation of financial incentives to encourage the repair of items. Creation of financial incentives to promote repair of cycles, shoes, leather goods, clothing, furniture, etc., considering opportunities to ease the tax burden by encouraging not to dispose of old items and reuse them. The measure will reduce landfill waste by 0.5% per year.

W3. Prevention of food waste. Raising public awareness and promoting behavioural change through social campaigns, media, social networks, internet and other information channels on food waste and how it can be avoided (consumption patterns, sorting of food waste, separate collection, recovery, etc.). Creating and promoting a mobile application about expired but safe and usable food. Food waste will be reduced by 21%.

K4. Improvement of residents' waste sorting skills. Raising public awareness of waste sorting opportunities, benefits, different waste disposal sites, sorted waste through media and other information channels. Development of mobile interactive applications for citizens to promote waste sorting (including all municipalities). The amount of sorted and recycled waste will increase due to improved population's sorting skills and sorting conditions. It is expected that recycled waste will increase to 15%.

W5. To improve the capacity of environmental authorities and other institutions to identify and classify hazardous waste. Develop a standard methodology for the identification of hazardous waste and to organise the training for environmental professionals to identify and classify hazardous waste, to consult business representatives.

3.5. Use of Kyoto mechanisms

Kyoto mechanisms allowed for Lithuania to meet its national emission reduction commitments of the Kyoto Protocol. The Kyoto Protocol introduced three market-based mechanisms: clean development mechanism (CDM); joint implementation (JI) and emissions trading. Use of Kyoto mechanisms must be supplemental to domestic action to achieve KP targets. These mechanisms are referred to as flexible mechanisms.

Certified emission reduction (CERs) units from the clean development mechanism and emission reduction (ERUs) units from JI projects, can be used to achieve the targets under the EU ETS and EU Effort Sharing Decision (with limitations).

In 2008-2012 there were implemented 11 Joint implementation projects related to GHG emissions reduction in electricity sector (10 wind power parks, 1 landfill biogas use for heat and electricity production) and the estimated GHG emissions reduction during whole period is 864 kt CO_2.

Together with the implemented JI projects during 2008-2012 period in Lithuania 64 wind power plants (total capacity 183.8 MW) had been installed (in 2002-2012 period there were 78 operating wind power plants in Lithuania with an installed capacity of 234.8 MW). And during the period 2003-2012 totally 20 biogas plants had been installed in Lithuania with the capacity of 20.32 MW.

GHG emissions reduction due to the 2 JI projects of N_2O emissions reduction in chemical industry amounts to 7,643,017 t CO_2eq. Thus, without the implementation of these projects in 2013 the ETS sector‘s verified emission could be 1.2 million t CO_2 eq. higher (8.7 million instead current 7.5 million t CO_2 eq.).

Lithuania’s total GHG emissions in the 2008-2012 commitment period were 109,786,321 t CO_2 eq., approximately 52 % lower than the assigned amount, which was 227,306,177 tonnes CO_2 eq. The total amount of Kyoto Protocol units retired in the first commitment period is 109,786,321. Lithuania has requested 71,822,887 AAUs, 246,966 CERs and 2,327,000 ERUs to be carried over to the second commitment period of the Kyoto Protocol.

According to projections “with existing measures” (WEM scenario) for 2020, Lithuania’s Kyoto target for the second commitment period will be met entirely by domestic actions.

3.6. Information on changes in domestic institutional arrangements

Lithuania has not made any significant changes in the domestic institutional, legal, administrative and procedural arrangements for domestic compliance, monitoring, reporting and archiving of information and evaluation of the progress towards emissions reductions obligations and targets since the submission of Lithuania’s Third Biennial Report.

The main change in the institutional arrangements was related to the implementation of the Commission’s Communication on a Framework Strategy for the Energy Union adopted on 25 February 2015. This strategy explains that the Energy Union needs an integrated governance and monitoring process, to make sure that energy-related actions at European, regional, national and local level all contribute to the Energy Union’s objectives. **National energy and climate plan for the period from 2021 to 2030** covers a holistic approach and addresses the five key dimensions of the

Energy Union: energy security; the internal energy market; energy efficiency; decarbonisation; and research, innovation and competitiveness, in an integrated way which recognises the interactions between the different dimensions. The national plan also includes a perspective until 2050 to ensure consistency with long-term policy objectives at the national and EU level. **The Ministry of Energy** and **Ministry of Environment** are jointly coordinating the Energy Union governance process within the Government of Lithuania.

3.1. National Economic and Financial Instruments for Climate Change Management

The following economic and financing instruments are applied in order to implement targets set in the Strategy for the National Climate Change Management Policy and sectorial strategies: the EU emissions trading system (ETS) from which revenues of auctioned allowances are earmarked to the Programme for Climate Change, the EU structural and investment funds for 2014–2020, e. g. the Cohesion Fund, the European Agricultural Fund for Rural Development via the Rural Development Programme for Lithuania 2014–2020, the JESSICA Holding Fund and Energy Efficiency Fund, etc.

In the Figure scheme the financial and economic instruments directly or indirectly contributing to management of climate change policy in Lithuania are shown.

Figure 3-3. Economic and financial support instruments contributing to management of climate change policy in Lithuania

For the implementation of the climate change mitigation measures planned in the Interinstitutional Action Plan implementing the Strategy for the National Climate Change Management Policy and other inter-sectoral and sectoral development programs from the government plans to invest from the EU Structural and Investment Funds 2014-2020 and the state budget's Programme for Climate Change about 2 billion EUR and about 0.9 billion EUR for adaptation measures. Sustainable growth of the Lithuanian economy has been ensured as the country's GDP has been growing and GHG emissions were decreasing (from 2005 to 2017 the total GHG emission of all sectors of the economy shrank by 9.8% and the GDP of the country increased by 36%).

The estimated cost of planned measures

Financing of planned RES measures in the electricity sector. Most of the investments related to the use of renewable energy in the electricity sector are intended for the development of RES capacity and integration into the network. Only a small amount of funds is planned to cover the electricity generation costs. The total need for the sector is about 1,870 million EUR. 1,677 million of which public funds and 703 million EUR private funds. The portfolio of public funds will mainly consist of 2021-2027 the EU Structural Funds, electricity tariff, Modernization Fund, funds received for statistical transfers.

Financing of planned RES measures in the heating sector. Investments are aimed at modernizing and developing heat production and transmission infrastructure. The major part of the investments will be directed to the development of production capacity from RES. The total need for the sector is 570 million EUR: 382 million EUR public funds, 188 million EUR private funds. Possible sources for public funds: 2021-2027 EU Structural Funds, Heat Tariff, Climate Change Program, „Life" Program.

Financing of planned measures in the energy efficiency sector. The sector requiring the largest additional investment. Most of the additional funding is planned for the modernization of buildings. Increasing efficiency in businesses and public infrastructure (modernizing street lighting) requires considerable investment. The total need for the sector is approximately 2,405 million EUR: 810 million EUR and private funds 1,595 million EUR. Energy efficiency measures are applied and implemented in different sectors and therefore have different sources of financing. The portfolio of public funds will mainly consist of EU Structural Funds 2021-2027, Climate Change Program, State and Municipal Budget, Life program.

Financing of planned measures in the transport sector. Most of the investment allocated to promote the use of electric vehicles and charging infrastructure, promoting low-emission measures, inland waterway transport. The total need for the sector is 3,752.66 million EUR: 2,798.96 million EUR public and 953.7 million EUR private. The portfolio of public funds will mainly consist of 2021-2027. EU funds, State's and Municipal budgets, Climate Change Program, „Life" Program, ERDF.

Financing of planned measures in the agricultural sector. Most of the investment goes to promoting the use of non-arable technology, providing support to farms for long-term climate change mitigation commitments, and investing in climate-friendly farming practices on livestock farms. The sector needs a total of 766 million EUR of which 627 million EUR in public funds and 139 million EUR in private funds and 256 million EUR in direct payments.

Financing of planned measures in the industrial and industrial process sectors. The most investments allocated to the introduction and promotion of technological eco-innovation, the introduction of modern technology and the digitization of industry. The total need for the sector is 875.8 million EUR, of which 341.53 million EUR public funds and 534.3 million EUR private funds. The portfolio of public funds will mainly consist of 2021-2027. EU Structural Funds, Invest EU, LIFE and Climate Change Program.

Financing of planned measures in the waste management sector. Most of the investments are allocated to waste reduction and sorting prevention. The total need of allocations is 5.1 million EUR. The public funds portfolio mainly consists of 2021-2027 EU Structural Funds and Waste Management Program.

Financing of planned measures in the LULUCF. It is planned to allocate EUR 102.1 million from the Lithuanian Rural Development Program for direct payments.

3.2. Estimates of emission reductions and removals and the use of units from the market-based mechanisms and land use, land-use change and forestry

In Lithuanian, there is no intention to use credits from market-based mechanisms for the compliance with the ESD 2020 target. However, in case of shortage of AEAs, Lithuania primarily plans to use a surplus of AEAs banked through the years 2013-2016.

The emissions from the LULUCF sector are not included in the EU joint target, or Lithuania's contribution to the emission reduction under this target under the UNFCCC, and therefore not given in the CTF Tables 4 and 4(a)I, but are presented in CTF Table 1. The LULUCF sector for 1990-2017 as a whole acted as a CO_2 sink except in 1996 and 1997 when emission constituted to 1,516 kt CO_2 eq. and 142.8 kt CO_2 eq. That is explained by sudden spruce dieback that caused huge losses in trees volume, in Lithuania's spruce stands, which has direct impact on biomass calculations and on CO_2 balance from this sector.

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PROJECTIONS

4. PROJECTIONS

4.1. Greenhouse gas emissions projections

This chapter provides information of future trends in GHG emissions and removals in Lithuania, given current national circumstances and adopted and implemented policies and measures described in Chapter above.

Projections of GHG emissions have been calculated carrying out systematic modelling of economy sectors of Lithuania. The model is based on an integrated approach and relies on statistical data, reflecting existing situation of ***base year 2017***, and special assumptions which affect the long-term development of the economic sectors, with account of the EU climate change and energy objectives by 2030 and targets by 2040. The same GHG projections were used for **Lithuanian National energy and climate plan.**

Activating only existing measures allowed the modelling of scenarios 'with existing measures' (WEM) related to climate change mitigation. Activating the planned measures also allowed modelling scenarios 'with additional measures' (WAM) (along with existing measures) related to climate change mitigation.

Projections as well as policies and measures are divided into the following reporting categories: energy, industrial processes, agriculture, LULUCF and waste.

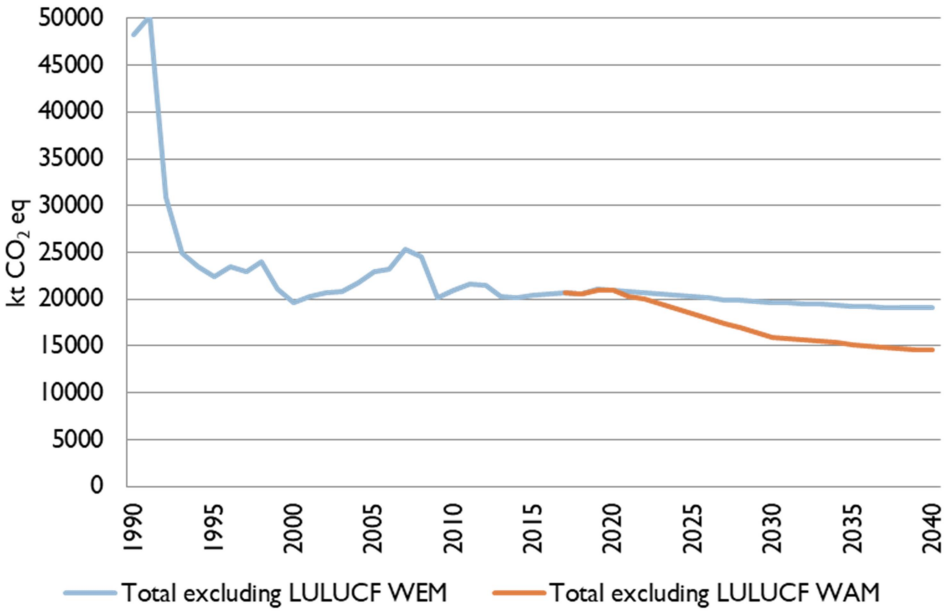

Figure 4-1. Aggregated projected GHG emissions by 2035, kt CO_2 eq.

Table 4-1. Projected GHG emissions in case of WEM scenario, kt CO_2 eq.

Sector	2017	2020	2025	2030	2035	2040
Energy	11 599	11 840	11 506	11 206	10 994	10 850
IPPU	3 638	3 929	3 710	3 557	3 489	3 447
Agriculture	4 403	4 399	4 364	4 303	4 346	4 379
LULUCF	-5 296	-4663	-3877	-3329	-3042	-2772
Waste	1 065	857	686	567	463	382
Total excl. LULUCF	20 706	21 026	20 266	19 634	19 292	19 059
Total incl. LULUCF	15 409	16 362	16 389	16 304	16 250	16 286

Table 4-2. Projected GHG emissions in case of WAM scenario, kt CO_2 eq.

Sector	2017	2020	2025	2030	2035	2040
Energy	11 599	11 793	10 063	8 261	7 736	7 292
IPPU	3 638	3 929	3 619	3 376	3 308	3 266
Agriculture	4 403	4 399	4 126	3 756	3 718	3 681
LULUCF	-5 296	-4663	-4114	-3936	-4003	-4385
Waste	1 065	857	662	528	411	318
Total excl. LULUCF	20 706	20 979	18 470	15 921	15 174	14 558
Total incl. LULUCF	15 409	16 315	14 356	11 985	11 170	10 172

Implementation of the additional measures would lead to reaching an advantageous effect from the social standpoint, which would be reflected in the creation of new jobs, improvement of life quality, competitiveness, saving financial resources for the purchasing of imported fossil fuel. GHG emissions projection suggests that a decreasing demand in energy from 2020 will result in decreasing GHG emissions. The implementation of additional measures could result in lower GHG emissions in 2040 if compared between WAM and WEM scenarios.

The projection of indirect GHGs is submitted under National Emission Ceilings Directive (2016/2284/EU) to European Commission[7] , therefore it is not provided in this report.

4.1.1. Energy

The emissions from energy sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-3. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2020	2025	2030	2035	2040
WEM scenario	5 646	5 181	5 020	5 012	4 989
WAM scenario	5 606	4 869	4 580	4 552	4 518

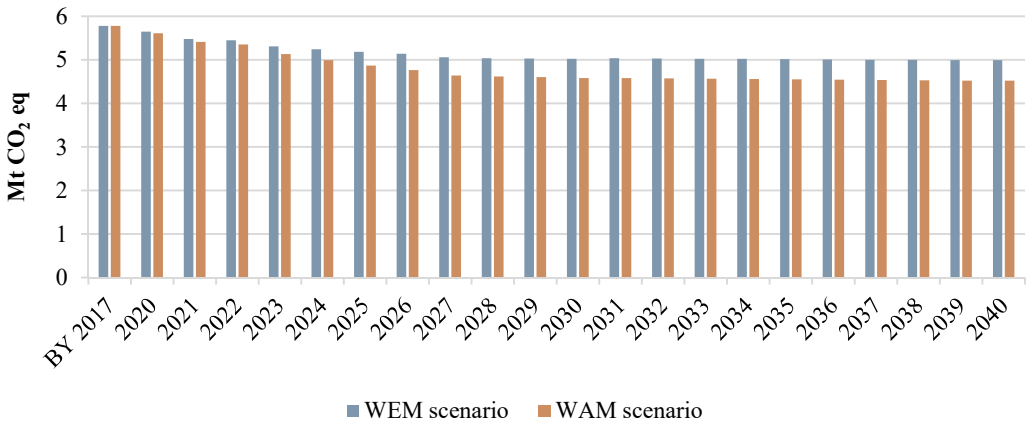

Figure 4-2. Projection of the WEM and WAM scenarios in energy sector

[7] https://cdr.eionet.europa.eu/lt/eu/nec_revised/projected/envxknvva/

Scenario "with existing measures" (WEM)

The GHG emissions in energy sector were determined by firstly estimating the consumption of fuel in energy consumption sectors. The projected primary energy consumption is presented in Figure 4-3.

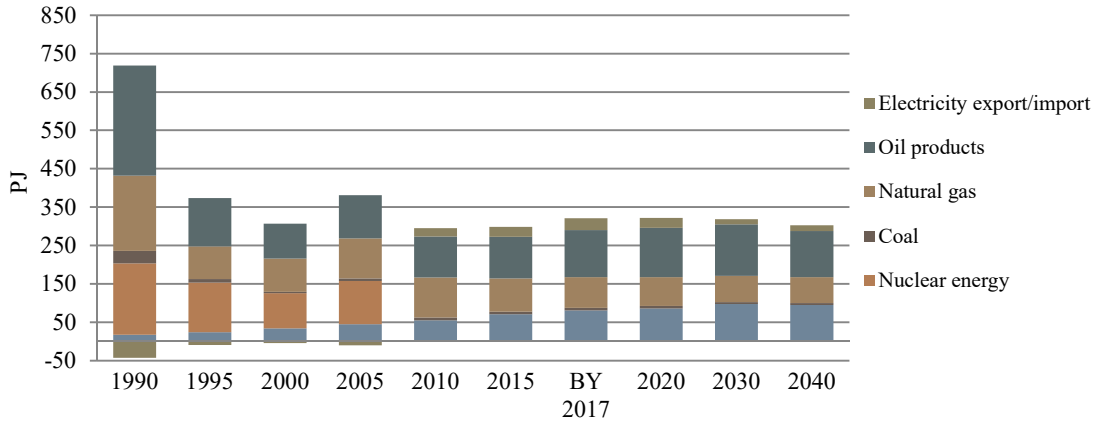

Figure 4-3. Primary energy consumption in Lithuania

It is estimated that the total primary energy consumption will decrease by 6% up to 2040 compared to 2017. Oil products shall remain the main energy source (40%), followed by RES and other indigenous energy (31%) and natural gas (23%).

The decrease in primary energy consumption is mainly associated with improvement of energy efficiency and decreasing population in Lithuania. It was assumed that regular population will be 2.789 million in 2020, 2.727 million in 2030 and 2.675 million in 2040 in Lithuania.

The share of each energy subsector in total projected GHG emissions is presented in Table 4-4. It is estimated that petroleum refining, manufacturing industries and residential sectors will remain the main sources of GHG emissions in energy sector. Emissions in public electricity and heat production shall reduce more than 2 times and will not belong to the main sources.

Table 4-4. Projected GHG emissions from energy subsectors, kt CO_2 eq

Sector	BY 2017	2020	2025	2030	2035	2040
Public Electricity and Heat Production	1137	983	615	526	534	530
Petroleum Refining	1383	1317	1317	1317	1317	1317
Manufacture of Solid Fuels and Other Energy Industries	53	55	55	55	55	55
Manufacturing industries	1185	1230	1190	1136	1136	1137
Commercial/Institutional	342	355	350	342	336	330
Residential	923	950	930	926	915	903
Agriculture/Forestry/Fishing	229	227	215	215	215	216
Fugitive emissions from fuels	525	530	510	503	503	502

It was estimated that increased energy consumption efficiency, use of biomass, wind and solar energy will decrease the use of fossil fuel in public electricity and heat production sector by 53% in 2040 which will lead to decrease in GHG emissions in this sector. GHG emissions in other sectors shall remain rather stable.

The overall situation in energy sector starting from 1990 and the projected emissions up to year 2040 are presented in Figures 4-4 and 4-5.

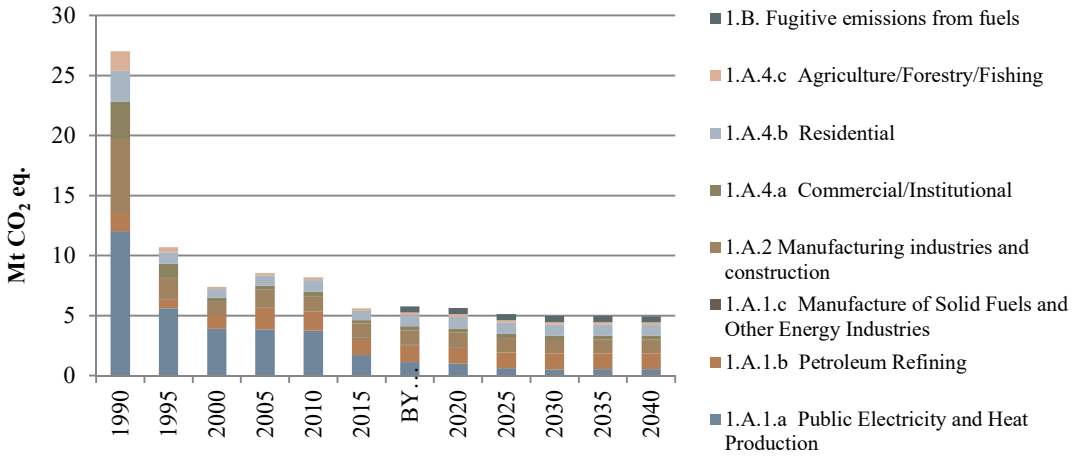

Figure 4-4. Historical and projected GHG emissions 1990-2040, kt CO_2 eq. (excluding transport sector)

It is estimated that the overall GHG emissions from energy sector (excluding the transport sector) will decrease by 82% in 2040 compared to 1990. Figure 4-5 shows the share of GHG emissions from each energy subsector in 2040.

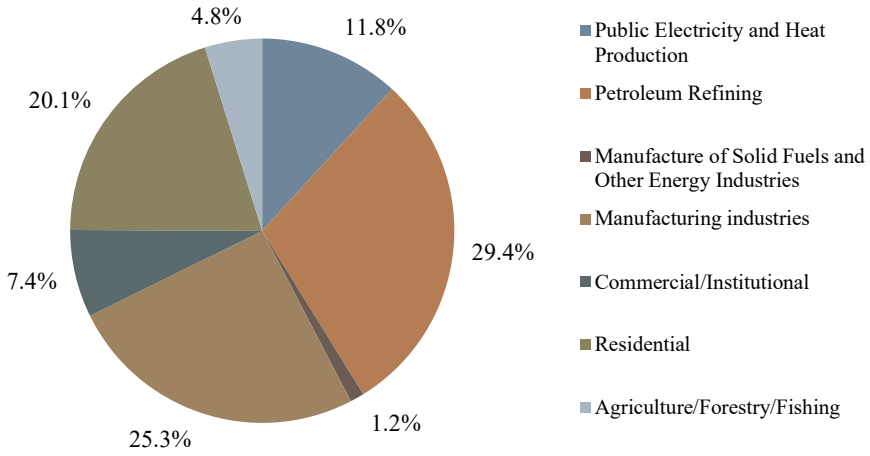

Figure 4-5. Estimated GHG emissions share by sectors in 2040

GHG emissions are estimated to reach a total of 4 989 kt CO_2 eq. in 2040. Most of the GHG will originate from Petroleum refining (29%), Manufacturing industries (25%) and Residential sector (20%). Manufacture of Solid Fuels and Other Energy Industries sector is still expected to remain the smallest GHG emitter of energy subsectors.

Several factors determine GHG emission projections in the EU ETS sectors and mainly in the public electricity and heat production sector. These sectors are currently undergoing a trend of switching fossil fuel to use of biomass. Emissions in public electricity and heat production sector shall also reduce up to 2030 due to the building renovation program. Two new waste-fuelled CHP's will start operation in Vilnius and Kaunas in 2021. This will reduce electricity imports for Lithuania, and reduce GHG emissions in public electricity and heat production as about half of municipal waste is biogenic fuel. For the current GHG projections it was assumed that the EU ETS carbon price will

increase up to 54.02 EUR/tonne CO_2 in 2035 and remain at the same level until 2040. However, carbon price is assumed not to do any impact for GHG emissions, except for EU ETS companies in pipeline transportation and commercial/institutional subsectors (less than 10 kt in total in 2018). Possible impact of carbon price on GHG emissions from the EU ETS sectors will be further investigated in sensitivity analysis chapter.

Scenario "with additional measures" (WAM)

The WAM scenario includes measures which pay the most attention to RES development, increasing energy efficiency and improving energy market.

Assessing the impact of additional PaMs in energy sector, it is important to emphasize the main foreseen large jump of installed power in installations using RES – 700 MW of installed power will be built in the period of 2025-2035 for off-shore wind power plants which will generate about 20.1 TWh of electricity up to 2040 and significantly increase RES share in electricity production.

The list of PaMs and total GHG reduction effect applying additional policies and measures is presented in Chapter 3.

Table 4-5. Projected GHG emissions from energy sector (kt CO_2 eq.)

	BY 2017	2020	2025	2030	2035	2040
Public Electricity and Heat Production	1 137	983	491	381	379	376
Petroleum Refining	1 383	1 317	1 317	1 317	1 317	1 317
Manufacture of Solid Fuels and Other Energy Industries	53	55	55	55	55	55
Manufacturing industries	1 185	1 230	1 178	1 104	1 088	1 072
Commercial/Institutional	342	355	301	294	288	283
Residential	923	910	787	684	679	669
Agriculture/Forestry/Fishing	229	227	215	195	195	196
Fugitive emissions from fuels	525	530	527	551	551	550

Additional measures will allow reduction of GHG emissions from energy sector by 20% in 2030, comparing to base year (2017).

Comparing to 1990, it is projected that applying additional policies and measures GHG emissions in energy sector should decrease by 83% in 2030, and remain approximately the same up to 2040.

Methodologies and key assumptions

Energy sector constitute of six main subsectors (*Energy Industries, Manufacturing Industries, Transport, Other sectors, Other and Fugitive emissions from fuels*) for which GHG emissions are projected. Projections of GHG emissions from transport sector are reported separately in the Chapter 5.1.2.

The projections were carried out by firstly determining the consumption of fuel in every subsector up to the year 2040. The obtained fuel consumption was then multiplied by emission factors of every fuel in order to estimate projected GHG emissions. Thus, GHG projections fully correspond to the methodology used for preparation of National GHG inventory.

The fuel consumption trends up to the year 2040 were obtained carrying out systematic modelling of consumed fuel and energy types in economy sectors of Lithuania. The model relies on statistical data, reflecting existing situation of energy consumption, and special assumptions which affect projections of energy consumption change (such as measures for the increase of direct energy consumption efficiency, electricity and heat production efficiency, measures for the change of fuel consumed, promotion of the change of consumer behavior, technology trends observed in the market, etc.). The same fuel consumption projections were used for Lithuanian National energy and climate plan.

Fuel demand for house heating will decline due to the increased energy efficiency and renovation of residential and public buildings.

Forecast of activity data of oil production, which was used in subsectors 1.B.2.a Oil and 1.B.2.c Venting and flaring, was provided by Lithuanian geological survey. Three scenarios of oil production activity were obtained which are presented in sensitivity analysis. For WEM scenario, it was assumed that oil production will be carried out only from currently existing oil fields. For projections in subsector 1.B.2.b Natural gas, forecast of gross consumption of natural gas was used.

The scenario “with existing measures” include the national legislation documents that include projections of energy demand, climate change mitigation measures, projects currently in development and will be set in motion during the period 2017–2040.

Main measures and assumptions used for projecting GHG emissions in energy sector:

- National Energy Independence Strategy determines the target to achieve that the part of RES in the final energy consumption balance would be no less than 30% by 2020, 45% by 2030 and 80% by 2050.

- National Energy Independence Strategy determines the target to reduce energy intensity by 1.5 time in 2030 compared to 2017 level, and by 2.4 times in 2050, compared to 2017 level.

- GHG emissions can be inversely proportional to the carbon price in the EU ETS market, therefore as the carbon price increase in sensitivity analysis it is assumed that a significant amount of GHG emissions will be reduced due to installation shifting to the use of biomass boilers instead.

- Two additional municipal solid waste (MSW) incinerators are planned to enter into operation in Vilnius and Kaunas cities in 2021. The CHP plant in Vilnius will generate electricity for the Lithuanian power grid and heat for the district heating system of Vilnius. The plant will consist of two units, one fueled by non-recyclable municipal waste and the other by biomass. The municipal waste incineration unit will be able to produce 18 MW of electrical power and 53 MW of thermal power. The biomass unit will have a capacity of 70 MW of electrical power and 174 MW of thermal power. It’s planned that the project promotes energy efficiency with expected energy savings of around 40%. It is assumed that operation of three MSW power plants will reduce the amount of MSW disposed of by landfilling and will overlay portion of fossil fuel used in public electricity and heat production sector. Promotion of high efficiency cogeneration in Vilnius, and the promotion of use of biofuel for heat energy generation - these assumptions were incorporated during the calculation of final fuel used in Lithuania.

- Support scheme for electricity generated from RES, (technologically neutral auctions). About 700 MW of installations consuming RES will be installed during the foreseen lifetime of the measure up to 2025, which will produce about 2.4 TWh of energy.

- Financial support for producing consumers (prosumers). The measure is approved in 2018 and foreseen to continue until 2030. Supported activity is installation of small solar power plants. It is planned that about 25000 consumers will take advantage of this support up to 2023, who shall install about 0.168 GW of new power installations and generate about 0.075 TWh of energy.

- Promoting use of RES in district heating sector (by using biofuel, solar energy technologies, heat pumps and/or heat storage).

- Installing additional RES capacities for heating. According to the approved measure, 70 MW of power of biomass heat plants will be built until 2023, which will produce about 0.42 TWh of heat.

- Renovation of apartment buildings. Renewed in 2014, this measure is being implemented up to 2020 and is planned to implement for the longer term. In case of WEM scenario, it is planned up to 2023. Further application of the measure is foreseen in WAM scenario. The objective of the measure is to renovate 500 apartment buildings each year. Planned heat savings due to the complex renovation will be about 70 kWh/m^2.

- Renovation of public buildings. This measure is being implemented since 2014 and will be continued up to 2030. The effect of the measure is assessed up to 2023 in WEM scenario. Further application of the measure is transferred to WAM scenario. It is foreseen that the measure will save about 20 GWh of energy each year until 2030 and 960000 m^2 of area of public buildings will be renovated. In total, amount of energy saved will be about 1.1 TWh up to 2030.

- Consumer education and consulting (by energy suppliers). Since 2017, energy suppliers have to make agreements with Ministry of Energy of the Republic of Lithuania concerning education and consulting of end users for issues of increasing efficiency. It is planned that this measure will save about 300 GWh of energy because of behavioral changes in end users each year up to 2030.

- PSO privilege for industrial companies implementing energy efficiency measures. This measure is approved in 2019. According to it, large industry companies are promoted to install measures increasing energy efficiency, thus reducing consumption of energy. It is planned that about 100 GWh of energy will be saved each year until 2030 in manufacturing industries.

- Agreements with energy companies on energy saving. Since 2017, energy companies have to make agreements with on the energy saving Ministry of Energy of the Republic of Lithuania. According to these agreements, they must install measures to increase energy efficiency for end users. It is planned that this measure will save about 100 GWh of energy each year until 2030.

The main additional (WAM scenario) measures to increase energy efficiency, which will reduce energy consumption in the period 2020-2040, are these: updating boilers into more efficient technologies, modernization of heating and water systems in apartment buildings, energy efficiency

improvements in non-industrial businesses and financial support for renovation of single-family houses.

Additional measures, which will contribute most to the promotion of consumption of RES in electricity production in the period of 2020-2040, are continued financial support for producing consumers, financial support for investments into small-capacity power plants, renewable energy resources for industry LT+ support for additional RES capacities and RES development in the Baltic Sea.

Heat sector will also change significantly in WAM scenario – RES share in public heat production will increase almost by 30%, and it should already amount slightly more than 91% in 2027. This will mostly be determined by Vilnius and Kaunas CHP projects, whose impact will be strengthened by the continued financial support for small-capacity CHPs and waste heat usage in public heat grids.

4.1.2. Transport

The emissions from transport sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-6. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2020	2025	2030	2035	2040
WEM scenario	6 194	6 325	6 186	5 982	5 861
WAM scenario	6 187	5 194	3 681	3 184	2 774

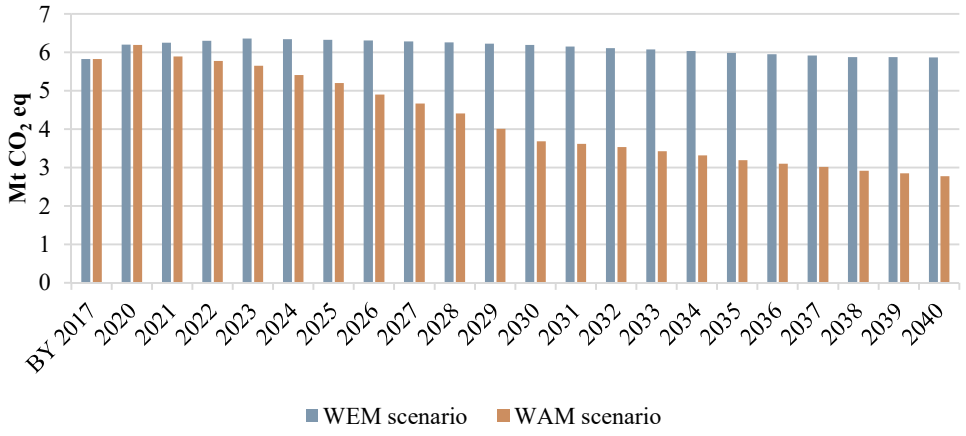

Figure 4-6. Projection of the WEM and WAM scenarios in transport sector

Scenario "with existing measures" (WEM)

Road transport sector is the main source of GHG emissions and fuel consumption in transport sector. It was assumed that GHG emissions in road transport sector are directly linked with fuel consumption which is influenced by the number of fossil fuel powered road vehicles registered in Lithuania. The total projected number of cars registered in Lithuania was provided by the Ministry of Transport and Communications. It was projected that the total number of road vehicles with internal combustion engine (including passenger cars, light and heavy duty vehicles and motorcycles) will reach 1 713 435 units in 2040 (Figure 4-7).

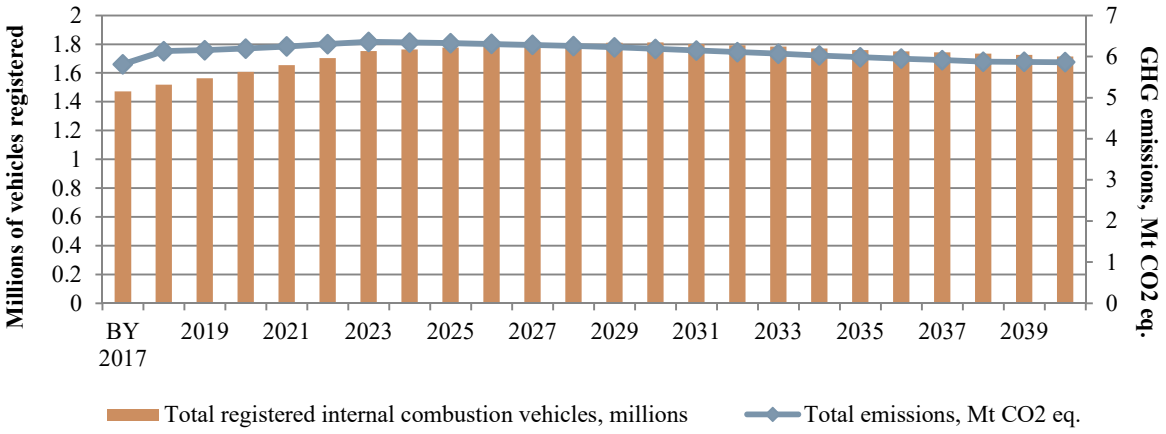

Figure 4-7. Projected number of vehicles registered and GHG emissions in road transport sector

Road transport sector is projected to remain the only gasoline and the main diesel oil consumption source in transport sector. According to the projected data, the gasoline consumption in this sector will increase by 38% and diesel oil consumption will decrease by 5% by 2040 (Figure 4-8). The fuel consumption in road transport shall increase from 77 952 TJ in 2017 to 86 917 TJ in 2023 and then decrease to 81 315 TJ in 2040.

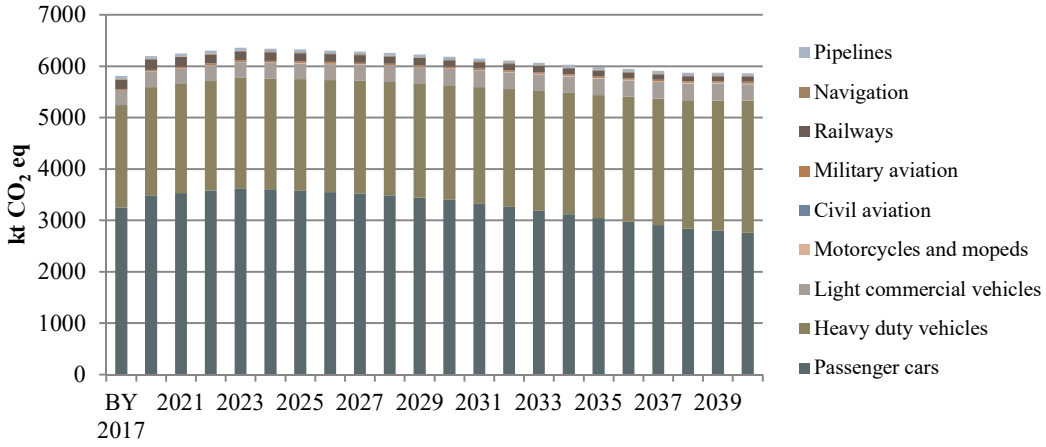

Figure 4-8. Projected fuel consumption and GHG emissions in road transport sector

The main fuel used in transport sector will remain diesel (70% in 2040) and gasoline (15% in 2040) (Figure 4-9). Road transport will remain the main fuel consumer in transport sector. As a result, it will remain the main GHG emissions source in this sector (97% of total transport sector emissions) in 2040 (Figure 4-10). This is a result of increase in vehicle number in Lithuania. It is projected that number of registered passenger cars in Lithuania will increase 1.2 times in 2040 (in total 1 622 986) and will stand for 88% of total registered road vehicles in Lithuania. It is projected that diesel oil and gasoline will remain the main fuel used in transport sector. This is mainly influenced by the fuel use trend in road transport sector.

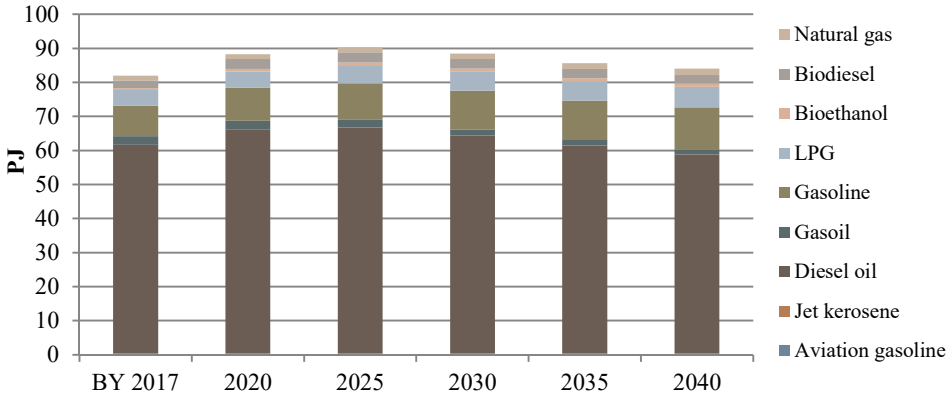

Figure 4-9. Projected total fuel consumption in transport sector

GHG emissions from transport sector are projected to increase up to 6 356 kt CO_2 eq. in 2023 and later to decrease down to 5 861 kt CO_2 eq. in 2040 (Figure 4-10). Compared to 2017, the GHG emissions from this sector will increase 1.1 times in 2023, and then will decrease 1.1 times over 17 years and therefore will almost reach the base year value in 2040. The increase of GHG is stipulated by the increased use of fossil fuel in road transport, and the later decrease occurs due to the implementation of sustainable mobility plans in Lithuanian towns and due to decreasing population.

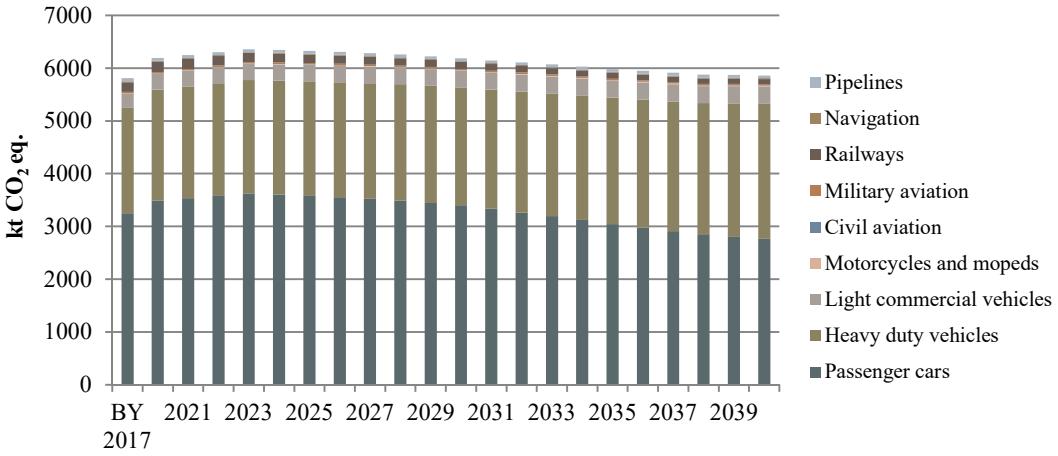

Figure 4-10. Projected total GHG emissions in transport sector

The second largest GHG emissions source in transport sector will remain railways sector. In civil aviation subsector it is estimated that the GHG emissions would increase 1.5 times, but this sector will remain a minor source of GHG emissions as there are only 8 aircraft operators[8] that have valid license issued to perform air communication in Lithuania. Most of the flights performed by the Lithuanian aircraft operators are international.

Railways sector is projected to emit less amount of GHG in 2040 (97 kt CO_2 eq. – decreased by 47% compared to 2017). This is due to the fact that the data provided by the Ministry of Transport and Communications suggests that the fuel consumption in railways would also decrease by 47% influenced by electrification of railways.

[8] Lithuanian transport safety administration data: https://ltsa.lrv.lt/lt/veiklos-sritys/civiline-aviacija/licencija-oro-susisiekimui-vykdyti

Transport sector is less affected by the EU ETS carbon price as in current situation only aviation, navigation sectors and pipeline transportation companies are involved in the EU ETS market. In Lithuania there are several aircraft operators that fall under the scope of the EU ETS and according to the latest data from EUROCONTROL[9] only one aircraft operator was not considered as small emitters in 2017 (emitted 68 441 t CO_2 per year).

Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of Environment, the Ministry of Transport and Communications, the Ministry of Energy and the Ministry of Agriculture. The implementation period of measures will cover period of 2020-2030. For the period of 2031-2040 all additional measures will continue to be implemented at the same rate as it is expected in 2030. Most of these measures focuses on incentives or taxes with the aim to change road vehicles to the low-GHG emitting ones or to the ones powered by alternative sources (electricity, LNG), also on fuel-efficiency (eco-driving, public and combined transport, etc.) and on use of RES in transport. Measures related to pollution taxes of cars (yearly car pollution tax and differentiation of vehicle registration fee by level of pollution) will have the largest effect for GHG emission reduction.

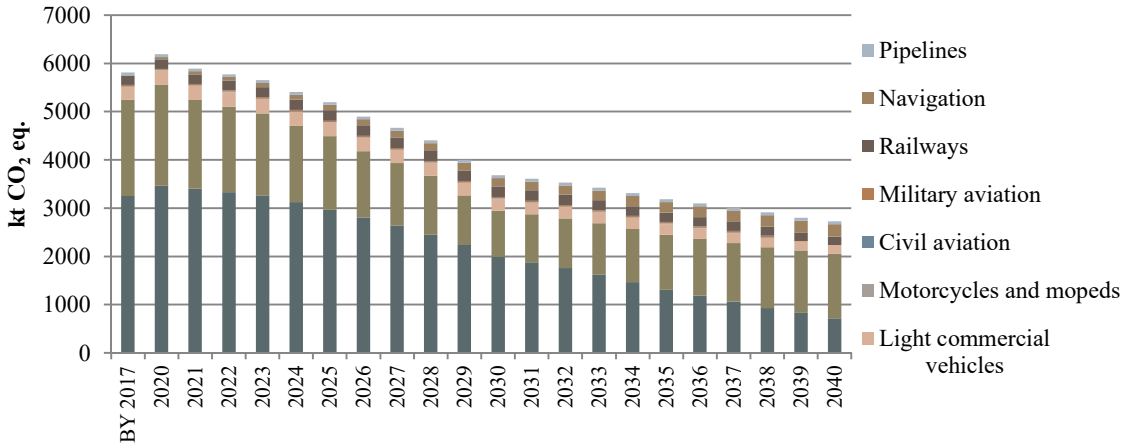

Figure 4-11. Projected GHG emissions in transport sector applying additional measures

The list of PaMs and total GHG reduction effect applying additional policies and measures is presented in Chapter 3.

Additional measures will allow reduction of GHG emissions in transport sector by 37% in 2030, comparing to base year (2017). Comparing to 1990, it is projected that applying additional policies and measures GHG emissions in transport sector should decrease by 43% in 2030, and by 53% in 2040.

Methodologies and key assumptions

The projections were carried out by firstly determining the consumption of each fuel type in every subsector (Civil aviation, Road transportation, Railways, Water-borne navigation, Other transportation) up to the year 2040. As the GHG emissions are directly linked to the fuel consumption

[9] European Organisation for the Safety of Air Navigation https://www.eurocontrol.int/

through specific fuel emission factors, knowing the fuel consumption during the specific time period would enable simplified calculation of the GHG emissions.

The scenario "with existing measures" include the national legislation documents that include projections of energy demand, climate change mitigation measures, projects currently in development and will be set in motion during the period 2017-2040.

The Ministry of Transport and Communications of Republic of Lithuania provided the required activity data for the estimation of projections in the transport sector. As the anticipated fuel consumption data was provided in 2-year intervals up to 2020 and in 10-year intervals thereafter, the data for specific year in these intervals was linearly interpolated according to the anticipated fuel consumption change and the statistical data on fuel consumption in 2017. The real fuel consumption for aviation gasoline in civil aviation in 2018 was already larger than anticipated consumption in 2020, therefore only the projected trend, but not the projected aviation gasoline consumption data itself was used for determination of aviation gasoline consumption in the civil aviation subsector. After that, the GHG emissions were calculated by applying the specific fuel emission factors used in NIR 2019.

Domestic civil aviation is essentially narrow (0.03% of GHG emissions in transport) in Lithuania. Aviation gasoline (avgas) is used for piston-type powered aircraft engines, while the jet fuel is used in turbine engines for aircraft and diesel engines. Aviation gasoline as a fuel is more common in private aircraft, while the jet fuel is used in airlines, military aircraft and other large aircraft. The anticipated fuel consumption for aircrafts used for civil international flights is provided in Table 4-7.

Table 4-7. Anticipated fuel consumption in international aviation, t

Fuel type	BY 2017	2018	2020	2025	2030	2035	2040
Aviation gasoline	0	0	0	0	0	0	0
Jet kerosene	102 503	100 559	101 166	103 190	105 213	109 896	114 579

The military aviation activity is defined as activities using fuel purchased by or supplied to the military authorities of the country. The GHG emissions in this sector are mainly related to the consumption of jet kerosene as main fuel.

Anticipated fuel consumption was provided by the Ministry of National Defense. However, only fuel consumed by Lithuanian airships was provided as the Ministry cannot anticipate fuel consumed by other NATO airships. The forecast showed no change in fuel consumption in the future. No other measures were applied for determination of fuel consumption in military aviation subsector.

Projection of GHG emissions in railways subsector was carried out by using data received from the Ministry of Transport and Communications. The data provided by the MoTC is shown in Table 4-8.

Table 4-8. Anticipated fuel consumption in railways subsector, TJ

Fuel type	BY 2017	2018	2020	2025	2030	2035	2040
Diesel oil	2 263	2 558	2 371	1 979	1 587	1 391	1 195
Biodiesel	76	79	83	69	55	49	42

No other measures were applied for determination of fuel consumption in railways subsector therefore the GHG emissions were calculated by applying the specific fuel emission factors used in NIR 2019.

The water borne navigation is composed of navigation through the inland waterways: navigable rivers, canals, lakes, man-made water bodies, and part of the Curonian Lagoon belonging to the Republic of Lithuania. In 2017 the GHG emissions from domestic navigation accounted for 17 kt CO_2 eq. Projection of GHG emissions in water borne navigation subsector was carried out by using data received from the Ministry of Transport and Communications. The forecast showed the same fuel consumption, passenger-kilometres and ton-kilometres for the period 2019-2040. No other measures were applied in projection of GHG emissions from water borne navigation subsector. GHG emission projections for international navigation were carried out on the assumption that the GHG emissions from navigation sector should be reduced by 40% by 2050 as laid down in the Strategy for National Climate Change Management Policy, adopted on 6 November 2012 by the Parliament Decree No XI-2375.

Road transportation is the most important GHG emissions source in the transport sector. This sector includes all types of vehicles on roads (passenger cars, light duty vehicles, heavy duty trucks, buses, motorcycles, mopeds). GHG emissions from road transport subsector accounted for 5 532 kt CO_2 eq. in 2017.

GHG emissions from Road transport calculation was based on the change of vehicle number (PC, LCV, motorcycles and buses) and the change of tonne-kilometers (cargo vehicles) in Lithuania according to the data of the Ministry of Transport and Communications. Exceptionally, only the trend of compressed natural gas consumption in road transport was linearly extrapolated according to the historic data from 2009 up to 2017. A projected number of cars was entered into a spreadsheet private cars turnover model. An assumption was made that average exploitation period of a car in Lithuania is 20 years. Using a distribution of cars by power source and their kilometrage in base year, a forecast of the breakdown of the passenger car fleet and kilometrage and by power source and by existing and newly bought cars was calculated by the model. The obtained kilometrages were then combined with fuel consumption per kilometer and GHG emission factors to produce projected emissions. Fuel consumption per kilometer was assumed to be 20% lower for newly bought cars. For heavy duty vehicles, base year (2017) emissions were separated into two parts (cargo vehicles and buses) taking into account numbers of these vehicles in base year. GHG emission projections from cargo vehicles were created proportionally to the growth of the projected tonne-kilometers in road transport, and projections from buses were created taking into account projected number of buses. Numbers of different vehicle types are presented in Table 4-8.

Additionally, the support from EU funds to municipal administrations for purchasing low-emission urban public transport vehicles (EU-funded instrument for 2014-2020, which should be continued up to 2030) provided funding for acquisition of environmentally safe busses. It is estimated that introduction of these buses will reduce GHG emissions from road transport sector by 46 t CO_2 eq./year. Total GHG emission reduction by 2030 will amount to 455 t CO_2 eq.

Table 4-9. Estimated numbers of vehicles registered in Lithuania

Vehicle type	BY 2017	2018	2020	2025	2030	2035	2040
Passenger cars	1 344 800	1 384 657	1 467 949	1 622 102	1 672 489	1 647 552	1 622 986
Light duty vehicles	56 243	59 640	61 940	68 086	74 841	82 267	90 429
Heavy duty vehicles	28 958	29 521	28 996	27 804	26 775	25 894	25 149
Motorcycles	42 106	45 297	51 579	67 284	82 989	98 694	114 399

Gasoline traded in the points of sale will have to contain not less than 10% of biofuel from 2020 (it is not obliged to blend biofuel into gasoline of A98 class). Taking into account that bioethanol is

blended by percentage of volume, there is an assumption that when share of bioethanol blended is increased from 5 to 10%, overall amount of bioethanol blended in gasoline by energy value will contain no more than 7 %.

The GHG emissions from natural gas transportation in pipelines sector were estimated according to the projected gross consumption of natural gas obtained from modelling of energy sector.

Scenario "with additional measures" (WAM)

Additionally, according to scenarios in data provided by the Ministry of Transport and Communications of the Republic of Lithuania, it is planned to provide financial incentives for persons who transferred its property rights to a waste handler. The incentive is planned to be flat-rate compensation which could be used to pay for public transport services in electronic ticketing systems or to purchase a used or new passenger car that meets low levels of emission criterion. This additional measure would reduce CO_2 eq. emissions by 48 kilotonnes by the year 2030.

Promoting alternative fuel use in intercity public transport vehicles would decrease the use of diesel oil by 5TJ in 2027 in transport sector. It is estimated that introduction of the buses would reduce GHG emissions from road transport sector by 49 t CO_2 eq./year. Total GHG emission reduction by 2027 will amount to 341 t CO_2 eq.

E-tolling for freight transport is planned to apply differentiated the "user pays" and "polluter pays" principles to freight transport. Since fuel consumption for heavy duty transport does not decrease when Euro standard increases, the effect is seen only on those companies who switch from conventional (non-Euro) vehicles into ones meeting Euro standards. It is estimated that this measure should reduce fuel consumption of heavy duty transport by 2.25 TJ in 2035.

An ambitious additional measure is providing incentives for carriers of intermodal units instead of transporting intermodal units by road to choose combined transport. It is estimated that combined transport should reduce GHG emissions by 319 kt CO_2 eq. by 2030 in road transport, but increase emissions in railways by 90 kt CO_2 eq. in 2030. Increase in railway sector should be lower after 2030 due to the planned electrification of railways. However, due to the incentives to choose combined transport, GHG emissions from railways in WAM scenario are higher than in WEM scenario from year 2021 (the year of the beginning of the implementation of this measure).

Formation and promotion of eco-driving skills impacts more or less drivers in all modes of road transport: cars, freight transport, buses and motorcycles. It is assumed that the largest impact of promotion of eco-driving will be during the first two years of its implementation (2021-2022) and the GHG reduction in road transport should reach 20 kt CO_2 eq. in 2022 (10 kt CO_2 eq/year). Later, the impact is estimated to be 0.3 kt CO_2 eq/year and in 2030 the effect should reach 23 kt CO_2 eq.

Comparing to WEM scenario, WAM has an ambitious objective to reduce actual amount of fuel consumption and to implement fuel-switch measures. A rapid decrease of diesel oil consumption is planned which is sought to be partly changed by natural gas use and electrification.

An existing measure "Electrification of railways" influences an additional measure "Introduction of incentives to use combined freight transport" as the increase of freight transportation in railways does not directly increase GHG emissions in railways (a large share of railways is going to use electricity but not fossil fuel because of the electrification). The measure "Renewal of transport fleet by using green public procurement for transport" is dedicated to implement of objectives provided in the

Directive of European Parliament and Council (EU) 2019/1161, however, the objectives provided in the measure are more ambitious than they are in the mentioned Directive.

A lot of measures together contribute to the increase of the number of electric cars and covers such aspects as pollution taxes for cars, subsidies for their acquisition, development of the infrastructure and social dissemination. An absence of any of these aspects would significantly reduce planned number of electric cars, e. g., there wouldn't be possibilities to subsidize acquisition of electric cars in the absence of pollution taxes, and electric cars would not be attractive if there was a bad infrastructure. These additional measures contribute to the existing measures promoting electric cars: an ability to use specially marked public transport lines in Vilnius and exemptions for car parking and entrance fees in Lithuanian towns. Only measures "Promotion of the use of electric cars and development of their charging infrastructure" and "Reduced VAT tariff for acquisition of new N1 electric cars" are intended to namely increase the number of electric cars – all other measures reduce GHG emissions in other ways, too.

Measures related to pollution taxes of cars (yearly car pollution tax and differentiation of vehicle registration fee by level of pollution) will have the largest effect for GHG emission reduction. If these measures are not implemented, not only the GHG reduction objective will not be reached, but also a lot of other measures will not be implemented, for which funding is required from Sustainable mobility funds. All the funds from purposive pollution taxes should fall into the mentioned fund, and they should be dedicated to promote the use of less polluting transport.

4.1.3. Industrial processes and product use

The emissions from Industrial process and product use sector (IPPU) for WEM and WAM scenarios are presented in the table and figure below.

Table 4-10. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	BY 2017	2020	2025	2030	2035	2040
WEM scenario	3638	3929	3710	3557	3489	3447
WAM scenario	3638	3929	3619	3376	3308	3266

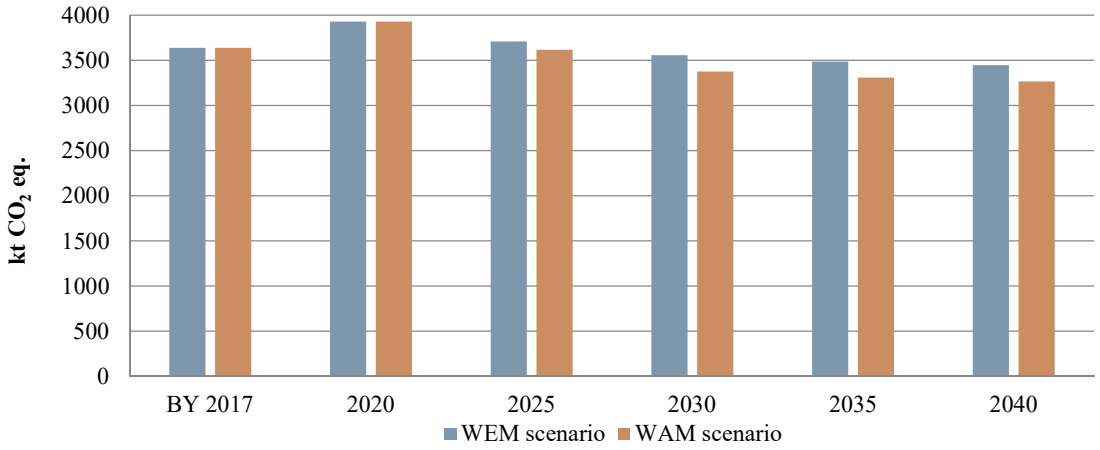

Figure 4-12. Projection of the WEM and WAM scenarios in IPPU sector

Scenario "with existing measures" (WEM)

The GHG emissions in industry sector are determined by technology processes and notable emission reduction per production output is hardly possible. Therefore, it is expected that GHG emissions will grow together with increasing industrial production. Nevertheless, it is expected that restrictions due to Regulation (EU) No 517/2014 have a decreasing effect on emissions from uses of F-gases. Compared to 2017 emissions from IPPU sector will decrease by 2% in 2030 and by 5% in 2040.

Historical and projected GHG emissions are presented in the table and figure below.

Table 4-11. The total emissions in IPPU sector in case of WEM scenario, kt CO_2 eq.

	BY 2017	2020	2025	2030	2035	2040
2.A Mineral Industry	493	900	902	902	903	903
2.B Chemical Industry	2 365	2 391	2 386	2 385	2 384	2 382
2.C Metal Industry	2	3	4	4	5	5
2.D Non-energy products from fuels and solvent use	54	53	53	52	52	51
2.E Electronics Industry	7	7	7	7	7	7
2.F Product uses as substitutes for ozone depleting substances	711	569	353	201	133	92
2.G Other product manufacture and use	6	6	6	6	6	6
2.H Other Production	NO	NO	NO	NO	NO	NO
Total	**3 638**	**3 929**	**3 710**	**3 557**	**3 489**	**3 447**

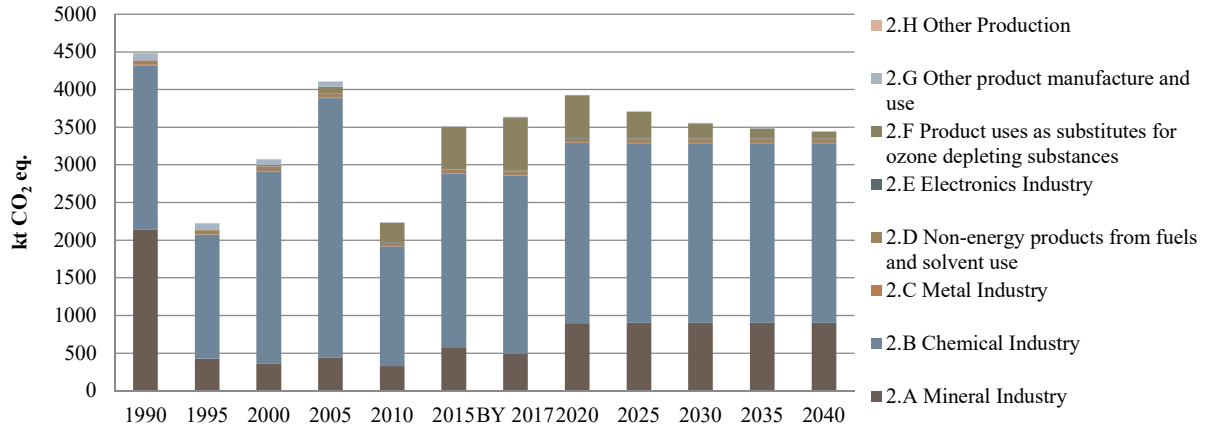

Figure 4-13. Historical and projected GHG emissions in IPPU sector

Mineral industry

The projections of CO_2 emissions from clinker production were based on activity data provided by the company. It is assumed that clinker production will increase in the period 2017-2020. From 2020 clinker production volume will remain stable until 2040. As volume of mineral industry is expected to increase for projected period, the GHG emissions will grow accordingly by approximately 45% compared to the base year (2017) in 2040.

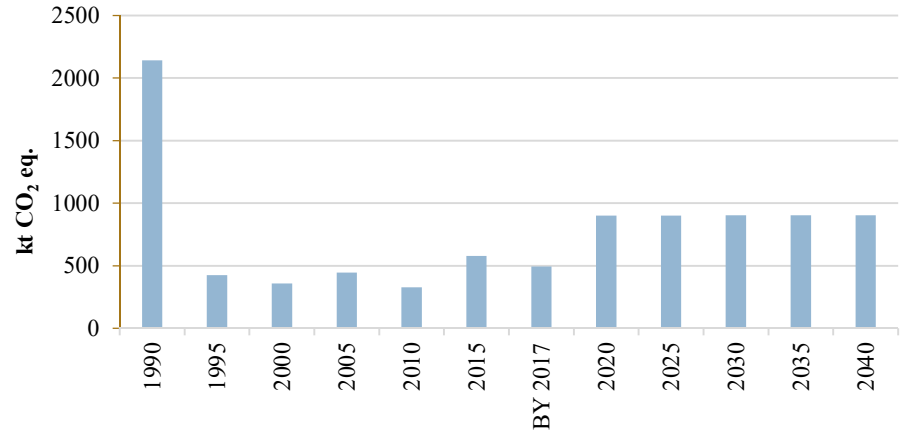

Figure 4-14. Historical and projected GHG emissions from mineral industry

Chemical industry

The main GHG emissions source in IPPU sector remains nitric acid and ammonia production (Figure 4-13, Table 4-10). Based on projected production volume data provided by chemical industry, the GHG emissions will increase by 17 kt CO_2 eq. in 2040 compared with 2017 (Figure 4-15).

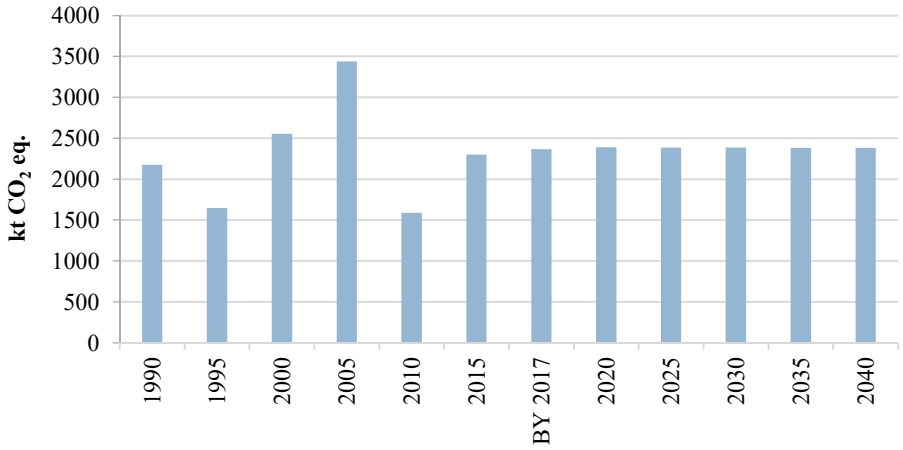

Figure 4-15. Historical and projected GHG emissions from chemical industry

Metal industry

The projections of CO_2 emissions from cast iron production were based on activity data provided by companies. According to market analysis it is assumed that cast iron production will increase and GHG emissions from metal industry (Figure 4-16) will grow together with increasing cast iron production.

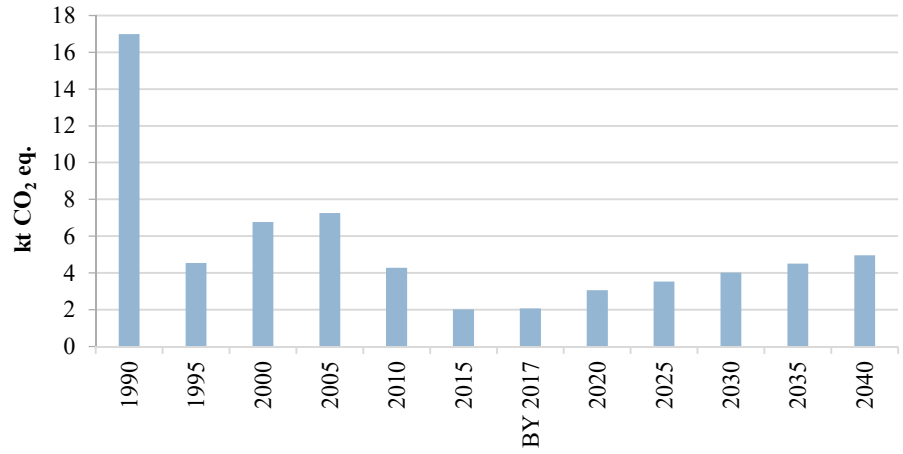

Figure 4-16. Historical and projected GHG emissions from metal industry

Non-energy products from fuels and solvent use

Emissions of non-energy products from fuels and solvent use will decrease mainly due to decreasing trend of population. Comparing with base year 2017 CO_2 emissions from non-energy products from fuels and solvent use category will decrease by 4% in 2040 (Figure 4-17).

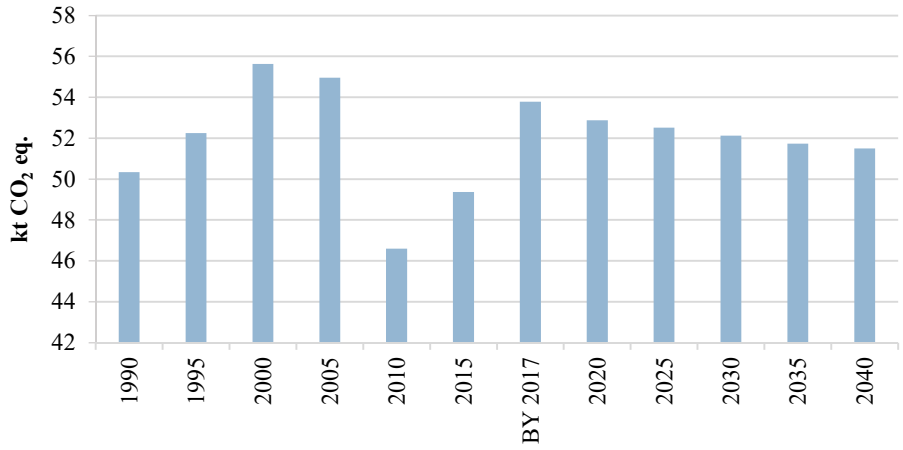

Figure 4-17. Historical and projected GHG emissions of non-energy products from fuels and solvent use

Product uses as substitutes for ozone depleting substances (ODS)

The projections of F-gases emissions for most sub-categories were based on 1990-2017 emissions trend by including relevant technological improvements and taking into account the impacts of the F-gases Regulation (EU) No 517/2014 implementation (introduced restrictions/controls of the use and introduction of quotas for placing on the market of HFCs). Projected emissions from consumption of HFCs in 2017-2040 are presented in the table below.

Table 4-12. Projected emissions from consumption of HFCs in 2017-2040, kt CO_2 eq.

	BY 2017	2020	2025	2030	2035	2040
2.F.1.a Commercial Refrigeration	368	292	172	102	60	35
2.F.1.b Domestic Refrigeration	2	2	2	1	1	1
2.F.1.c Industrial Refrigeration	57	45	28	18	14	12
2.F.1.d Transport Refrigeration	86	74	56	36	17	1
2.F.1.e Mobile AC	138	109	56	9	9	10
2.F.1.f Stationary AC	18	16	13	10	7	7
2.F.2 Foam blowing	32	20	16	15	15	15
2.F.3 Fire extinguishers	3	2	1	1	1	1
2.F.4 Metered Dose inhalers	8	8	9	9	9	9
Total	711	569	353	201	133	92

It should be noted that restrictions due to Regulation (EU) No 517/2014 have a decreasing effect on emissions. Emissions from domestic refrigeration equipment are expected to decline due to EU wide measures and technical changes resulting in decreased leakage. One can be assumed that due to the ban on HFCs in new domestic refrigerators and freezers since 2015 only emissions from existing stocks and disposal will occur. It is expected that emissions from commercial and industrial refrigeration sectors will decline in 2020–2040. The projected decline in 2020 is expected due to the entering into force of the new prohibition on the use of HFCs with GWP of more than 2500. According to Lithuanian GHG inventory data, commercial and industrial refrigeration equipment contains HFC-32, HFC-125, HFC-143a and HFC-134a gases. The GWP of HFC-125 and HFC-143a is higher than 2500, therefore the use of these gases will be prohibited from 2020. Furthermore, refrigerators and freezers for commercial use that contain HFCs (HFC-32, HFC-134a) with GWP of more than 150 will be prohibited to place on the market from 2022. Implementation of F-gases quota system will reduce amount of HFCs placed on the market by 79% between 2015 and 2030 (see Table 4-16). Considering that the lifetime of the equipment/cars and road vehicles is 15-24 years, most of the emissions in 2030-2040 from disposal will occur. Taking into account these assumptions, it is predicted that in 2040 emissions from commercial and industrial refrigeration sectors will account only 11% compared to F-gases emissions in these sectors in 2017. The emissions from mobile air-conditioning will decrease also taking into account implementation of EU MAC Directive, which prohibits the use of F-gases with GWP of more than 150 in new types of cars and vans introduced from 2011, and in all new cars and vans produced from 2017. Emissions from Transport Refrigeration account for up to 12% of the total Lithuanian F-gas emissions in base year of 2017 and are predicted to decrease slightly in the upcoming years due to impact of the HFC phase down which is a key feature of Regulation (EU) No 517/2014. The phase down will reduce the quantity of HFCs that can be sold in the EU. In addition to this, emissions from foam blowing are expected to decrease due to restrictions of Regulation (EU) No 517/2014. Despite this it is assumed that emissions from metered dose inhalers will continue to increase, due to the F-gas regulation does not prohibit the use of HFCs for medical devices and despite declining population, historical data shows that the use of metered dose inhalers is increasing.

Electronics industry

The projected consumption of NF_3 and SF_6 gases were based on activity data provided by companies. It is assumed that emissions after 2020 will remain stable until 2040 (Table 4-12).

Table 4-13. Projected emissions from consumption of NF_3 and SF_6 gases in Electronics industry, kt CO_2 eq.

	BY 2017	2020	2025	2030	2035	2040
2.E.1Semiconductor manufacture	7.1	7.1	7.1	7.1	7.1	7.1
2.E.3 Photovoltaics	0.01	0.12	0.12	0.12	0.12	0.12
Total	**7.1**	**7.2**	**7.2**	**7.2**	**7.2**	**7.2**

Other product manufacture and use

Assumptions on the projected amounts of consumption of the SF_6 gases in electrical equipment and accelerators and N_2O from product uses are based on historical data and projected emissions are presented in the table below.

Table 4-14. Projected SF_6 emissions from Electrical equipment, Other non-specified and N_2O from product uses, kt CO_2 eq.

	BY 2017	2020	2025	2030	2035	2040
2.G.1 Electrical equipment	0.5	0.8	0.8	0.8	0.8	0.8
2.G.2 Other non-specified	0.2	0.2	0.2	0.2	0.2	0.2
2.G.3 N_2O from product uses	5.1	5.0	5.0	5.0	5.0	5.0
Total	**5.8**	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**

Consumption of the SF_6 gases in electrical equipment and accelerators is projected to be equal to 2017 level and emissions during the period 2017–2040 will remain stable, while emissions of N_2O from product uses will gradually decline due to decrease of the population during the projection period.

Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of the Economy and Innovation of the Republic of Lithuania and Ministry of Environment of Republic of Lithuania, the implementation period of measures will cover period of 2021-2030. For the period of 2031-2040 all additional measures will continue to be implemented at the same rate as it is expected in 2030.

The planned policies and measures in industrial sector are focusing on implementation and promotion of technological eco-innovation and modern technologies, support (partial financing) of replacement of pollutant technologies with greener technologies, promoting traditional industrial transformation and reduction of F-gases use in business companies. Financial support for companies acquiring new or replacing existing equipment with equipment using other technological alternatives (refrigerants with lower GWP) will reduce the amount of F-gases used to refill old equipment or to fill the new equipment for the first time and the refrigerants with lower GWP will be used, leading to reduction in GHG emissions.

List of policies and measures and cumulative GHG reduction effect for 2021-2030 is provided in Chapter 3.

Table 4-15. Projected GHG emissions from IPPU sector (kt CO_2 eq.)

	BY 2017	2020	2025	2030	2035	2040
2.A Mineral Industry	493	900	902	902	903	903
2.B Chemical Industry	2365	2391	2325	2263	2262	2261
2.C Metal Industry	2	3	2	1	2	2
2.D Non-energy products from fuels and solvent use	54	53	36	21	20	20
2.E Electronics Industry	7	7	7	7	7	7
2.F Product uses as substitutes for ozone depleting substances	711	569	341	176	108	67

	BY 2017	2020	2025	2030	2035	2040
2.G Other product manufacture and use	6	6	6	6	6	6
2.H Other Production	NO	NO	NO	NO	NO	NO
Total	**3638**	**3929**	**3619**	**3376**	**3308**	**3266**

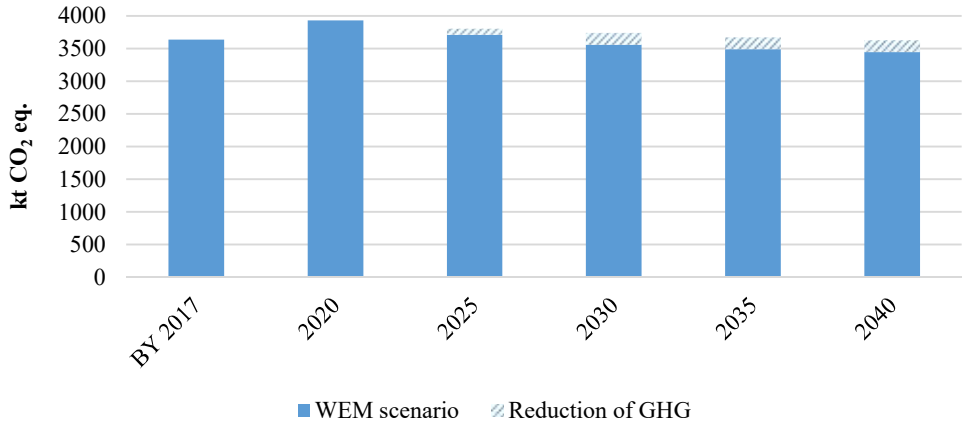

Figure 4-18. Projected emissions of IPPU sector under WAM scenario

Methodology and key assumptions

The GHG emissions projections from IPPU sector with existing policies and measures were estimated using projected production levels data (activity data) by 2040 provided by the main emitters in this sector: clinker, lime, glass, ammonia and nitric acid producing companies. Emissions from these industries covered up about 78% of total IPPU sector emissions in 2017.

Projections of CO_2 emissions arising from ammonia production are calculated using projected natural gas consumption data and applying the 2006 IPCC Guidelines [10] Tier 3 method, which states that CO_2 recovered for downstream use in urea production must be subtracted from the total quantity of CO_2 generated from ammonia production. While EU ETS emissions are estimated according data provided by the companies where CO_2 recovered for downstream use in urea production are not subtracted from the total quantity of CO_2 generated from ammonia production. This differences in methodologies leads to differences in estimated total GHG and EU ETS emissions in chemical industry.

The projections of GHG emissions from other sectors were estimated by applying emission factors taken from Methodological guidance for the preparation of National GHG projections guidelines prepared by Lithuanian Energy Institute in 2016. The emission factors were used are presented in the table below.

Table 4-16. Emission factors in industry sector

Industrial Processes	**CO_2**
Clinker production, t/t	0.537
Lime production, t/t	0.773
Glass production, t/t	0.182
Mineral wool production, t/t	0.157
Lubricant use, t/TJ	0.590

[10] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_3_Ch3_Chemical_Industry.pdf

Industrial Processes	CO_2
Paraffin wax use, t/TJ	0.590
Solvent use, t/thous. inhabitants	0.012

All projected data were available for the 2020, 2025, 2030, 2035 and 2040. The data in between were linearly interpolated. The base year for the GHG IPPU projections is 2017.

Table 4-17. Percentage to calculate the maximum quantity of hydrofluorocarbons to be placed on the market (based on Annex V of Regulation (EU) No 517/2014)

Years	Percentage to calculate the maximum quantity of HFCs to be placed on the market and corresponding quotas
2015	100%
2016–2017	93%
2018–2020	63%
2021–2023	45%
2024–2026	31%
2027–2029	24%
2030	21%

Summary table of assessed emissions from IPPU sector, methods applied and emission factors are provided in the table below.

F-gases emission projections are performed at the same subcategory level as in Lithuanian GHG inventory using 2006 IPCC Guidelines emission factors. The WEM projection scenario for F-gases are generally based on the assumptions from Annexes III and V (Table 4-16) of F-gases Regulation (EU) No 517/2014[11], that creates bans, controls on the use and emissions of F-gases and EU MAC Directive[12], which prohibits the use of F-gases with GWP of more than 150 in new types of cars and vans introduced from 2011, and in all new cars and vans produced from 2017.

Table 4-18. Methods and emissions factors used to estimate emission from IPPU sector

CRF	Source	Emissions reported	Methods	Emission factor
2.A	Mineral Industry	CO_2	Tier 1, Tier 2	PS, D, CS
2.B	Chemical Industry	CO_2, N_2O, CH_4	Tier 1, Tier 3	PS, D, CS
2.C	Metal Industry	CO_2	Tier 2	D
2.D	Non-energy products from fuels and solvent use	CO_2	Tier 1, Tier 2	D, CR
2.E	Electronics Industry	SF_6, NF_3	Tier 2, Tier 3	PS
2.F	Product uses as substitutes for ozone depleting substances	HFCs	Tier 1a, Tier 1b, Tier 2	D, CS
2.G	Other product manufacture and use	SF_6, N_2O	Tier 1, Tier 3	D, CS, OTH
2.H	Other Production	CO_2	Tier 1	D

[11] Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006

[12] Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC

Mineral Industry

The projections of CO_2 emissions from mineral industry were based on activity data provided by the companies (Table 4-18). Mineral industry's projected emissions are based on industrial companies' projections and taking into account planned maximal production capacities and implemented best available technologies according companies' environmental permits.

Table 4-19. Base year and projected volume of mineral industry, kt

	BY 2017	2020	2025	2030	2035	2040
Clinker production	839	1 500	1 500	1 500	1 500	1 500
Lime production	27	80	80	80	80	80
Glass production	41	87	93	93	95	95
Mineral wool production	87	82	85	88	90	91

A significant share of GHG emissions in mineral industry sector belongs to the CO_2 emissions from cement production. It is assumed that clinker production will increase in the period 2017-2020. From 2020 clinker production volume will remain stable until 2040.

The projections of CO_2 emissions from lime production were based on activity data provided by the only lime production company. It is projected that lime production during the 2017-2020 period will increase about 3 times and will remain at the same level until 2040.

The projections of CO_2 emissions from glass production were based on activity data provided by glass companies. It is projected that glass production will increase significantly (2 times) during the period 2017-2020 and after 2025 will stabilize at approx. 94 kt.

The projections of CO_2 emissions from mineral wool production were based on activity data provided by one company's authorities and it is projected that mineral wool production will be increasing gradually during the projected period.

Chemical Industry

The main GHG emissions source in IPPU sector remains nitric acid and ammonia production. Based on data from company the GHG emissions trends will remain stable in a period of 2020-2040 due to constant production capacity, while fuel consumption will decrease slightly in a period of 2020-2040 (Table 4-19).

Table 4-20. Base year and planned ammonia and nitric acid production, natural gas consumption volume

	BY 2017	2020	2025	2030	2035	2040
Ammonia production, kt	1 126	1 146	1 146	1 146	1 146	1 146
Natural gas consumption, thous. m^3	1 222 693	1 206 254	1 203 518	1 202 917	1 202 315	1 201 714
Nitric acid production, kt	1 251	1 319	1 319	1 319	1 319	1 319

Metal industry

The projections of CO_2 emissions from cast iron production were based on activity data provided by two companies (Table 4-20). According to market analysis it is assumed that cast iron production will increase 2.4 times in 2040 compared to 2017.

Table 4-21. Base year and planned volume of metal industry, kt

	BY 2017	2020	2025	2030	2035	2040
Cast iron	2.4	3.6	4.2	4.7	5.3	5.8

Non-energy products from fuels and solvent use

No projections on lubricant oil and paraffin waxes consumption were made, therefore, GHG emissions from consumption of lubricant oil and paraffin waxes for non-energy purposes were calculated based on the constant value at the level of 2017 (Table 4-21).

Projections of solvent use are based on the population trends up to the year 2040, which were obtained from the Comprehensive Plan of the Territory of the Republic of Lithuania[13]. Emissions from Solvent use sector are projected to decrease a little due to projection of population show a decreasing trend. Projected parameters of non-energy products from fuels and solvent use presented in the table below.

Table 4-22. Base year and projected parameters of non-energy products from fuels and solvent use, kt

	BY 2017	2020	2025	2030	2035	2040
Lubricant use	22	22	22	22	22	22
Paraffin wax use	6	6	6	6	6	6
Population in Lithuania, thous.	2 863	2 789	2 759	2 727	2 695	2 676

Product uses as substitutes for ozone depleting substances (ODS)

Emissions from 2.F.1 category (HFCs) were calculated applying the 2006 IPCC Guidelines Tier 1a, Tier 1b and Tier 2 methods using default and country specific emission factors. The assumptions used for HFC emission projections are as follows:

- Commercial Refrigeration (2.F.1.a): a ban on the use of HFCs with GWP of more than 2500 in new commercial equipment since 2020 and with GWP of more than 150 since 2022. The average lifetime of equipment - 15 years.
- Domestic Refrigeration (2.F.1.b): HFCs with GWP of more than 150 in domestic refrigeration were phased out since 2015 and only emissions from stock (old equipment) and disposal will occur. The average lifetime of the refrigerator and freezers is 20 years.
- Mobile AC (2.F.1.e): a ban on the use of F-gases with GWP of more than 150 in new types of cars and vans produced from 2017. It is assumed, that the average lifetime of cars and vans is 17-24 years (depending on vehicle category).
- Transport Refrigeration (2.F.1.d): it is assumed, that 5% per year refrigeration systems of newly registered road vehicles are filled using refrigerants with the lowest GWP (150 and less). The average lifetime of road vehicles is 16-19 years (depending on vehicle category).
- Stationary AC (2.F.1.f): a ban on the use of HFCs with GWP of more than 2500 in new stationary equipment since 2020.
- Foam blowing (2.F.2) and Fire extinguishers (2.F.3): projected emissions were based on existing measures (Regulation (EU) 517/2014 Annex V) and extrapolated until 2040. Regression analysis of historical data and GDP was performed. In this context, the forecast for 2040 was set.
- Metered Dose inhalers (2.F.4): it is assumed that HFCs emissions from metered dose inhalers will continue to increase, due to the F-gas regulation does not prohibit the use of HFCs for medical devices. Regression analysis of historical data and population dependency was performed. In this context, the forecast for 2040 was set.

[13] http://www.bendrasisplanas.lt/2019/06/03/en/

Electronics industry

Emissions from 2.E.1 subcategory were calculated applying the 2006 IPCC Guidelines Tier 3 method using plant specific emission factors. Projected consumption of the SF_6 gases were based on activity data provided by semiconductor manufacturing company in Lithuania for 2017 and it is assumed that consumption of SF_6 gases will remain stable until 2040 as the company's maximum production/use capacity will remain unchanged (Table 4-22).

Emissions from 2.E.3 subcategory are calculated applying the 2006 IPCC Guidelines Tier 2 method using plant specific emission factors. The projected consumption of NF_3 gases were based on activity data provided by the company, which is an established European manufacturer and distributor of PV cells and modules in Lithuania. It is assumed that consumption of NF_3 gases after 2020 will remain stable until 2040 as the company's maximum production/use capacity will remain unchanged (Table 4-23).

Table 4-23. Projected amount of NF_3 and SF_6 gases consumption of electronics industry, t

Planned use of gases	2017 BY	2020	2025	2030	2035	2040
SF_6	0.624	0.624	0.624	0.624	0.624	0.624
NF_3	0.068	0.680	0.680	0.680	0.680	0.680

Other product manufacture and use

Emissions from 2.G.1 and 2.G.2 subcategories are calculated applying the 2006 IPCC Guidelines Tier 3 method using country specific emission factors. Consumption of the SF_6 gases in electrical equipment and accelerators is projected based on historical data and projected amount of SF_6 gases consumption are presented in the table below (Table 4-24).

Table 4-24. Projected amount of SF_6 gases consumption of electrical equipment and other product manufacture and use, t

Planned use of gases	2017 BY	2020	2025	2030	2035	2040
SF_6	0.027	0.040	0.040	0.040	0.040	0.040

Other

Activity data (limestone use) was supplied by power plant. The company has reported that limestone had not used since 2017, so emissions will not occur after 2017 (Table 4-10).

4.1.4. Agriculture

The emissions from agriculture sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-25. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2020	2025	2030	2035	2040
WEM scenario	4 399	4 364	4 304	4 346	4 379
WAM scenario	4 399	4 126	3 756	3 718	3 681

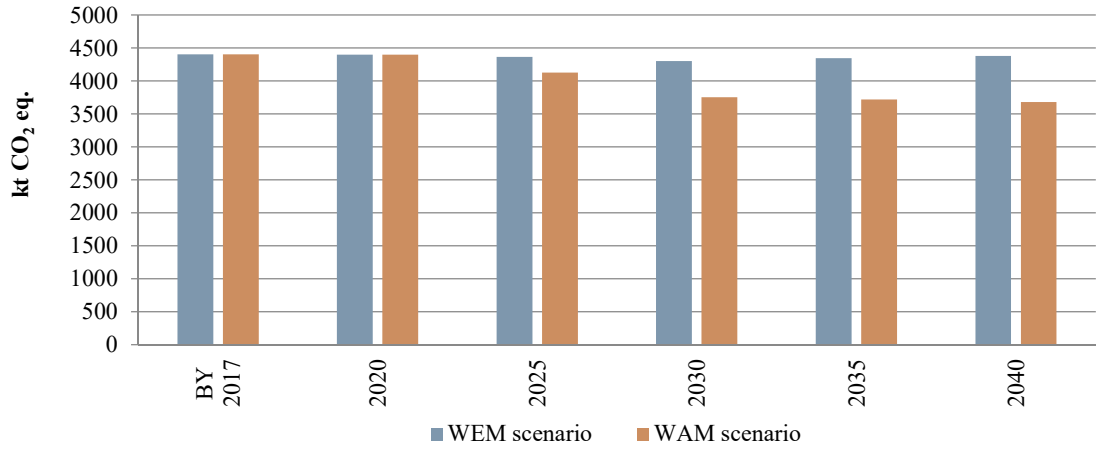

Figure 4-19. Projection of the WEM and WAM scenarios in agriculture sector

Scenario "with existing measures" (WEM)

GHG emissions projections for agriculture sector are provided for five subsectors: enteric fermentation, manure management, agricultural soils and CO_2 emissions from liming and urea. Table below presents aggregated GHG emissions from agriculture sector. The largest source of GHG emissions is agricultural soils, particularly direct soils emissions. The share of GHG emissions will not change a lot during projected period, agricultural soils subsector will remain the largest source of emissions in agriculture sector. Compared to 2017 emissions from agriculture sector will decrease by 2% in 2030 and by 1% in 2040.

Table 4-26. Projected total GHG emissions from agriculture sector, kt CO_2 eq.

Agriculture sector categories	BY 2017	2020	2025	2030	2035	2040
Enteric fermentation	1 542	1 528	1 464	1 385	1 392	1 393
Manure management	423	421	434	440	456	470
Agriculture soils	2 407	2 415	2 432	2 444	2 463	2 481
Urea application	18	19	19	19	19	19
Liming	12	16	16	16	16	16
Total GHG emissions	4 443	4 399	4 364	4 304	4 346	4 379

The figure bellow represents GHG emissions trend during the historical and projected period.

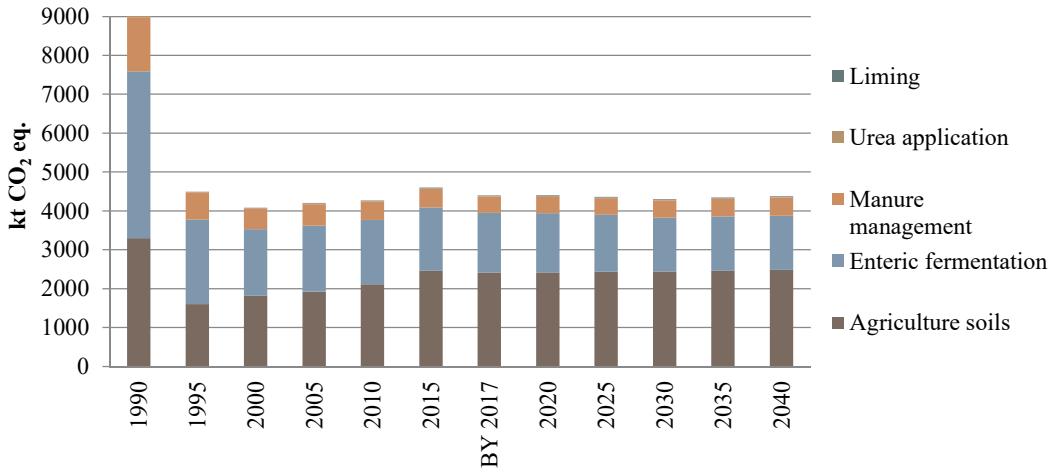

Figure 4-20. Historical and projected GHG emissions from agriculture sector by categories

Enteric fermentation

Projected emissions from enteric fermentation for each livestock category are provided in the table below.

Table 4-27. Projected CH_4 emission from enteric fermentation, kt CO_2 eq.

Livestock categories	BY 2017	2020	2025	2030	2035	2040
Dairy cattle	861	842	763	670	666	655
Non-dairy cattle	599	594	586	578	571	564
Swine	21	18	22	26	28	30
Sheep	46	59	76	94	111	127
Goats	2	2	2	2	2	2
Horses	7	7	7	6	6	5
Fur-bearing animals	6	7	7	8	9	10
Total	1542	1529	1464	1385	1392	1393

CH_4 emissions from enteric fermentation mainly depend on livestock population. As it can be seen from the table above it is projected that emissions from enteric fermentation will be decreasing during projected period compared to the 2017.

In the 2017 the majority of these emissions comprised from dairy and non-dairy cattle enteric fermentation – 95%. During the projected period the share of emissions from livestock categories will not change a lot, therefore dairy and non-dairy cattle categories will remain main source of CH_4 emissions from enteric fermentation. It is projected that emissions from enteric fermentation will decrease by 10% in 2040 compared with 2017.

Manure management

CH_4 emission from manure management

CH_4 is produced from the decomposition of organic matter remaining in the manure under anaerobic decomposition. The amount of CH_4 produced from manure depends on: manure characteristics linked to animal type and diets, the amount of feed consumed, the digestibility of the feed, the type of manure management system and the climate conditions during the storage.

Table 4-28. Projected CH_4 emission from manure management, kt CO_2 eq.

Livestock categories	By 2017	2020	2025	2030	2035	2040
Dairy cattle	69	70	68	65	70	74
Non-dairy cattle	69	66	65	64	63	62
Swine	62	52	60	66	64	62
Sheep	2	2	3	4	5	5
Goats	0	0	0	0	0	0
Horses	1	1	1	1	1	1
Poultry	8	7	7	7	7	8
Fur-bearing animals	25	33	37	41	46	52
Total	235	230	240	247	255	262

According to 2017 data the highest CH_4 emissions from manure management occur among dairy and non-dairy cattle, swine and fur-bearing animal's categories and constitute 96% of total manure management CH_4 emissions. However, it is projected that the share of CH_4 emissions from manure management from fur-bearing animals will be increasing due to rapidly growing populations, especially minks and rabbits. It is projected that CH_4 emission from manure management from fur-bearing animals will increase 2 times in 2040 compared to 2017. It is projected that overall CH_4 emissions from manure management will increase by 11% in 2040 compared to 2017.

Direct and indirect N_2O from manure management

N_2O emissions from manure management systems include both direct and indirect emissions (provided in the tables below). Direct N_2O emission occurs through nitrification and denitrification of nitrogen contained in the manure. Indirect N_2O emissions occur from volatile nitrogen losses that occur primarily in the forms of ammonia and NO_x.

According to 2017 data the highest N_2O emissions from manure management occur among dairy cattle, non-dairy cattle and fur-bearing animals and constitute 92% of total N_2O emissions from manure management.

Table 4-29. Projected direct N_2O emission from manure management, kt CO_2 eq.

Manure management system	BY 2017	2020	2025	2030	2035	2040
Liquid system	25	25	25	24	26	28
Solid storage system	60	62	61	59	59	59
Other systems*	12	12	12	12	13	13
Total	97	99	98	95	98	100

*Other systems include – deep bedding, with/without litter, etc.

Table 4-30 Projected indirect N_2O emission from manure management, kt CO_2 eq.

Manure management system	BY 2017	2020	2025	2030	2035	2040
Liquid system	35	35	39	42	45	50
Solid storage system	35	35	34	32	32	32
Other systems	15	15	15	16	16	16
Total	85	86	88	89	93	97

It is expected a slight increase of direct and indirect N_2O emissions from manure management during projected period. Direct N_2O emissions from manure management will increase by 3% in 2040 compared to 2017, indirect N_2O emissions will increase by 18% during the same period.

Agricultural soils

Agricultural soils category includes direct and indirect N_2O emissions. It is assumed that in a long-term period there will be no significant changes in this category and the highest N_2O emissions from agricultural soils as it is already, will occur from direct N_2O emissions. It is assumed that consumption of inorganic N fertilizers will remain the highest emission source in this category.

Table 4-31. Projected total direct and indirect N_2O emissions from agricultural soils, kt CO_2 eq.

Agricultural soils subcategories	BY 2017	2020	2025	2030	2035	2040
Direct N_2O emissions from agricultural soils						
Inorganic N fertilizers	783	802	803	803	807	811
Organic N fertilizers	149	153	157	158	165	171
Urine and dung from grazing	173	172	163	152	154	156
Crop residue	369	367	385	404	405	406
Mineralized N from loss of C stocks	NO	NO	NO	NO	NO	NO
Cultivation of organic soils	520	499	499	499	499	499
Total direct N_2O emissions	1 993	1 994	2 007	2 016	2 030	2 044
Indirect N_2O emissions from agricultural soils						
Atmospheric deposition	102	104	103	103	104	106
Leaching and runoff	313	318	322	326	329	332
Total indirect N_2O emissions	415	422	425	428	433	437

N_2O emissions from organic N fertilizers included animal manure applied to soils, sewage sludge and compost used as soil amendments. Animal manure applied to soils and urine and dung from grazing animals were calculated based on the calculations performed in manure management category. In 2017 organic C in mineral soils was accumulated and emissions were not occurring from this subcategory, therefore it was assumed that during the projected period organic C in mineral soils will continue to accumulate. According to the MoA, area of grasslands during the projected period should increase, therefore area of cropland should be decreasing, thus emissions from cultivation of histosols subcategory were estimated based on this assumption. It is expected that direct N_2O emissions from agricultural soils will increase by 3% in 2040 compared to 2017. Indirect N_2O emissions from agricultural soils during the same period will increase by 6%.

CO_2 emissions from liming and urea application

It is projected that emission from liming application will be slightly increasing during the projected period. It is expected that CO_2 emissions will increase by 33% in 2040 compared to the 2017.

Table 4-32. Projected CO_2 emissions from liming application, kt

Liming application	BY 2017	2020	2025	2030	2035	2040
CO_2 emissions from liming	12	16	16	16	16	16
CO_2 emissions from urea application	18	19	19	19	19	19

It is projected that emissions from urea application will increase slightly during the projected period. CO_2 emissions will increase by 2% in 2040 compared to 2017.

Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the MoA, the implementation period of measures will cover period of 2021-2030. For the period of 2031-2040 all additional measures will continue to be implemented at the same rate as it is expected in 2030. Most of these measures focuses on more sustainable use of inorganic N fertilizers, also application of environmentally friendly technologies.

The main focus in the agriculture sector is on the more effective and precise use of inorganic N fertilizers and the education of farmers. Also, the growth of the agriculture sector is based on technologies that are territorially and environmentally balanced, climate-friendly, resilient, competitive and innovative. Sustainable farming, keeping organic farming areas, rational use of inorganic N fertilizers, and their replacement with organic N fertilizers, promoting use of biogas plants are the most important measures in reducing GHG emissions[14].

List of policies and measures and cumulative GHG reduction effect for 2021-2030 is provided in Chapter 3.

Table 4-33. Projected GHG emissions from agriculture sector (kt CO_2 eq.)

	BY 2017	2020	2025	2030	2035	2040
Enteric fermentation	1 542	1 528	1 450	1 357	1 364	1 364
Manure management	423	421	388	353	349	346
Agricultural soils	2 407	2 415	2 253	2 011	1 970	1 935
Urea application	18	19	19	19	19	19
Liming	12	16	16	16	16	16
Total GHG emissions	4 403	4 399	4 126	3 756	3 718	3 681

14 https://epilietis.lrv.lt/uploads/epilietis/documents/files/NECP_draft_version_20181214.pdf

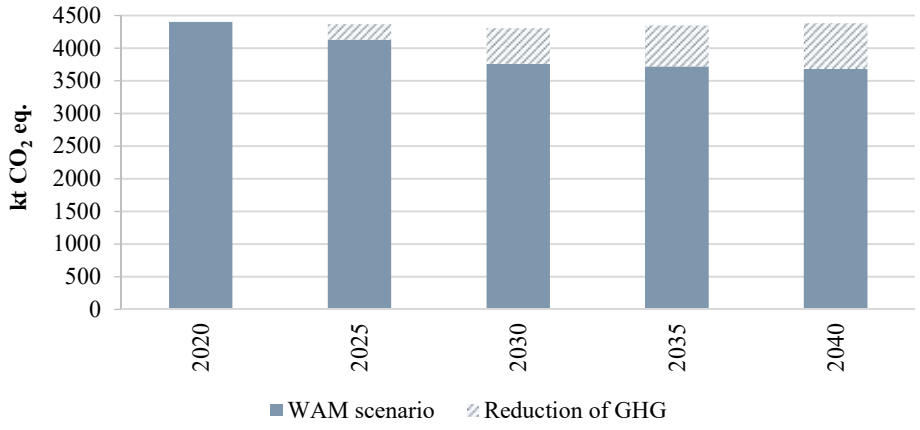

Figure 4-21. Projected emissions of agriculture sector under WAM scenario

Methodology and key assumptions

Projections of GHG emissions from agriculture sector with existing (WEM) measures is based on forecasted livestock population, milk production, milk fat, and the share of manure management systems for the main livestock categories (dairy cattle, non-dairy cattle and swine). GHG projections of agricultural soils category are based on forecasted consumption of inorganic and organic N fertilizers, main harvested crops and area harvested, application of urea and consumption of liming materials (limestone and dolomite) used for soils. Forecast of the data mentioned above are provided by the Ministry of Agriculture (MoA)[15]. Scenario with additional measures (WAM) is based on additional measures provided by the MoA.

All projected data were available for the years of 2020, 2030 and 2040. The data in between were linearly interpolated. The base year for the GHG agriculture projections is 2017.

Summary table of assessed emissions from agriculture sector, methods applied and emission factors are provided in the table below.

Table 4-34. Methods and emissions factors used to estimate emission from agriculture sector

CRF	Source	Emissions reported	Methods	Emission factor
3.A	Enteric fermentation	CH_4	T1, T2	CS, D
3.B	Manure management	CH_4, N_2O	T1, T2	CS, D
3.D	Agricultural soils	N_2O	T1	D
3.G	Liming application	CO_2	T1	D
3.H	Urea application	CO_2	T1	D

To project CH_4 emissions from enteric fermentation emission factors of 2017 were used, except for dairy cattle. CH_4 emissions from manure management for dairy cattle, non-dairy cattle, swine emission factors were calculated using projected activity data. For other livestock categories (sheep, goats, horses, poultry, fur-bearing animals) emissions factors of 2017 were used.

Livestock populations

The most important projection parameter in agriculture sector is livestock populations. The values of livestock population are presented in the table below.

[15] The Ministry of Agriculture of the Republic of Lithuania. Available: *http://www.zum.lt/index.php?842077961*

Table 4-35. Projected number of livestock population in Lithuania, thous. heads

Livestock categories	BY 2017	2020	2025	2030	2035	2040
Dairy cattle	279	268	232	195	188	180
Non-dairy cattle	425	421	416	410	405	400
Swine	638	550	675	800	850	900
Sheep	179	230	300	370	435	500
Goats	14	14	15	15	15	15
Horses	16	16	15	14	13	12
Fur-bearing animals*	1 590	2 039	2 294	2 549	2 854	3 159
Poultry	11 137	11 168	11 578	11 988	12 293	12 598

*Fur-bearing animals include rabbits, minks, nutrias and foxes populations

It is projected that dairy cattle population will decrease by 36% from 279 thous. heads in 2017 to 180 thous. heads in 2040. The projection of dairy cattle population depends on the milk purchase price, it is expected that during the projected period the policy of milk purchase prices will remain as it is now.

Population of non-dairy cattle will decrease by 6% from 425 thous. heads in 2017 to 400 thous. heads in 2040. The projection is based on growing population of beef cattle, it is also assumed that the subsidies will not be abolished. It is projected that price of beef and veal will be increasing until 2020. This kind of convergence is foreseen due to beef cattle increase in the structure of cattle population what improves the quality of meat[16].

It is projected that population of swine will be increasing from 2020 during the whole period. Swine population from the 2017 until 2040 will increase by 41%. It is assumed that around 80% of swine population are grown under industrial pork production therefore it is expected that African swine fever (ASF) will be overcome.

It is projected that sheep population will increase around 3 times from 179 thous. heads in 2017 to 500 thous. heads in 2040. The projection of sheep population is based on the historical data.

It is projected that goat's population will increase 8% from 13.9 thous. heads in 2017 to 15 thous. heads in 2040. The projection is based on the historical data of last decade. Horse population will decrease by 23% from 16 thous. heads in 2017 to 12 thous. heads in 2040. However, goats and horses constitute very small proportion in total livestock populations as it could be seen in table above. It is expected that the subcategories of horses for sport and entertainment will increase, however this would not compensate for the overall decline.

It is projected that fur-bearing animals (nutria, rabbits, minks, foxes) population will increase 2 times from 1,590 thous. heads in 2017 to 3 159 thous. heads in 2040. It is expected that demand for healthier diet products will increase, therefore rabbits' population will increase by 20% in 2040 compared to 2017. Nutria, minks and foxes' population projections are based on historical data.

It is projected that overall poultry population will increase by 13% in 2040 compared to 2017. It is expected that broiler population will increase by 14% in 2040 compared to 2017, this is related to export of high quality (broiler chicken breast) poultry due to modern farming and poultry processing technologies,[17] also increase in consumption per capita. Layer hen's population will increase by 11%

[16] Melnikienė, R. 2011. *The concept of the Republic of Lithuania on long-term livestock development strategy up to 2020*. Vilnius: Lithuanian Institute of Agrarian Economics. Available from: *http://www.laei.lt/index.php?mt=aktualijos&naujiena=149*

[17] Melnikienė, R. 2011. *The concept of the Republic of Lithuania on long-term livestock development strategy up to 2020*. Vilnius: Lithuanian Institute of Agrarian Economics. Available from: *http://www.laei.lt/index.php?mt=aktualijos&naujiena=149*

assuming that the situation in the domestic market will remain without major changes. It is expected that turkey's population will increase by 15% in 2040 compared to 2017 due to high price difference between chicken and turkeys in the domestic market. It is projected that ducks and geese's will decrease respectively by 6% and 9% in 2040 compared to 2017.

Other livestock activity data projections

Other important livestock data are milk production and manure management systems. The MoA has provided projections of distribution of manure management systems for the most important livestock categories.

Table 4-36. Projected values of livestock production

Livestock production	BY 2017	2020	2025	2030	2035	2040
Milk production, kg/yr	5 601	5 800	6 450	7 100	7 800	8 500
Milk fat content, %	4	4	4	4	4	4

It is projected that milk production will increase by 52% in 2040 compared with 2017. Milk fat will remain constant during projected period comparing with the 2017.

Table 4-37. Projected values of distribution of manure management systems, %

Manure management systems	BY 2017	2020	2025	2030	2035	2040
Dairy cattle						
Solid storage	37.5	36.0	35.0	34.0	32.5	31.0
Liquid	22.5	24.0	27.5	31.0	35.0	39.0
Pasture	40.0	40.0	37.5	35.0	32.5	30.0
Non-dairy cattle						
Solid storage	36.8	38.0	38.3	38.5	38.8	39.0
Liquid	21.5	20.5	19.4	18.3	17.2	16.0
Deep bedding	10.3	10.0	10.5	10.9	11.5	12.0
Pasture	31.3	31.5	31.9	32.3	32.7	33.0
Swine						
Solid storage	9.8	9.3	8.2	7.0	6.0	5.0
Liquid	62.0	61.6	57.3	53.0	49.0	45.0
Deep bedding	1.9	1.7	1.4	1.0	0.5	0.0
Anaerobic digesters	26.4	27.4	33.2	39.0	44.5	50.0

For dairy cattle it is expected that solid manure management system will decrease by 7%, as liquid manure management system will increase by 17% in 2040 compared to 2017. As the number of small farms are decreasing it is expected that fewer dairy cattle will be grazed on pastures therefore the period that animals will be grazed is projected to decrease by 10% in 2040 compared to 2017.

For non-dairy cattle it is projected that solid and deep bedding manure management system will increase by 2% in 2040 compared to 2017. Liquid system will decrease by 6% in 2040 compared to 2017. It is expected that grazing period will increase by 2% in 2040 compared to 2017.

For swine category it is projected that compared to 2017 solid and deep bedding manure management systems will gradually decrease by 5% and 2% in 2040, respectively. As anaerobic digesters are promoted it is expected that this manure management system will increase by 24% in 2040 compared to 2017. As the share of manure which is handled in anaerobic digesters will increase, manure that are handled in liquid manure management system will decrease by 17% in 2040 compared to 2017.

Crops residue projections

The projections of area harvested and harvested crops are based on historical data, situation of global market and development of agro-biotechnology. The projections of main activity data are presented in the table below.

Table 4-38. Projected amount of crops harvested and area harvested

Activity data	BY 2017	2020	2025	2030	2035	2040
Harvested crops (thous. tons)						
Winter wheat	3 245	3 175	3 375	3 575	3 575	3 575
Spring wheat	672	675	749	823	796	770
Triticale	247	248	284	320	340	360
Barley	519	594	612	629	611	592
Rye	63	38	34	30	28	25
Oats	196	261	287	312	319	325
Rape	544	534	573	612	627	642
Peas	449	300	325	350	368	385
Beans	230	188	188	189	189	189
Sugar beet	957	935	1 018	1 100	1 100	1 100
Buckwheat	53	60	72	84.0	84.0	84.0
Potatoes	237	225	187	150	150	150
Vegetable	195	96	100	104	104	104
Area harvested (thous. ha)						
Winter wheat	621	635	643	650	650	650
Spring wheat	191	250	243	235	228	220
Triticale	76	75	78	80	85	90
Barley	142	180	175	170	165	160
Rye	26	19	16	12	11	10
Oats	76	101	108	116	118	121
Rape	181	220	220	220	225	230
Peas	154	100	100	100	105	110
Beans	67	75	73	70	70	70
Sugar beet	17	17	19	20	20	20
Buckwheat	49	60	65	70	70	70
Potatoes	19	15	13	10	10	10
Vegetable	12	13	13	13	13	13

In general, it is projected that crop yield will be increasing by reducing crops cultivation in less fertile areas and implementing intensive growth technologies in specialized more efficient (fertile) soil farms. Crop yield will be also increasing due to concentration of farms in the lands of middle Lithuania, the rise of farming culture, implementation of new technologies and best practice of the EU[18].

According to projections provided by the MoA harvest of cereals (winter wheat, triticale, barley, rye, sugar beet and oats) crops will increase. Wheat, barley and sugar beet will remain the main grown crops in the country. Increase in wheat yield from 2017 is related to projected increase in livestock population, wheat demand for ethanol production and also for the possibility to export it into the EU. One of the most susceptible segments of the barley consumption structure in the internal market is livestock. The major share of the barley domestic consumption fund is consumed for livestock feed (more than 65%), the rest – in industry (beer production). It is projected that in 2020 barley consumption for feed will constitute 57% and malting barley share will increase almost double and will reach 35% of the share. Though growth of barley in Lithuania is more profitable rather than rye as growth of barley is more efficient and purchase price is higher. Increase in rape yield is closely related to biofuel (biodiesel) production. It is projected that there will be a smaller share of imported rape for biofuel production as increased demand of rape will be satisfied by local market. It is projected that harvest of legumes crops (peas and beans) will decrease by 6% in 2040. Consumption

[18] Kriščiūnaitė, I., Andrikienė, S., Galnaitytė, A., Jedik, A. 2010. *The outlook of the agriculture sector development*. Scientific study. Vilnius: Lithuania Institute of Agrarian Economics. Available from: http://www.laei.lt/?mt=leidiniai&straipsnis=292&metai=2010

of fresh potatoes is decreasing all over the world, however, demand for processed potatoes products for fast food and snacks are increasing. The same situation is currently observed in Lithuania. Forecasting potatoes yield the relatively low use of certified potatoes seeds and prevalence of diseases. It is projected that harvest of potatoes will decrease by 57% in 2040 compared to the 2017[19,20]. It is expected that the harvested area of triticale, ray, barley, sugar beet, spring rape and potatoes will decrease over projected period due to adverse trade conditions and structure of agriculture production.

Inorganic and organic N fertilizer projections

Projections of inorganic and organic N fertilizers consumption were based on the projected harvest area and yield of crops.

The projections of activity data are presented in the table below.

Table 4-39. Projected amount of inorganic and organic N fertilizers consumption, kt N

Activity data	BY 2017	2020	2025	2030	2035	2040
Inorganic N fertilizers	167	171	171	171	172	173
Urea application	12	12	12	12	12	12
Animal manure	30	31	32	32	34	35
Compost	0.085	0.086	0.086	0.086	0.086	0.087
Sewage sludge	1.372	1.387	1.388	1.388	1.396	1.403

As provided in the table above consumption of inorganic N fertilizers will be increasing during the projected period. It is expected that consumption of inorganic N fertilizers will increase by 4% in 2040 compared to 2017. The increase of inorganic N fertilizers consumption is strongly related with increase in crop yield. As consumption of total inorganic N fertilizer will be increasing, likewise urea application also will slightly increase.

The use of organic N fertilizers will increase by 15% in 2040 compared to 2017. The major increase will be in animal manure applied to soils compared to compost and sewage sludge. It is expected that animal manure applied for soils will increase by 16% in 2040 compared to 2017.

Liming materials projections

Projections of liming materials were based on the changes of crops area. Projected activity data are provided in the table below.

Table 4-40. Projected amount of limestone and dolomite consumption, tones

Activity data	BY 2017	2020	2025	2030	2035	2040
Limestone	30 656	30 992	31 005	31 018	31 178	31 338
Dolomite	4 970	5 128	5 130	5 132	5 159	5 185

It is projected that consumption of limestone and dolomite will increase during the projected period. Consumption of both limestone and dolomite will increase, respectively by 2% and 4% in 2040 compared to 2017.

[19] *Ibid.*

[20] Baležentis, T., Kriščiukaitienė, I. 2016. *Production and Price Risk in Lithuanian Crop Farming*. Scientific Study. Vilnius: Lithuanian Institute of Agrarian Economics. Available from: *http://www.laei.lt/?mt=aktualijos&naujiena=405*

About three decades (1964-1994) soils has been consistently limed (every 5-7 years), but since 1997 soils liming has decreased sharply and as a result, currently about 66% of soil is acidic[21].

4.1.5. LULUCF

Projected GHG removals and emissions from LULUCF sector, according to scenario with existing measures (WEM) and scenario with additional measures (WAM) are presented in the Table and Figure below.

Table 4-41. Projected total GHG removals from LULUCF sector under WEM and WAM scenarios, kt CO_2 eqv.

LULUCF categories	2020	2025	2030	2035	2040
WEM scenario	-4 663	-3877	-3 329	-3 042	-2 772
WAM scenario	-4 663	-4114	-3 936	-4 003	-4 385

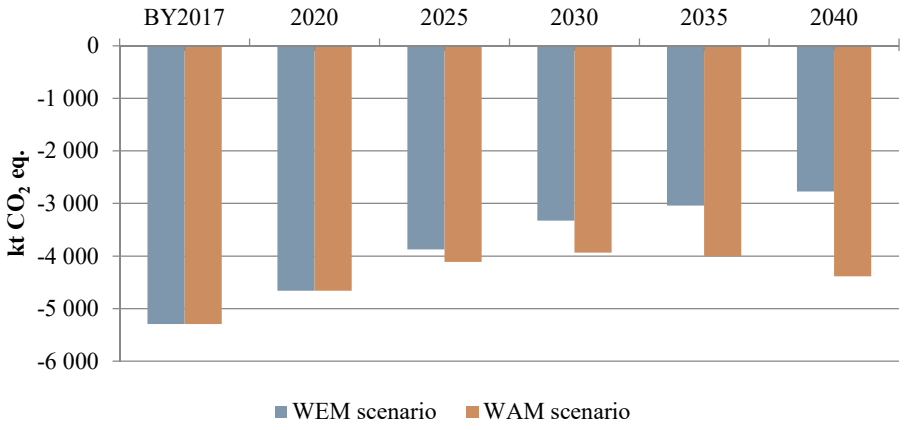

Figure 4-22. Projections under WEM and WAM scenarios in LULUCF sector

Scenario "with existing measures" (WEM)

GHG removals and emissions projections for LULUCF sector are provided for seven categories (6 land use categories and 1 production category): forest land, cropland, grassland, wetlands, settlements, other land and harvested wood products. Table below presents aggregated GHG removals and emissions from LULUCF sector. The largest GHG sink is forest land, with significant amount of GHG removed in harvested wood products and grassland categories, while largest source of GHG emissions – cropland and wetlands land-use categories. Historical GHG removals and emissions trends will not change a lot during projected period, except of foreseen reduction of GHG removals in forest land category. Compared to 2017 emissions from LULUCF sector will decrease by 33% in 2030 and by 47% in 2040.

[21] Repšienė, R., Karčauskienė, D., Ambrazaitienė D. 2014. *The use of lime materials enriched with humus in acidic soil*. Scientific article. Klaipėda. Available from: http://www.zak.lt/mokslo_darbai/2014_157_164.pdf

Table 4-42. Projected total GHG emissions from LULUCF sector, kt CO_2 eq.

LULUCF sector categories	BY 2017	2020	2025	2030	2035	2040
Forest land	-7 863	-7 040	-6 229	-5 737	-5 541	-5 375
Cropland	2 738	2 851	2 851	2 851	2 851	2 851
Grassland	-845	-972	-972	-972	-972	-972
Wetlands	1 044	893	893	893	893	893
Settlements	593	640	640	640	640	640
Other land	58	64	64	64	64	64
Harvested wood products	-1 045	-1 123	-1 148	-1 092	-1 001	-896
Total GHG removals	-5 296	-4 663	-3 877	-3 329	-3 042	-2 772

The figure bellow represents GHG emissions trend during the historical and projected period.

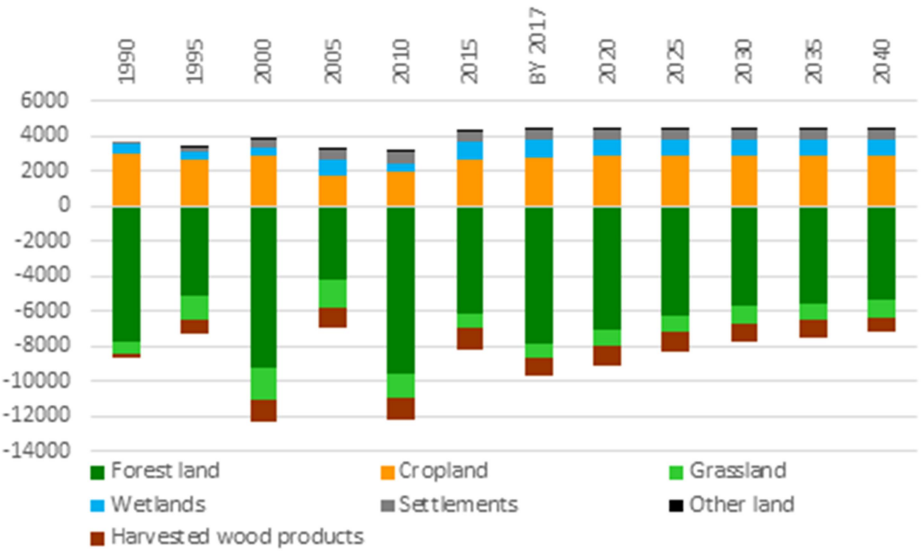

Figure 4-23. Historical and projected GHG emissions from LULUCF sector by categories

Forest land

Projected GHG emissions and removals in Forest land category are provided for Forest land remaining forest land and Land converted to forest land subcategories. It is projected that GHG removals both in Forest land remaining forest land and Land converted to forest land decreases in 2040 compared to 2017: 25 and 53 % respectively (Table 4-42). However, it is projected that GHG removals in Land converted to forest land will increase in 2040 comparing to 2035 due to the increasing growing stock volume increment of young tree stands in those areas.

Table 4-43. Projected CO_2 removals from forest land, kt CO_2 eq.

Forest land subccategories	BY 2017	2020	2025	2030	2035	2040
Forest land remaining forest land	-7 315	-6 126	-5 504	-5 272	-5 546	-5 436
Land converted to forest land	-1 018	-980	-871	-733	-446	-482

GHG projections for Forest land involves estimations of changes in carbon stocks in five carbon pools (above-ground biomass, below-ground biomass, dead wood and litter, soil organic matter) as well as estimations of non-CO_2 gases from those pools. The main sink of GHG is living biomass – carbon accumulated in above and below-ground biomass. It is projected that GHG removals in living biomass is decreasing due to the decreasing growing stock volume changes in Forest land remaining forest land and Land converted to forest land. GHG emissions due to the drainage of organic soils are increasing due to the increasing total Forest land area, since area of drained organic soils in Forest land is estimated as a share from total Forest land area. Emission factors, applied for reported and projected GHG emissions estimated from drained organic soils and other reporting categories are provided below.

Table 4-44. Methods and carbon stock change/emission factors applied in GHG reporting and projections

Reporting category	Method	Factor information
Carbon stock changes in living biomass	Tier 2	CS, D
Carbon stock change in dead organic matter	Tier 2	CS, D
Carbon stock changes in soils	Tier 2	CS, D
Emissions and removals from drainage and rewetting and other management of organic and mineral soils	Tier 1, Tier 2	D
GHG emissions from biomass burning	Tier 1, Tier 2	CS, D

Reported and projected carbon stock changes in different pools in Forest land are provided in the Table below. As it is mentioned before, the most significant pool is living biomass, where carbon gains are projected to decline, whereas the largest source of GHG emissions – organic soils – is projected to increase.

Table 4-45. Reported and projected carbon stock changes in pools of Forest land category

Reporting category	BY 2017	2020	2025	2030	2035	2040
Carbon stock changes in living biomass, kt C	2146.2	2233.4	2005.1	1857.8	1740.4	1710.5
Carbon stock change in dead organic matter, kt C	59.2	40.2	46.9	36.7	38.5	36.4
Carbon stock changes in soils, kt C	60.3	47.0	22.4	12.6	1.2	0
Emissions from drainage of organic soils, kt CO_2 eq.	470.5	483.2	490.0	496.8	503.6	508.2
GHG emissions from biomass burning, kt CO_2 eq.	0.3	0.3	0.3	0.3	0.3	0.3

Cropland and Grassland

GHG projections for Cropland and Grassland involves estimations of changes in carbon stocks in carbon pools – biomass, dead wood, litter and soil organic matter as well as estimations of non-CO_2 gases from those pools. The largest sources of GHG emissions in Cropland are mineral and organic soils – organic carbon losses due to conversion from other land uses to Cropland and drainage of

organic soils. Due to the fact that most of carbon stock changes occur due to land use changes, largest share of total GHG emissions are from Land converted to cropland subcategory. The largest GHG emissions sinks in Grassland are living biomass and mineral soils – organic carbon gains in biomass and mineral soils due to conversion from other land uses to grassland. The largest source of GHG emissions in Grassland is organic soils due to drainage of organic soils which leads to decomposition of organic matter sequestrated in soil. Another source of GHG emissions in Cropland and Grassland categories is biomass burning, with only minor emissions of CH_4, N_2O, CO and NO_X. There are no carbon stock changes reported in Grassland remaining grassland. Methods and factors applied for GHG estimation in Cropland and Grassland are provided in the table below.

Table 4-46. Methods and carbon stock change/emission factors applied in GHG reporting and projections

Reporting category	Method	Factor information
Carbon stock changes in living biomass	Tier 1	D
Carbon stock change in dead organic matter	Tier 2	CS, D
Carbon stock changes in soils	Tier 2	CS, D
Direct N_2O emissions from N mineralization/immobilization	Tier 1, Tier 2	D
Emissions and removals from drainage and rewetting and other management of organic and mineral soils	Tier 1	D
GHG emissions from biomass burning	Tier 1	CS

Projected GHG emissions and removals in Cropland and Grassland categories are presented in Tables below.

Table 4-47. Reported and projected GHG emissions from Cropland category, kt CO_2 eq.

Reporting category	BY 2017	2020	2025	2030	2035	2040
Carbon stock changes in living biomass	917.21	1 052.57	1 052.57	1 052.57	1 052.57	1 052.57
Carbon stock change in mineral soils	593.43	628.81	628.81	628.81	628.81	628.81
Direct N_2O emissions from N mineralization/immobilization	56.62	53.64	53.64	53.64	53.64	53.64
Emissions and removals from drainage and rewetting and other management of organic and mineral soils	1 167.01	1 117.01	1 117.01	1 117.01	1 117.01	1 117.01
GHG emissions from biomass burning	0.00	0.01	0.01	0.01	0.01	0.01

Due to the lack of strategies and measures planned for agriculture sector development (in case of land use management and land use changes), for all the reporting categories it was assumed that situation (areas of Land converted to cropland and grassland) will remain as described during the past 5 years

(2013–2017). Carbon stock changes due to the conversion from agricultural lands to Forest and other land uses are included in projections of GHG emissions and removals in Forest and other land use categories.

Table 4-48. Reported and projected GHG emissions and removals in Grassland, kt CO_2 eq.

Reporting category	BY 2017	2020	2025	2030	2035	2040
Carbon stock changes in living biomass	-121.39	-174.91	-174.91	-174.91	-174.91	-174.91
Carbon stock change in mineral soils	-782.71	-858.61	-858.61	-858.61	-858.61	-858.61
Emissions and removals from drainage and rewetting and other management of organic and mineral soils	58.62	59.00	59.00	59.00	59.00	59.00
GHG emissions from biomass burning	0.52	2.14	2.14	2.14	2.14	2.14

No direct N_2O emissions from N mineralization/immobilization are reported from Grassland category, since there are no conversions with carbon loss in mineral soils reported in Land converted to grassland category.

Wetlands

GHG projections for Wetlands involves estimations of GHG emissions in Peat extraction remaining peat extraction and Land converted to Flooded land subcategories. Changes in carbon stocks in biomass, dead wood, litter and soil organic matter pools are estimated as well as emissions of non-CO_2 gases from those pools. The largest source of GHG emissions in Wetlands are organic soils in Peat extraction sites where GHG emissions occur due to the decomposition of organic matter in peat. GHG emissions from land converted to wetlands are reported in Land converted to flooded land category and are the largest when Forest land is converted to flooded land, due to the loss of carbon in soils. Methods and carbon stock change/emission factors applied for GHG estimation in Wetlands are provided in the Table 4-48.

Table 4-49. Methods and carbon stock change/emission factors applied in GHG reporting and projections

Reporting category	Method	Factor information
Carbon stock changes in living biomass	Tier 1	D
Carbon stock changes in dead organic matter	Tier 2	CS, D
Carbon stock changes in soils	Tier 2	CS, D
Direct N_2O emissions from N mineralization/immobilization	Tier 1, Tier 2	D

It is projected that GHG emissions from Peat extraction remaining peat extraction will remain stable as reported on average in 2013–2017. It is projected that there will be minor conversions from other

land uses to flooded land, average conversion rates as reported in 2013–2017 were applied. Reported and projected GHG emissions from wetlands are provided in Table 4-49. It is projected that GHG emissions from dead organic matter will not be present due to the very small conversions of forest land converted to flooded land projected in the future, however, GHG emissions from mineral soil will remain present due to long-term carbon decomposition process in soil.

Table 4-50. Reported and projected GHG emission from Wetlands, kt CO_2 eq.

Reporting category	BY 2017	2020	2025	2030	2035	2040
Carbon stock changes in living biomass	0	0	0	0	0	0
Carbon stock changes in dead organic matter	32.99	0	0	0	0	0
Carbon stock change in mineral soils	238.50	49.57	49.57	49.57	49.57	49.57
Carbon stock change in organic soils	747.40	834.93	834.93	834.93	834.93	834.93
Direct N_2O emissions from N mineralization/immobilization	25.04	8.94	8.94	8.94	8.94	8.94

Settlements

GHG projections for Settlements involves estimations of changes in carbon stocks in carbon pools - biomass, dead wood, litter and soil organic matter as well as estimations of non-CO_2 gases from those pools. No carbon stock changes occur in Settlements remaining settlements as it is assumed to remain in steady state according to 2006 IPCC Guidelines Tier 1 methodological assumption. The largest sources of GHG emissions in Settlements are living biomass and mineral soils – organic carbon losses due to conversion from other land uses to settlements. Methods and carbon stock change/emission factors applied for GHG estimation in Settlements are provided in the Table 4-50.

Table 4-51. Methods and carbon stock change/emission factors applied in GHG reporting and projections

Reporting category	Method	Factor information
Carbon stock changes in living biomass	Tier 1	D
Carbon stock changes in dead organic matter	Tier 2	CS, D
Carbon stock changes in soils	Tier 2	CS, D
Direct N_2O emissions from N mineralization/immobilization	Tier 1, Tier 2	D

It is projected that GHG emissions from sources in Settlements category will remain stable as reported on average during 2013–2017. It is projected that GHG emissions from dead organic matter will not be present due to the very small conversions of forest land converted to settlements projected in the future. GHG emissions from mineral soils will increase due to projected increasing conversions from grassland to settlements.

Table 4-52. Reported and projected GHG emission from Settlements, kt CO_2 eq.

Reporting category	BY 2017	2020	2025	2030	2035	2040
Carbon stock changes in living biomass	25.60	46.68	46.68	46.68	46.68	46.68
Carbon stock	0	0	0	0	0	0

Reporting category	BY 2017	2020	2025	2030	2035	2040
changes in dead organic matter						
Carbon stock change in mineral soils	519.90	544.34	544.34	544.34	544.34	544.34
Carbon stock change in organic soils	3.06	3.23	3.23	3.23	3.23	3.23
Direct N_2O emissions from N mineralization/immobilization	44.27	46.07	46.07	46.07	46.07	46.07

Other land

GHG projections for Other land involves estimations of changes in carbon stocks in carbon pools - biomass, dead wood, litter and soil organic matter as well as estimations of non-CO_2 gases from those pools. No carbon stock changes occur in Other land remaining other land as it is assumed to remain in steady state according to 2006 IPCC Guidelines Tier 1 methodological assumption. The largest sources of GHG emissions in Other land are living biomass and mineral soils – organic carbon losses due to conversion from other land uses to Other land. Methods and carbon stock change/emission factors applied for GHG estimation in Other land are provided in the Table 4-53.

Table 4-53. Methods and carbon stock change/emission factors applied in GHG reporting and projections

Reporting category	Method	Factor information
Carbon stock changes in living biomass	Tier 1	D
Carbon stock changes in dead organic matter	Tier 2	CS, D
Carbon stock changes in soils	Tier 2	CS, D
Direct N_2O emissions from N mineralization/immobilization	Tier 1, Tier 2	D

It is projected that GHG emissions from sources in Other land category will remain stable as reported on average during 2013–2017. It is projected that GHG emissions from dead organic matter will not be present due to the fact that there are no changes from Forest land to other land projected in the future.

Table 4-54 Reported and projected GHG emission from Other land, kt CO_2 eq.

Reporting category	BY 2017	2020	2025	2030	2035	2040
Carbon stock changes in living biomass	0	3.74	3.74	3.74	3.74	3.74
Carbon stock changes in dead organic matter	0	0	0	0	0	0
Carbon stock change in mineral soils	53.01	55.2	55.2	55.2	55.2	55.2
Carbon stock change in organic soils	0.26	0.29	0.29	0.29	0.29	0.29
Direct N_2O emissions from N mineralization/immobilization	4.51	4.70	4.70	4.70	4.70	4.70

Harvested wood products

GHG removals in Harvested wood products are divided into three product subcategories – sawn wood, wood-based panels and paper and paper board. It is projected that GHG removals in Harvested

wood products will decrease in future (after 2025), despite the slightly increasing total harvested volume. Reported and projected GHG removals in Harvested wood products are provided in Table below.

Table 4-55. Projected GHG removals in Harvested wood product categories, kt CO_2 eq.

Reporting category	BY 2017	2020	2025	2030	2035	2040
Sawnwood	-512	-532	-563	-552	-518	-474
Wood-based panels	-607	-596	-580	-537	-481	-422
Paper and paperboard	28	5	-5	-3	-2	0

In order to comply with the obligation under Regulation (EU) No 2018/841, the annual difference between GHG emissions and removals accounted under LULUCF sector (subject to the specific accounting rules in this Regulation) shall be negative, i.e. emissions from accounting categories shall not exceed removals from accounting categories. Total GHG emissions and removals under accounting categories shall be reported from 2021 to 2030. Emissions and removals will be accounted subtracting reference levels from total reported emissions and removals from managed forest land, managed cropland and managed grassland, and total emissions and removals reported in afforested land and deforested land. Managed forest land reference level is the projected amount of GHG emissions and removals, based on actual forest management as observed during 2000–2009 and age class development. Preliminary estimated reference level of managed forest land (-2,722 kt CO_2 eq/year) will be revised following the review by the European Commission according to the comments received. Reference levels for managed cropland and managed grassland is an average of GHG emissions/removals reported during 2005–2009. The preliminary reference level for managed cropland is 3,768 kt CO_2 eq per year, for managed grassland: -970 kt CO_2 eq per year. Based on the accounting rules set in LULUCF Regulation (EU) No 2018/841 it is projected that during 2021-2025 accounted GHG removals from LULUCF sector will be -6,227 kt CO_2 eq each year, part of which can be used to meet the GHG emission reduction commitments in non-ETS sectors. During 2026-2030 (second commitment period under Regulation (EU) No 2018/841), accounted GHG removals is projected to be -5,252 kt CO_2 eq each year, part of which could be used to meet emisson reduction commitments in non-ETS sectors.

Scenario "with additional measures" (WAM)

WAM scenario is based on the additional measures provided by the MoA and MoE, the implementation period of measures will cover period of 2021-2030, however, since measures are related to carbon stock changes in biomass or soil, effect of the measures will be evident during 2031 – 2040 as well. Additional policies and measures in the LULUCF sector will focus on increasing GHG absorption in the biomass with afforestation/reforestation measures, human induced forest regeneration (instead of natural regeneration), and promoting expansion of perennial cropland in agricultural land. In addition to this, significant focus will be given to grassland preservation and restoration of wetlands (bogs and marshes).

List of policies and measures and cumulative effect for enhanced GHG removals for 2021-2030 is provided in Chapter 3 and CTF table3.

Table 56. Projected GHG removals in LULUCF sector, kt CO_2 eq.

	BY 2017	2020	2025	2030	2035	2040
Forest land	-7 863	-7 040	-6 273	-6037	-6252	-6 737
Cropland	2 738	2 851	2 771	2 766	2 819	2 818

	BY 2017	2020	2025	2030	2035	2040
Grassland	-845	-972	-1 038	-1 099	-1 095	-1 095
Wetlands	1 044	893	846	798	798	798
Settlements	593	640	640	640	640	640
Other land	58	64	64	64	64	64
Harvested wood products	-1 045	-1 123	-1 148	-1 092	-1 001	-896
Total GHG removals	-5 296	-4 663	-4114	-3 936	-4 003	-4 385

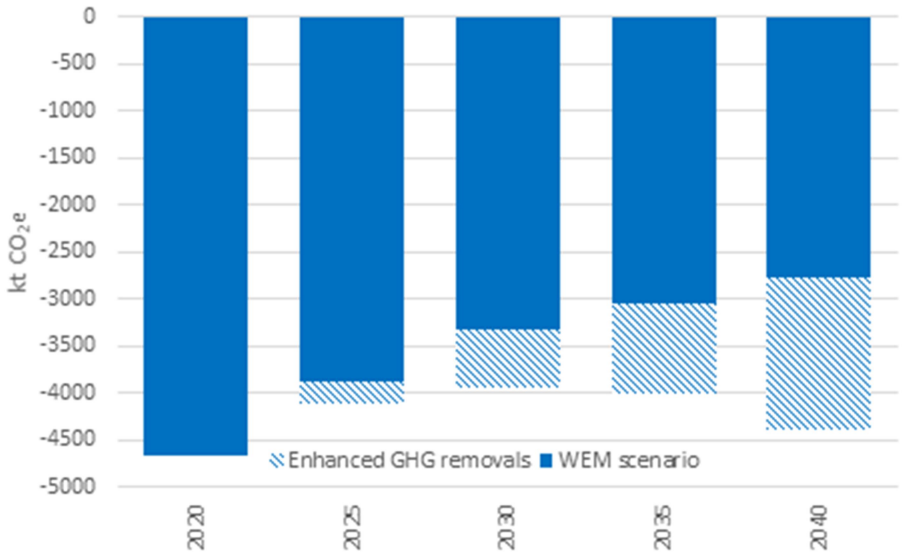

Figure 4-24. Projected GHG removals in LULUCF sector under WAM scenario

Based on the accounting rules set in LULUCF Regulation (EU) No 2018/841 it is projected that during 2021-2025 accounted GHG removals from LULUCF sector will be -6,263 kt CO_2 eq. each year, part of which can be used to meet the GHG emission reduction commitments in non-ETS sectors. During 2026-2030 (second commitment period under Regulation (EU) No 2018/841), accounted GHG removals is projected to be -5,548 kt CO_2 eq. each year, part of which could be used to meet emisson reduction commitments in non-ETS sectors.

Methodology and key assumptions

Projections of GHG removals in LULUCF sector with existing measures (WEM) is based on projected growing stock volume changes in forest land, land use changes and carbon stock changes in biomass and soils, related to those changes between land uses. Forecast of the data mentioned above is done taking into account trends in past activity data. Scenario with additional measures (WAM) is based on additional measures provided by the MoE and MoA.

Projected GHG emissions from sources and removals in sinks were estimated using 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, as those are applied in National Greenhouse Gas Inventory Report. Projected GHG emissions and removals were estimated using abovementioned projected data and default carbon stock change/emission factors from 2006 IPCC Guidelines or nationally developed country specific factors.

Summary table of assessed GHG removals and emissions from LULUCF sector, methods and stock change/emission factors applied are provided in the table below.

Table 4-57. Methods and emissions factors used to estimate removals and emissions from LULUCF sector

CRF	Source	Emissions reported	Methods	Emission factor
4.A	Forest land	CO_2, CH_4, N_2O,	T1, T2	CS, D
4.B	Cropland	CO_2, CH_4, N_2O	T1, T2	CS, D
4.C	Grassland	CO_2, CH_4, N_2O	T1, T2	CS, D
4.D	Wetlands	CO_2, N_2O	T1, T2	CS, D
4.E	Settlements	CO_2, N_2O	T1, T2	CS, D
4.F	Other Land	CO_2, N_2O	T1, T2	CS, D
4.G	Harvested Wood Products	CO_2	T1, T2	D

Forest land

Forest land is one of the most important categories in LULUCF sector. Forest land category is the largest sink in the sector, with living biomass being the most important sink in Forest land category. Amount of GHG annually sequestrated in living biomass is related to growing stock volume changes, which is a balance of growing stock volume increment, increment use (harvest) and natural mortality. Historical and projected growing stock volume increment, increment use, natural mortality and increment accumulated in forest is provided in table below.

Table 4-58. Historical and projected growing stock volume increment and its structure, million m^3

Indicator		NFI data			Projections				
		2007	2012	2017	2020	2025	2030	2035	2040
Total growing stock volume increment		15.95	19.38	20.51	20.46	20.37	20.26	20.15	20.04
Growing stock volume use, stem volume:	final	5.46	4.84	6.53	6.94	7.63	7.88	7.83	7.76
	intermediate	4.22	3.21	3.58	3.57	3.56	3.68	3.88	3.99
	total	9.68	8.05	10.11	10.52	11.20	11.56	11.71	11.75
Natural mortality		3.34	3.83	3.66	3.61	3.52	3.43	3.33	3.22
Accumulation in forest		2.93	7.50	6.74	6.33	5.64	5.27	5.11	5.07

Growing stock volume changes

Growing stock volume accumulation in forest and thus carbon sequestration in biomass is projected to decline, taking into account age class distribution and historical trends of forest use (harvest). The total growing stock volume of trees, growing stock volume increment, forest use (harvest) and natural mortality in Lithuania are projected according to the data of changes in growing stock volume and its use as observed during National Forest Inventory (NFI) measurements in 2002–2017. This data is used as a starting point for assessing gross growing stock volume increment and its structure (final harvest, intermediate harvest, natural mortality and growing stock volume change/accumulation in forest) in 2018-2040. Growing stock volume increment, as observed during 2007–2017 NFI measurements, for 2018–2040 was projected as a multiplication of projected area and projected mean growing stock volume increment for corresponding species. It is evident from the table, mean annual growing stock volume increment is decreasing, taking into account increasing mean stand age. As it was mentioned, growing stock volume increment decrease is mainly determined by changes in stand age class distribution: middle-aged stands, now occupying largest areas and generating highest growing stock volume increment and carbon accumulation, is aging, therefore areas of elderly stands, which generates lower growing stock volume increment and carbon accumulation, are increasing.

Taking into account recent use and replanting of pine stands, the largest decrease in growing stock volume increment is projected for those stands. Decrease of growing stock volume increment is also related to relatively small areas of young stands, meaning that taking into account shift in age classes, there will also be relatively small areas of the most productive middle-aged forests in the future. Decrease in growing stock volume increment accumulated in forest is also related to increasing harvested volume. Harvested volume increases due to increased final harvest in mature stands as well as increasing amount of wood harvested in intermediate fellings. Increase in intermediate harvest is projected taking into account aim to increase forest sustainability, reduce volume of dying trees and therefore reduce losses for forest growth. Final forest use (harvest) was determined multiplying equivalent area of mature stands available for harvest (taking into account historical area of final harvest and area of mature stands) with mean growing stock volume in mature stands. Equivalent area of mature stands for annual harvest was estimated taking into account age class distribution for different tree species and ensuring availability of mature forest stand use for 12 to 15 years. It was estimated that property restoration in nearly 200 thous. ha of forest land (either private property restoration or attributing areas to state forests) will have an impact for increasing growing stock volume use by final harvest.. Intermediate forest use, taking into account historical trends, is projected as a 40–50 % share from final forest use. Due to the increasing intermediate and final forest use (harvest), total growing stock volume used (harvested) in country's forests is projected to increase from 10.11 million m^3 in 2017 to 11.75 million m^3 in 2040 (Table 4-57). Increase in intermediate growing stock volume use (harvest) affects projected natural losses (volume of dying trees). Due to increased intermediate forest use, natural forest mortality rates are projected to decrease. Data from NFI 2007 – 2017 show that mean annual mortality rates – share from total growing stock volume increment – has decreased from 21 to 18%. Since intermediate and final forest use (harvest) in total consists of 72–75 % of growing stock volume increment, share of growing stock volume increment accumulated in forests is projected to be approx. ¼ of total growing stock volume increment, which complies with the principles of sustainable forest management.

Projected growing stock volume changes (accumulation in forest) in Land converted to forest land were estimated separately from growing stock volume changes in Forest land remaining forest land. Under the WEM scenario projected increase in forest land area was assumed to 3.2 thous. ha annually, taking into account mean area of new forest land observed by NFI during 2013–2017. The share of human induced afforestation/reforestation and natural forest expansion was applied as observed in 2017. Growing stock volume changes, which is used for GHG removals estimation in biomass were projected using annual area of forest land expansion and function of growing stock volume changes in new forests, as applied in National GHG Inventory Report.

Soils

Carbon stock changes in mineral and organic soils are projected according to total Forest land area changes (Table 4-58).

Table 4-59. Reported and projected Forest land area, thous. ha

	BY 2017	**2020**	**2025**	**2030**	**2035**	**2040**
Forest land	2208.30	2217.75	2233.50	2249.50	2265.50	2281.50

Carbon stock changes in soils are estimated only in Land converted to forest land due to the gains of soil organic matter in mineral soils and losses of soil organic matter in organic soils. Due to the projected smaller areas of Land converted to forest land, carbon stock changes in soils are projected to decline in the future.

GHG emissions from drainage of organic soils are increasing due to increasing total Forest land area, since GHG emissions are estimated multiplying corresponding area of drained organic soils (estimated as a share from total Forest land) with default emission factor from 2006 IPCC Guidelines applied. Share of drained organic soils in Forest land is estimated from National Forest Inventory data.

Cropland and Grassland

Due to the lack of adopted policies and measures in agriculture sector, all reporting categories are projected to remain stable as reported on average during 2013–2017. Conversions between cropland and grassland categories are projected to remain stable due to Common Agriculture Policy aim to maintain stable area of permanent grasslands.

Carbon stock changes due to afforestation of cropland and grassland areas are projected under Forest land category.

Wetlands

Due to the lack of adopted policies and measures in Peat extraction activity of other wetland management, all reporting categories are projected to remain stable as reported on average during 2013–2017. Peat extraction highly depends on natural conditions (i.e. on precipitation and moisture content) and opening of new Peat extraction sites is not allowed if area on peat soil is under environmental protection. In addition to this, most of the known peatland areas are in Natura 2000 network areas, therefore peat extraction there is not allowed. This information supports assumption of not linearly increasing extracted peat quantity, but maintaining the highest extracted quantity as reported on average during 2013–2017.

Settlements

Observed tendency of increasing Settlements area is also projected in the future. Conversions from Cropland and Grassland are projected to be the same as reported on average during 2013–2017. Significant amount of GHG emissions are projected to occur from living biomass after Cropland and Grassland conversion to settlements. In addition to GHG emissions from living biomass, another significant source is soils. Emissions both from mineral soils due to carbon loss after conversion and from organic soils due to drainage are projected to remain in 2013–2017 level due to the same Land converted to settlements area.

Other land

Minor conversions from other land use categories to Other land category are projected due to the tendencies observed in the most recent years. Almost no new conversions to other land are reported recently, except for Grassland – Forest land, Cropland and Settlements converted to other land areas are continuously decreasing (no new conversions occurred from these land use categories to Other land). The most significant amount of GHG emissions is projected to emerge from mineral soils due to soil organic matter decomposition after Grassland conversion to other land.

Harvested wood products

GHG removals in Harvested wood products are projected in relation to the projected total harvest rate. Ratio between total harvest observed in 2017 and projected harvest was applied to project production quantity for Harvested wood products estimation in 2018–2040. The share between different wood

semi-products is maintained as reported in 2017. Projected different semi-product quantities are provided in Table below.

Table 4-60. Projected production quantities for removals in Harvested wood product categories

Reporting category	BY 2017	2020	2025	2030	2035	2040
Sawnwood, m^3	1406000	1462741	1557308	1607652	1628512	1634353
Wood-based panels, m^3	919384	956487	1018325	1051244	1064885	1068704
Paper and paperboard, m^3	127377	132517	141085	145646	147536	148065

Decrease in total projected GHG removals (Table 4-57) in Harvested wood products category after 2025 are related to lower increase in production quantity comparing to historical production rates. Large amount of historically produced harvested wood products will be decaying, therefore even increasing future production of wood semi-products does not provide increase in total GHG removals.

4.1.6. Waste

The emissions from Waste Sector for WEM and WAM scenarios are presented in the table and figure below.

Table 4-61. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	BY 2017	2020	2025	2030	2035	2040
WEM scenario	1 061	817	659	545	463	382
WAM scenario	1 061	817	631	503	411	318

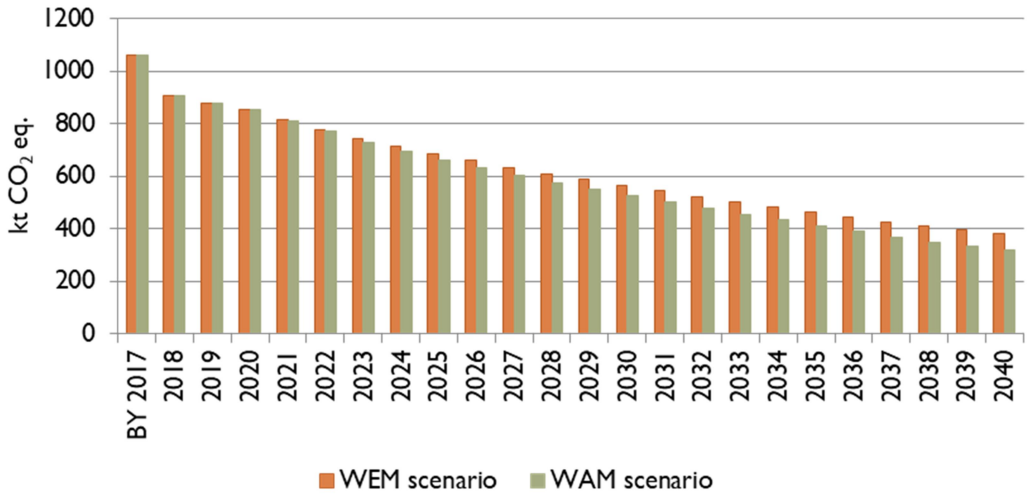

Figure 4-25. Projections in case of WEM and WAM scenarios

Scenario "with existing measures" (WEM)

GHG emissions projections are provided in four subsectors: disposal in landfills, composting and anaerobic digestion, incineration of waste and wastewater treatment and discharge. In the WEM scenario the amount of waste disposed in landfills is expected to continue on a decreasing trend,

mainly as a result of the requirements of the Landfill Directive[22], the Packaging and Packaging Waste Directive[23], the Waste Framework Directive[24], but also because waste incineration and other forms of treatment are becoming more important.

Historical and projected GHG emissions are presented in the table and figure below.

Table 4-62. Projected GHG emissions from waste sector (kt CO2 eq.)

	BY 2017	2020	2025	2030	2035	2040
Solid waste disposal*	799	612	456	351	264	200
Biological treatment of waste	77	80	81	82	83	84
Waste incineration	1	2	2	2	2	2
Wastewater treatment and discharge	184	163	148	133	114	97
Total	1 061	857	687	568	463	383

*Including emissions from sewage sludge and CH_4 recovery

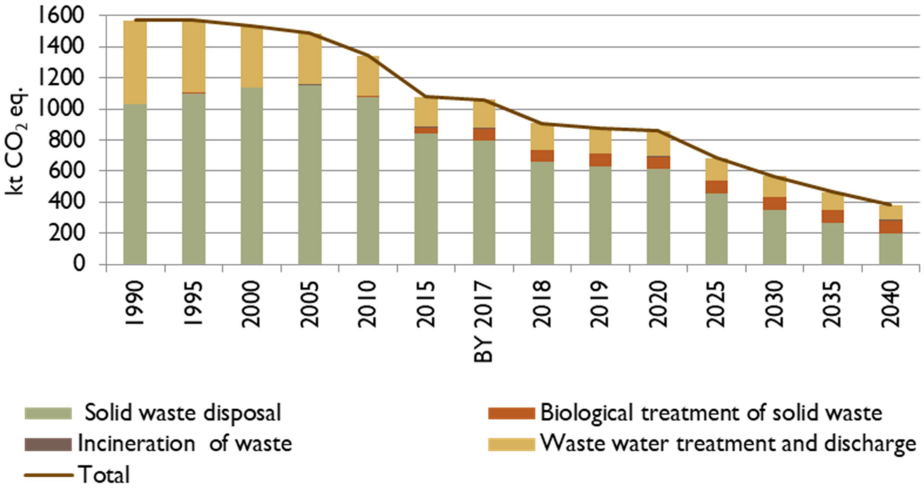

Figure 4-26. Historical and projected GHG emissions from waste sector

Solid waste disposal on land

National targets to reduce CH_4 emissions from solid waste disposal on land are set in the National Waste Management Plan for 2014-2020. GHG projections were estimated based on the assumption that targets such as reduction of the quantity of landfilled waste, increase of biodegradable waste composting, increase of the recovered gas use for energy will be achieved. Implementation of these targets will lead to gradual reduction of CH_4 emissions and will reach 204 kt CO_2 eq. (incl. CH_4 recovery) by 2040.

[22]https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01999L0031-20180704
[23]https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0852&from=EN
[24]https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008L0098-20180705&from=EN

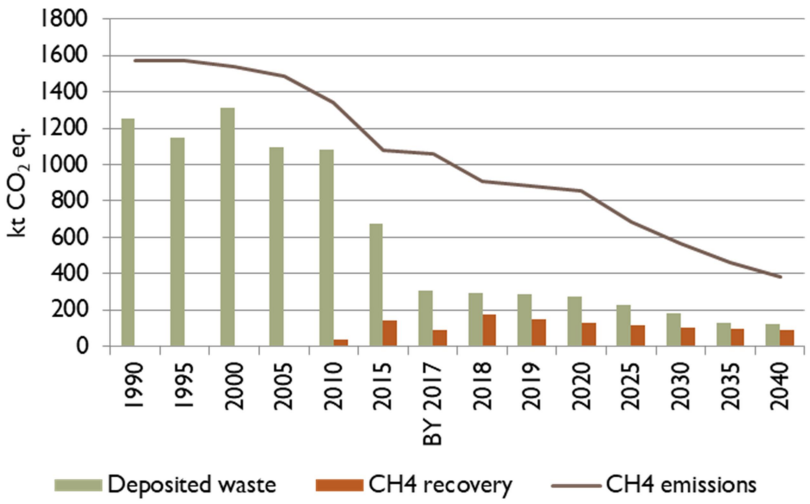

Figure 4-27. Methane emissions, CH4 recovery and deposited waste

Biological treatment of solid waste

One of the main targets set in National Waste Management Plan is to reduce the amount of biodegradable waste going to landfills. To achieve these targets the mechanical-biological treatment plants have been launched in 2016. As it was expected the amount of biodegradable waste going to landfills was reducing, resulting in lower emissions from the landfills. However, the GHG emissions from biological treatment of waste will grow due to increase of the amount of treated waste.

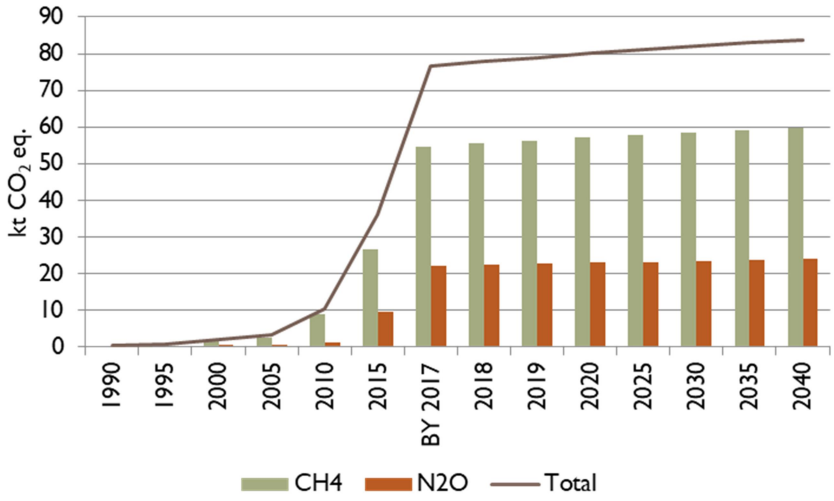

Figure 4-28. Historical and projected emissions from biological treatment of waste

Wastewater treatment and discharge

There are close to 1 800 wastewater discharge points in Lithuania. 99% of wastewater is treated in centralized aerobic wastewater treatment plants. The main source of CH_4 emissions are septic tanks. CH_4 emissions will decrease due to increase of population connected to centralized sewer networks and it is projected to be 56 kt CO_2 eq. by 2040.

No projections on protein consumption were made, therefore, N_2O emissions from human sewage were calculated based on the constant value. Emissions will drop due to decrease of the population and it is projected to be 41 kt CO_2 eq. by 2040.

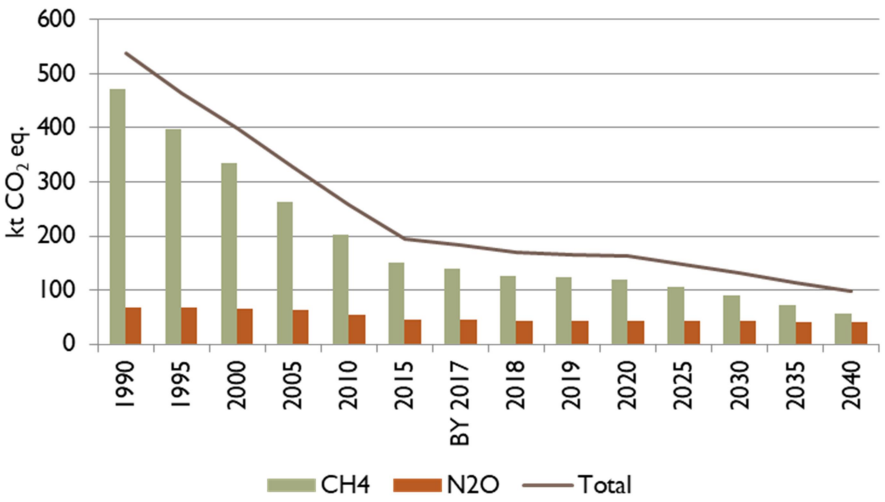

Figure 4-29. Historical and projected CH_4 and N_2O emissions

Incineration of waste

Emissions from waste combustion for energy recovery are reported in Energy Sector. In general, municipal, industrial and hazardous wastes are combusted for energy recovery. Only small amount of hazardous waste is incinerated without energy recovery.

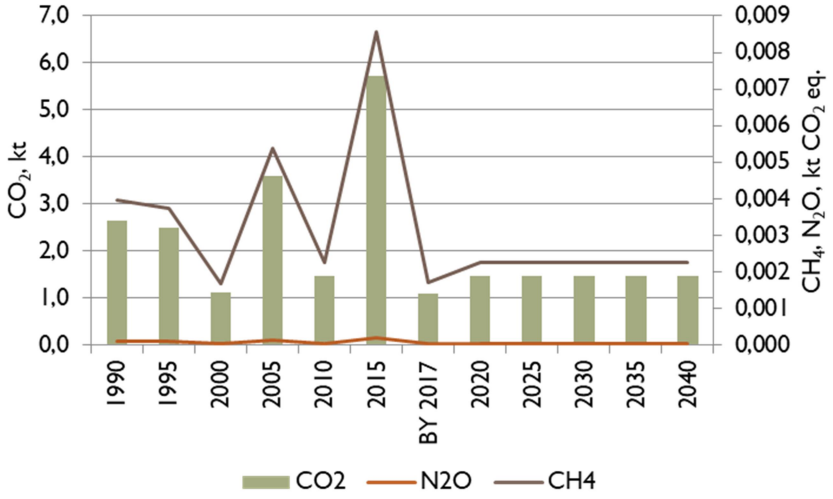

Figure 4-30. Historical and projected emissions from waste incineration

Scenario "with additional measures" (WAM)

Lithuania is taking steps towards realizing the concepts of "recycle, repair and re-use" and avoiding waste at all stages of the value chain with its EU circular economy package. The 2015 Circular Economy Package emphasizes the need to move towards a lifecycle-driven 'circular' economy, with a cascading use of resources and residual waste that is close to zero.

The WAM scenario is based on the additional measures provided by the Ministry of Environment. The implementation period of measures will cover period of 2020-2030. For the period of 2031-2040 all additional measures will continue to be implemented at the same rate as it is expected in 2030. The planned policies and measures are focusing on education and information the public about preventing and reducing food waste, improving waste sorting skills, developing information websites and

applications, and creating interactive maps. All planned policies and measures will reduce the amount of waste going to landfills, leading to progressive reductions in GHG emissions from landfills.

List of policies and measures and cumulative GHG reduction effect for 2021-2030 is provided in Chapter 3.

Table 4-63. Projected GHG emissions from waste sector (kt CO_2 eq.)

	BY 2017	2020	2025	2030	2035	2040
Solid waste disposal*	799	612	432	311	212	136
Biological treatment of waste	77	80	81	82	83	84
Waste incineration	1	2	2	2	2	2
Wastewater treatment and discharge	184	163	148	133	114	97
Total	1 061	857	663	528	411	319

*Including emissions from sewage sludge and CH_4 recovery

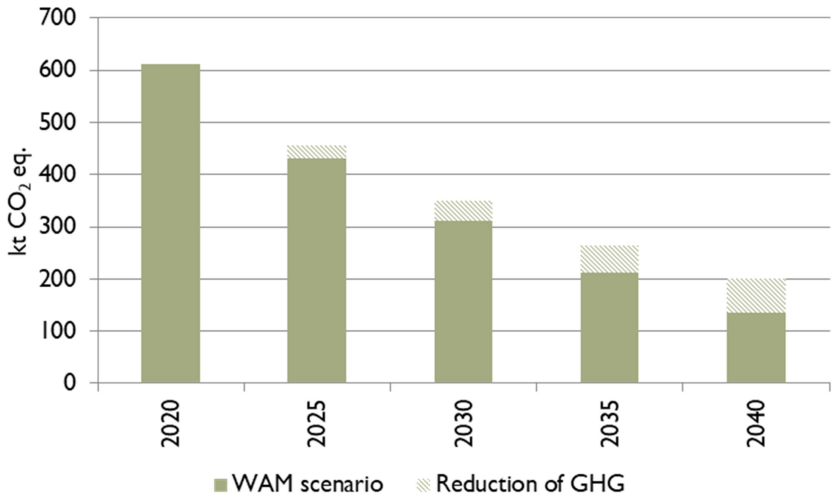

Figure 4-31. Projected emissions of CH4 from waste disposal on land under WAM scenario

Methodologies and key assumptions

Projections of GHG emissions from Waste Sector are based on the National Waste Management Plan[25] for 2014-2020, the Landfill Directive[26], the Packaging and Packaging Waste Directive[27], the Waste Framework Directive[28], data provided by the Ministry of Environment[29], the Environmental Protection Agency[30], the Regional Waste Management Centres[31].

Methane emission arising from *Solid Waste Disposal* on land is calculated applying the IPCC (Intergovernmental Panel on Climate Change) Tier 2 (First Order Decay) method, taking into account historical waste disposal data. This method assumes that the degradable organic component in waste

[25]https://www.e-tar.lt/portal/lt/legalAct/TAR.9945210D6571/ZtaLvZPcai
[26]https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01999L0031-20180704
[27]https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0852&from=EN
[28]https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008L0098-20180705&from=EN
[29]The Ministry of Environment. Available http://am.lrv.lt/
[30]The Environmental Protection Agency. Available: *http://gamta.lt/cms/index?lang=en*
[31]The Regional Waste Management Centres. Available: *http://ratca.lt*

decays slowly throughout a few decades. CH_4 is generated as a result of degradation of organic material under anaerobic conditions. Part of the CH_4 generated is recovered for energy or flaring, therefore CH_4 actually emitted is smaller than the amount generated. The model calculations are performed using national statistics of landfill site characteristics and amounts of waste fractions deposited each year. The parameters used for emission projections are the same as those used in the Lithuanian GHG inventory.

Solid waste disposal on land including stored sewage sludge is the largest GHG emission source from waste sector. Projections of waste generation are based on historical as well as projected data on the population and the annual GDP growth rate. Projected population data are provided in Comprehensive Plan of the Territory of the Republic of Lithuania[32] and GDP growth are provided in the study "Baltic Energy Technology Scenarios 2018" [33]prepared by Nordic Council of Ministers. The amounts of waste disposed in landfills are predicted taking into account the targets set in National Waste Management Plan for 2014-2020 and the Landfill Directive. Assumptions are thus in line with the assumptions made for developments of mechanical-biologically treated waste reported under sector Biological Treatment of waste. Some minor amounts of sludge are expected to be stored as well. Assumptions on the projected amounts of sludge are based on historical data.

The projected data on waste generation and disposal are presented in the table below.

Table 4-64. Base year and projected amount of waste generation and disposal

Parameter	Units	BY 2017	2020	2025	2030	2035	2040
Generation of municipal waste	t	1 286 434	1 281 825	1 293 543	1 300 958	1 306 148	1 314 184
Municipal waste generated per capita	kg/capita	452	460	469	477	485	491
Disposal to landfills	%	24	22	18	14	10	10

Constantly decreasing share of CH_4 recovery and flaring from landfills is assumed due to the decreasing gas generation potential of deposited waste. The assumption is based on data provided by Regional Waste Management Centers.

Biological Treatment of waste covers composting of green waste, composting and anaerobic digestion in MTB plants and household composting. Methane and nitrous oxide emissions from Biological Treatment of waste are calculated by multiplying the amount of waste by the corresponding emission factors (see the table below). CH_4 emissions from anaerobic digestion of sewage sludge are calculated using the IPCC 2006 default EF of 5% CH_4 of biogas produced.

Table 4-65. Emission factors from biological treatment of waste (IPCC default)

Type of biological treatment	CH_4 EF (g CH4/kg waste treated)	N_2O EF (g N2O/kg waste treated)
Composting	10	0.6
Anaerobic digestion	2	Assumed negligible

EU structural and investment funds are an important source of funding for municipal waste management infrastructure development. Implementing EU funded projects 9 sewage sludge, 55 green waste composting facilities, 1 mechanical sorting and 8 regional mechanical sorting and biological treatment plants were constructed by 2016.

[32]http://www.bendrasisplanas.lt/2019/06/03/en/

[33]http://norden.diva-portal.org/smash/get/diva2:1195548/FULLTEXT01.pdf

The projected data on amount of composted waste and waste treated in anaerobic digestion plants were provided by Regional Waste Management Centres. The amount of waste undergoing mechanical-biological treatment assumed to increase as separate collection of kitchen and food waste is foreseen since 2019. Household composting was evaluated by the number of composting bins distributed and the amount of composted waste (220 kg) per household. Sewage sludge amounts treated in anaerobic digestion plants are assumed to stay constant at the level of 2017.

Methane is generated from *Wastewater Treatment* in anaerobic conditions while nitrous oxide can be produced as nitrification and denitrification product in both aerobic and anaerobic conditions. Wastewater treatment and Discharge covers CH_4 emissions from wastewater transportation and treatment as well as from septic tanks used by population not connected to centralized sewer networks and N_2O emissions from human sewage. CH_4 and N_2O emissions are calculated applying IPCC Tier 1 method, using IPCC default values.

EU structural and investment funds are an important source of funding for water sector. In 2007-2013 around 570 million EUR were invested into the wastewater collection and treatment system, focusing on the cities with more than 2 000 inhabitants. In 2014-2020, around 125 million EUR are planned to invest into wastewater collection and treatment system, focusing on the small town and villages with 200-2 000 inhabitants. These investments will help to further develop waste water collection and treatment systems.

Biochemical oxygen demand (BOD) is one of the main parameters for assessing discharged wastewater compliance with requirements for discharges from urban waste water treatment plants. BOD data was predicted based on historical data as well as the future development of wastewater collection and treatment system. BOD is expected to increase in line with the rising percentage of population connected to wastewater collecting system. The projected data on BOD and percentage of population connected to wastewater collecting system has been provided by the Ministry of Environment.

The main parameter to estimate N_2O emissions from human sewage is protein consumption. Protein consumption per capita was evaluated by the Health education and disease prevention Centre (77.4 g/capita/day in 1998, 78.1 g/capita/day in 2002, and 81.9 g/capita/day in 2007, 64.5 g/capita/day in 2013). The protein consumption is left as 2016 and remains stable during the 2017-2040 period.

Carbon dioxide, methane and nitrous oxide emissions from *Waste Incineration* are calculated based on the IPCC Tier 1 method and default emission factors are applied. Emission factors are consistent with the emission factors used in the Lithuanian GHG inventory.

Summary table of assessed emissions from waste sector, method applied and emission factors are provided in the table below.

Table 4-66. Methods and emissions factors used to estimate emission from waste sector

CRF	Source	Emissions reported	Methods	Emission factor
5.A	Solid Waste Disposal	CH_4	T2	D
5.B	Biological Treatment of Waste	CH_4, N_2O	T1	D
5.C	Incineration and Open Burning of Waste	CO_2, CH_4, N_2O	T1	D
5.D	Wastewater Treatment and Discharge	CH_4, N_2O	T1	D

Waste incineration without energy recovery is the smallest source of GHG in Waste sector and it is not expected to expand. Assumptions on the projected amounts of incinerated hazardous and clinical waste are based on historical data.

Cogeneration power plant has started incineration of MSW in 2013 and two additional MSW incinerators are under construction. It is assumed that operation of three MSW power plants will reduce the amount of MSW disposed of by landfilling and will overlay portion of fossil fuel used in public electricity and heat production sector. This assumption was incorporated in the final fuel used in Energy sector.

4.2. Sensitivity analysis

4.2.1. Energy sector

An important parameter in preparing GHG emissions projections can be considered the EU ETS carbon price. Most of installations under the EU ETS are local districts heat providers. Over the last five years and from the start of the 3rd EU ETS trading period many smaller installations producing heat energy started to switch from fossil fuel to biomass. This can be explained by the fact that the European Commission proposed the EU ETS market back-loading solution to decrease the surplus of EUAs in the market and therefore increase carbon price. Therefore, the switch to biomass may greatly reduce the amount of EUAs needed for installations to cover the GHG emissions or even opt-out from the EU ETS. The EU ETS carbon prices used in sensitivity analysis for the EU ETS sectors are presented in Table 4-48.

Table 4-67. Carbon price used for GHG sensitivity analysis

	Carbon price (in constant €2013/t CO_2)						
	2015	**BY 2017**	**2020**	**2025**	**2030**	**2035**	**2040**
Stable price used in projections	7.5	6	25	25	25	25	25
2019 State of the EU ETS Report[34]	7.5	6	27	40	25	25	25
EC recommended[35]	7.5	9	15	22	33	42	50

Results of the EU ETS GHG emissions sensitivity analysis are presented in Figure 4-30.

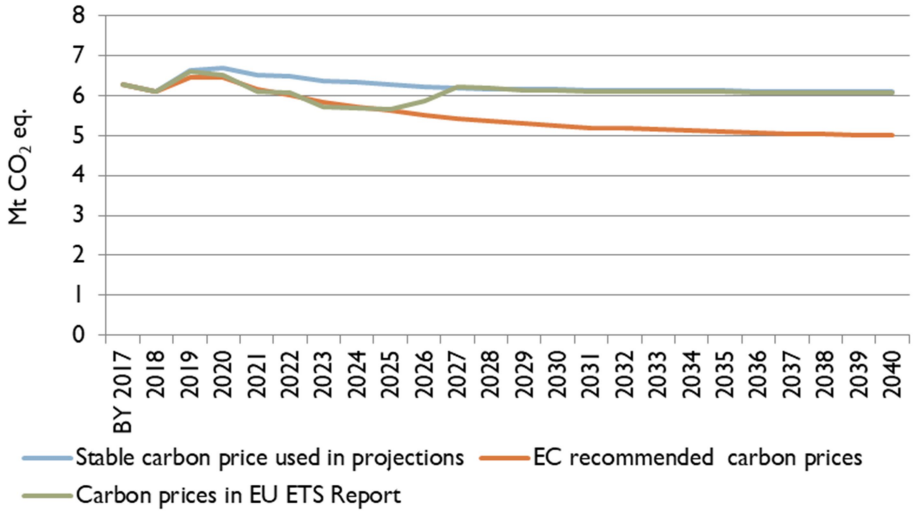

Figure 4-32. Results of carbon price impact on GHG emissions in Lithuania's EU ETS sectors

Sensitivity analysis results showed considerable margin between GHG emissions projected using stable carbon price and increasingly high carbon price in 2040. Huge distinction can be explained due

[34] https://www.i4ce.org/wp-core/wp-content/uploads/2019/05/2019-State-of-the-EU-ETS-Report.pdf
[35] Commission guidance for reporting on GHG projections in 2019 under the MMR

to increase of expenditures for GHG emissions from installations. The operators will most likely consider switching to use biomass instead of fossil fuels. Also, it is more likely that those operators will start investing in energy efficiency due to not only increasing fossil fuel prices, but also due to increasing EUAs price.

Results show that because of increase of EUAs price up to 50 EUR/t CO_2 the biggest reduction of GHG will be seen in Public electricity and heat production sectors and in Manufacturing industries and construction sectors. This is due to the fact that at a current state fossil fuel fired combustion units are still vastly used in these sectors and there is a potential to replace them with biomass using units or to change electricity production sources from thermal CHPs into wind or solar power plants.

Three scenarios of oil production activity data for subsectors 1.B.2.a (Oil) and 1.B.2.c (Venting and flaring) were obtained from Lithuanian geological survey. Oil production activity data impact in sector 1.B "Fugitive emissions", taking into account those 3 scenarios, is provided in Figure 4-31.

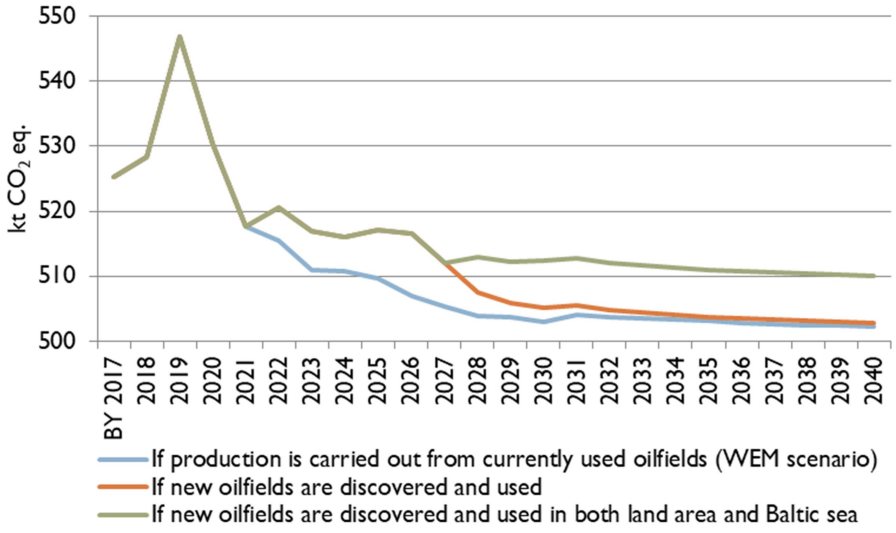

Figure 4-33. Total GHG in sector 1.B "Fugitive emissions" with different oil extraction scenarios in Lithuania

4.2.2. Industrial processes and product use

Sensitivity analysis for IPPU sector emissions is based on the scenarios, where population and annual real GDP growth rate (table below) are based on the values given by the European Commission.

Table 4-68. Values given by European Commission

Indicator	2020	2025	2030	2035	2040
Annual real GDP growth rate (in market prices), %	3.3	0.7	0.7	0.8	0.8
Population in Lithuania, thousands	2 840	2 603	2 366	2 263	2 159

Under sensitivity scenario (SEN), population and GDP growth rate recommended by EC were both implemented in calculations (table below) in Product uses as substitutes for ozone depleting substances subcategory. The methodology for calculating WEM scenario is provided in Chapter 4.1.3.

Table 4-69. GHG emission per subcategory, kt CO_2 eq.

Subcategory	2020	2025	2030	2035	2040
Product uses as substitutes for ozone depleting substances (WEM)	569	354	201	133	92
Product uses as substitutes for ozone depleting substances (SEN)	567	351	198	131	91
Difference, %	-0.04	-0.8	-1.4	-1.5	-1.2

Projections from IPPU sector with existing policies and measures in most subcategories were estimated using projected production levels data (activity data) by 2040 provided by the main emitters in this sector and these subcategories are not affected by the change of population and GDP growth rate.

4.2.3. Agriculture sector

For the estimation of GHG emissions projections from agriculture sector livestock population's projections were provided by the Ministry of Agriculture (MoA). Moreover, EPA also received projections on livestock populations from Institute of Animal Science (IAS). Projections on livestock populations from both institutions slightly differs. IAS provided different livestock population projection for dairy cattle, swine and poultry.

Two databases, International fertilizer association and Statistics Lithuania, provides data on consumption of inorganic N fertilizer. According to the data of 2017, the difference between data on databases is 3%, therefore the assumption was made that under sensitivity scenario (SEN) the consumption of inorganic N fertilizer will be higher by 3% than the amount used in WEM scenario. The methodology for calculating WEM scenario emissions is provided in the Chapter 4.1.4.

Results of sensitivity analysis on the agriculture sector emissions are provided in the table below.

Table 4-70. Comparison of livestock population's and inorganic N fertilizer consumption sensitivity analysis, kt CO_2 eq.

	2017	2020	2025	2030	2035	2040
Enteric fermentation WEM	1 542	1 528	1 463	1 385	1 392	1 393
Enteric fermentation SEN	1 542	1 528	1 515	1 493	1 462	1 421
Difference, %	0.0	0.0	3.6	7.8	5.0	2.0
Manure management WEM	423	421	434	440	456	470
Manure management SEN	423	421	433	442	453	460
Difference, %	0.0	-0.0	-0.3	0.3	-0.7	-2.0
Agriculture soils WEM	2 407	2 415	2 432	2 444	2 463	2 481
Agriculture soils SEN	2 407	2 446	2 469	2 489	2 492	2 494
Difference, %	0.0	1.3	1.5	1.8	1.2	0.5

4.2.4. LULUCF sector

Sensitivity analysis for LULUCF sector was performed applying two different datasets of projected growing stock volume increment and its structure in Forest land to evaluate differences in carbon stock changes of living biomass and dead organic matter pools in Forest land category. Different datasets were provided due to different historical datasets used to evaluate trends in growing stock volume increment and its structure (intermediate and final harvest, natural mortality and accumulation in forest). Historical trends of abovementioned growing stock volume increment and its structure were afterwards applied to project total growing stock volume in future. First projection with straightforward applied growing stock volume increment and its structure trends from historical period (sensitivity scenario – SEN) to future projections was afterwards revised and adjusted in order to better represent recent growing stock volume change tendencies in forests (scenario with existing measures – WEM). Activity data applied for GHG emissions and removals estimation in WEM and SEN scenarios are presented in tables below.

Table 4-71. Activity data for SEN and WEM scenarios, million m^3

	2017	2020	2025	2030	2035	2040
Growing stock volume increment WEM	20.51	20.46	20.37	20.26	20.15	20.04
Growing stock volume increment SEN	20.51	19.82	19.52	19.59	19.52	19.49
Harvested volume WEM	10.11	10.52	11.20	11.56	11.71	11.75
Harvested volume SEN	10.11	10.66	11.48	12.25	12.98	13.64
Natural mortality WEM	3.66	3.61	3.52	3.43	3.33	3.22
Natural mortality SEN	3.66	3.55	3.55	3.67	3.76	3.83
Growing stock volume accumulation WEM	6.74	6.33	5.64	5.27	5.11	5.07
Growing stock volume accumulation SEN	6.74	5.62	4.49	3.68	2.78	2.03

Results of sensitivity analysis in the Forest land category carbon stock changes (living biomass and dead wood) are provided in the table below.

Table 4-72. Comparison of living biomass and dead wood carbon stock changes in Forest land category sensitivity analysis, kt C

	2017	2020	2025	2030	2035	2040
Living biomass WEM	2146.2	2233.4	2005.1	1857.8	1740.4	1710.5
Living biomass SEN	2146.2	2006.3	1637.1	1347.4	994.1	764.0
Difference, %	0	-10.2	-18.4	-27.5	-42.9	-55.3
Dead organic matter WEM	59.2	40.2	46.9	36.7	38.5	36.4
Dead organic matter SEN	59.2	46.8	51.4	54.7	56.5	57.3
Difference, %	0	16.4	9.6	49.0	46.8	57.4

4.2.5. Waste sector

Sensitivity analysis for Waste sector emissions are based on the scenarios, where population and annual real GDP growth rate (table below) are based on the values given by the European Commission.

Table 4-73. Values given by European Commission

Indicator	2020	2025	2030	2035	2040
Annual real GDP growth rate (in market prices), %	3.3	0.7	0.7	0.8	0.8
Population in Lithuania, thousands	2 840	2 603	2 366	2 263	2 159

Under sensitivity scenario (SEN), population and GDP growth rate recommended by EC were both implemented in calculations (table below). The methodology for calculating WEM scenario is provided in Chapter 4.1.6. The subcategories Biological Treatment of waste and Waste incineration are not affected by the change of population and GDP growth rate.

Table 4-74. GHG emission per subcategory, kt CO_2 eq.

Subcategory	2020	2025	2030	2035	2040
Solid waste disposal (WEM)	612	456	351	264	200
Solid waste disposal (SEN)	613	455	346	256	189
Difference, %	0.1	-0.1	-1.4	-3.3	-5.4

Subcategory	2020	2025	2030	2035	2040
Wastewater treatment and discharge (WEM)	163	148	133	114	97
Wastewater treatment and discharge (SEN)	173	140	110	91	74
Difference, %	6.4	-5.1	-16.7	-20.1	-24.1

4.3. Changes compared to the Third Biennial Report

The methodology and assumptions used for the preparation of the projections is different from that used for the preparation of the emission projections for the BR3 report.

The main differences in methodology and assumptions are as follow:

a) The base year in the BR4 is 2017, while in the BR3 was 2014
b) In the BR3 GHG emission projections were estimated for the 1990-2035, whereas in the BR4 emissions are estimated for the 1990-2040.
c) The projected GDP growth rate was taken from Lithuanian energy sector development analysis published by the Lithuanian Energy Institute in the BR3, but for the BR4 it is obtained from the study "Baltic Energy Technology Scenarios 2018" [36]prepared by Nordic Council of Ministers.
d) The projection for population was taken from EU Reference Scenario 2016 in the BR3, while in the BR4 it is taken from the Comprehensive Plan of the Territory of the Republic of Lithuania[37]
e) A WAM scenario was presented in the BR3 for the energy, waste and LULUCF sectors, while in BR4 WAM scenario is presesnted for all sectors.
f) The sensitivity analysis in the BR3 was reported for energy, agriculture and LULUCF sectors, whereas in the BR4 it is reported for all sectors.
g) The GHG emission projections in Energy sector were based on Lithuanian energy sector development analysis performed by Lithuanian energy institute in 2014 in BR3. For BR4, projections were carried out by firstly determining the consumption of fuel in every subsector up to the year 2040. The fuel consumption trends up to the year 2040 were obtained carrying out systematic modelling of consumed fuel and energy types in economy sectors of Lithuania. The model is controlled by Lithuanian Energy Agency.
h) The total number of cars registered in Lithuania was linearly interpolated according to historic data from 2005 to 2014 available from the State Enterprise "Regitra" in BR3. For BR4, the required activity data for the estimation of projections in the Transport sector was provided by The Ministry of Transport and Communications of Republic of Lithuania. Exceptionally, only the trend of compressed natural gas consumption in road transport was linearly extrapolated according to the historic data from 2009 up to 2017. A projected number of cars was entered into a spreadsheet private cars turnover model which calculated a forecast of the breakdown of the passenger car fleet and kilometrage and by power source and by existing and newly bought cars.
i) For BR3 country-specific CO_2 emission factors in Energy and Transport sectors have been derived in study "Determination of national GHG emission factors for energy sector"[38]

[36]http://norden.diva-portal.org/smash/get/diva2:1195548/FULLTEXT01.pdf
[37]http://www.bendrasisplanas.lt/2019/06/03/en/

(performed in 2012 by Lithuanian Energy Institute). For BR4 these emission factors have been updated in study "Update of country specific GHG emission factors for energy sector"[39] (performed in 2016 by Lithuanian Energy Institute), except for all oil products (gas/diesel oil, gasoline, LPG and jet kerosene) produced at AB "ORLEN Lietuva" (oil refinery), for which the accredited Laboratory of Quality Research Centre of this refinery performed measurements for CO_2 emission factors in 2017.

j) The GHG emission projections in Agriculture and LULUCF sector is estimated according to 2006 IPCC Guidelines in the BR4, while in the BR3 GHG emission projections were estimated according to National GHG projections methodology prepared by Lithuanian Energy Institute. The methodology for Agriculture sector was changed due to more detailed data obtained from the Ministry of Agriculture, which allowed a more accurate calculation of emissions. The methodology for LULUCF sector was changed in order to include more detailed activity data needed for projections, such as projections of carbon stock changes in forest land category pools, taking into account historical trend of growing stock volume increment and its use (harvest, mortality and accumulation in forest).

Table 4-75. Changes in projections since BR3 report (WEM scenario), kt CO_2 eq

Projections in BR3 report (using WEM scenario)						
Sector	**2017**	**2020**	**2025**	**2030**	**2035**	**2040**
Energy	11 331	11 758	12 109	12 872	13 582	-
IPPU	3 725	3 945	3 781	3 743	3 738	-
Agriculture	4 917	4 989	5 044	5 093	5 160	-
Waste	846	638	491	427	430	-
LULUCF	-7 944	-7 954	-7 972	-7 990	-8 006	-
Total excl. LULUCF	20 819	21 330	21 425	22 135	22 910	-
Total incl. LULUCF	12 876	13 376	13 453	14 146	14 904	-
Projections in BR4 report (using WEM scenario)						
Sector	**2017**	**2020**	**2025**	**2030**	**2035**	**2040**
Energy	11 599	11 840	11 506	11 206	10 994	10 851
IPPU	3 638	3 929	3 710	3 557	3 489	3 447
Agriculture	4 403	4 399	4 364	4 304	4 346	4 379
Waste	1 061	857	686	567	463	382
LULUCF	-5 296	-4 663	-3 877	-3 329	-3 042	-2 772
Total excl. LULUCF	20 706	21 026	20 266	19 634	19 292	19 059
Total incl. LULUCF	15 409	19 308	20 131	20 982	21 964	22 779

k) The generation of waste in the BR3 report for period 2015-2020 was taken from the National Waste Management Plan for 2014-2020 and for the 2021-2035 period was calculated following the increase during the period 2015-2020, while in the BR4 projections of waste generation are based on historical data as well as projected data on the population and the annual GDP growth.

l) In the BR3 the amount of municipal waste landfilled was provided by Ministry of Environment, whereas in the BR4 it follows the requirements of the Landfill Directive.

m) In BR4 projected emissions from consumption of F-gases are estimated according to 2006 IPCC Guidelines and WEM projection scenario are generally based on the assumptions from

[38]https://am.lrv.lt/uploads/am/documents/files/KLIMATO%20KAITA/Studijos%2C%20metodin%C4%97%20med%C5%BEiaga/Energetikos_EF_studija.pdf

[39]https://am.lrv.lt/uploads/am/documents/files/KLIMATO%20KAITA/Studijos%2C%20metodin%C4%97%20med%C5%BEiaga/Ataskaita_Energetikos_EF_galutine_20160502.pdf

Annexes III and V of F-gases Regulation (EU) No 517/2014[40]. Moreover, in some subcategories projected emissions are based on historical data as well as projected data on the population and the annual GDP growth rate, while in the BR3 projected emissions were extrapolated based on historical data.

The comparison of the parameters used for the projections for the BR3 and BR4 for 2020 and 2030 are provided in the Annex IV.

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[40] Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006

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Photo credits: BOD group

PROVISION OF FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT TO DEVELOPING COUNTRY PARTIES

5. PROVISION OF FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT TO DEVELOPING COUNTRY PARTIES

Article 4(1) of the UNFCCC states that all parties shall fulfil their obligations taking into account their common, but differentiated responsibilities. By doing so, the countries should evaluate their specific national and regional development priorities, objectives and circumstances. Lithuania is among the countries listed in Annex I with the specific added condition that the country is undergoing the process of transition to market economy.

Article 4(3) of the UNFCCC (to provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations under Article 12, paragraph 1), article 4(4) (to assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects) and article 4(5) (to take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties) are applicable to developed countries and countries listed in Annex II of the UNFCCC. Lithuania is not referred to as a developed country listed in Annex II of the UNFCCC.

In December 2009, all Parties of the Convention met in Copenhagen (COP15) and agreed to provide developing countries with new and supplementary, larger-scale, foreseeable and adequate funding to enable them to take more active measures to combat climate change. Developed countries pledged 30 million dollars for 2010-2012, which was called *Fast Start Financing* (FSF). They also set a long-term target for 2020 to jointly mobilize USD 100 billion annually from a variety of sources: public, private and alternative. Despite the difficult economic situation and tight budgetary constraints, the EU and its member states have fulfilled their FSF commitment: in 2010-2012 they jointly awarded 7.34 billion EUR in support.

In line with the Paris Agreement, the commitment of the UN 2030 Agenda and the SDGs, in May 2018, the Commission proposed to set a more ambitious goal for climate mainstreaming across all EU programmes, including in external cooperation, with a target of 25% of EU expenditure contributing to climate objectives for the period 2021 to 2027[41].

In 2013 climate finance provided by the EU to developing countries reached 9.5 billion EUR, in 2014 –14.5 billion EUR, in 2015 –17.6 billion EUR, in 2016 –20.2 billion EUR, in 2017 –20.4 billion EUR.

Although Lithuania is among the countries listed in Annex I with the specific added condition that the country is undergoing the process of transition to market economy and do not have obligations to support developing countries, as part of the EU, Lithuania voluntary has been providing technical and financial support in climate change area to developing countries since 2011.

Lithuania's aim to ensure financial and technological support for the implementation of climate change mitigation and adaptation measures in other countries, as well as cooperating with other countries in developing climate change-oriented projects is determined in various legal acts:

[41] https://ec.europa.eu/clima/policies/international/finance_en

Law on Development Cooperation and Humanitarian Assistance (approved by the Parliament on 16th May 2013). This law determines the goals of the Lithuanian development cooperation policy, formation, implementation, coordination and financing of the Lithuanian development cooperation, and ways of providing humanitarian aid. One of the priority areas of cooperation development is climate change mitigation and adaptation measures.

Law on financial instruments for climate change management (approved by the Parliament in 2009) states that the funds of the Climate Change Programme may be used for climate change mitigation and adaption measures in third countries in accordance with the EU legislation, the UNFCCC, the Kyoto Protocol and other international agreements.

Inter-institutional action plan of implementation of objectives and tasks of the National climate change management policy strategy for 2013-2020 (approved by the Government in 2013 and annually updated). In the inter-institutional Action Plan the identification of potential finance sources in public and private sectors and contribution to financing and implementation of measures of climate change mitigation and adaptation in developing countries are foreseen in 2013 and onwards (up to the year 2020) by the Ministry of Environment.

National Interinstitutional Development Cooperation Action Plan for the period 2017-2019 (approved by the Government in 2016 with the latest amendment in 2017, setting measures for 2018-2020). This Plan lays down development cooperation policy guidelines and sets out concrete measures in order to contribute to the achievement of the sustainable development goals set by the UN 2030 Agenda within the aid recipient countries. The Plan is based on the Lithuanian Law on Development Cooperation and Humanitarian Aid, Lithuania's foreign policy priorities, taking into account relevant strategic documents of the UN and EU, and international commitments. The Plan will help to ensure continuous and efficient implementation and coordination of the development cooperation activities and to enhance Lithuania's role as a reliable and responsible donor country in the international community.

Lithuanian institutions responsible for financial support to developing countries in the field of climate change mitigation and adaptation through are:

- Ministry of Environment through the funding from the Climate Change Programme (the main financial fund);
- Ministry of Foreign Affairs which administrates development cooperation projects, some of the projects are climate related;
- Ministry of Finance that makes contribution to international funds and programs, including EPTATF.

Through 2011-2013 period the Ministry of Environment provided climate finance through various multilateral and regional funds. In 2015 Ministry of Environment made a contribution to the Green Climate Fund (more information can be found in the table 5-1 below).

From 2014 onwards the Ministry of Environment supports **bilateral development cooperation projects** related to climate change. The decision to focus on bilateral support was due to new legislation and policy adopted by the Government of Lithuania (mentioned above). The Ministry of Environment concludes that bilateral support is more efficient and beneficial for both parties, not only helps to share Lithuanian experience and gain valuable relationships through cooperation, but creates enabling environment to using public finances to mobilize private sector investments into low carbon solutions under bilateral cooperation projects transferring technologies to developing countries.

Eligible for this bilateral support are a variety of Lithuanian entities (private and public) which intend to implement climate change mitigation and adaptation projects in developing countries. Each year Ministry's *Commission on development cooperation and humanitarian aid* announces calls for project concepts/applications and selects the most distinguished projects. Requirements for projects and all procedural issues are laid down in the *Manual on the implementation of development cooperation activities by state and municipal institutions and agencies*, approved on 26 March 2014 by Resolution No 278 of the Government of the Republic of Lithuania).

Generally, applicants are required to contribute financially at least 10% of total eligible costs of the project. In this way Lithuania is seeking to mobilize private finance. The Commission approves the list of eligible countries. **Calls for submission of bilateral development cooperation projects** are announced each year – usually in the second quarter – on www.am.lrv.lt, www.orangeprojects.lt and in the national press.

2017 call for bilateral development cooperation projects

Last update: 31.07.2017

The Ministry of Environment of the Republic of Lithuania invites local companies, institutions and organisations to submit projects of bilateral development cooperation in the field of climate change according to conditions confirmed 27.07.2017 by the ministry's Commission on development cooperation and humanitarian aid (see the table below).

Grants are being provided from the funds of the Climate Change Special Programme, administered by the Ministry of Environment of the Republic of Lithuania.

Requirements for bilateral development cooperation projects:

Recipient country(-ies)	Low or lower-middle income (GNP per capita up to 3955 USD) developing country(-ies) according to World bank's classification, included in OECD DAC list of ODA recipients: * **Europe & Central Asia**: Afghanistan, Armenia, Georgia, Kyrgyzstan, Kosovo, Moldova, Tajikistan, Uzbekistan; * **Near East & North Africa**: Egypt, Jordan, Morocco, Syria, Tunesia, West Bank and Gaza Strip, Yemen; * **Latin America & Caribbean**: Bolivia, Guatemala, Haiti, Honduras, Nicaragua, El Salvador; * **East & South Asia, the Pacific Ocean**: Bangladesh, Bhutan, Cambodia, India, Indonesia, , Kiribati, Korea DPR, Lao PDR, Micronesia, Myanmar, Mongolia, Nepal, Pakistan, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka, Timor-Leste, Vanuatu, Viet Nam; * **Sub-Saharan Africa**: Angola, Benin, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Congo DR, Cote d'Ivoire, Djibouti, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Kenia, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, South Sudan, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Figure 5-1. Calls announcements

In 2014 finance was given to the Lithuanian solar cell producer "BOD Group" which implemented project in Malaysia. During the project two solar power plants were installed on the roof-top of the University and in the harbor in the Perak state of Malaysia (total capacity of the solar plants is 60 kW). The total costs of the project were 222,300 EUR, from which 144,000 EUR were subsidy from the Ministry of Environment.

Figure 5-2. Project in Malaysia (photo credits: BOD group)

In 2017 the Ministry of Environment approved 3 solar power plants projects in developing countries.

Lithuanian company "Saulės grąža" is planning by the end of 2020 in Mali (Bamako city) to install 2 solar power plants of total capacity of 200 kW in local university and hospital. The total budget of the project is 385,703.14 EUR, from which 258,385 EUR is the subsidy. Another Lithuanian company "Nogridas" is planning to construct 120 kW solar power plant on a rooftop of Tbilisi University. The total budget of project – 286,757.9 Eur, and subsidy amount equals to 153,695 EUR. The third project in Armenia by "Soli tek Cells" was cancelled due to technical reasons.

In 2018, 3 projects were selected by the Commission on development cooperation and humanitarian aid. Lithuanian company "*Saulės grąža*" is planning to build solar power plant in India (total capacity – 250 kW). Project value is 475 909,02 EUR, of which 239 476,40 EUR is subsidy. In the end of 2019, another company "Solet Technics" has installed 127,8 kW capacity solar power plants on a refugees camp in Georgia. The total cost of the project is 243 627,46 EUR, the subsidy amount equals to 137 604,01 EUR. The third project by "*Saulės aukštis*" in Nepal was cancelled due to technical reasons.

In 2019 during the call for submission, 15 applications were received by the Environment Project Management Agency. It is planned that projects will be selected in the beginning of 2020. The total budget for the call is 1.6 million EUR.

Table 5-1. The data on international climate finance provided by Lithuania

Year	Thousands, EUR	Type of support	Recipient of support	Provider of support
2011	25.7	multilateral	ESMAP - Energy Sector Management Assistance Program, administered by the World Bank	MoE
	29.0	regional	E5P - Eastern Europe Energy Efficiency and Environment Partnership Fund, administered by the European Bank for Reconstruction and Development	MoFA
	34.8	bilateral	Development cooperation projects (Moldova, Georgia)	MoFA
2012	29.0	multilateral	ESMAP	MoE
2013	105.4	regional	E5P (Moldova, Georgia, Armenia)	MoE
	9.2	bilateral	Development cooperation project (Ukraine)	MoFA
2014	222.3	bilateral	Development cooperation project (Malaysia, solar power plants)	MoE
	6.8	regional	Development cooperation project (Armenia, Moldova, Ukraine)	MoFA
	50.0	multilateral	EPTATF - Eastern Partnership Technical Assistance Trust Fund, administered by the European Investment Bank	MoFin
2015	100	multilateral	Green Climate Fund	MoE
	397.4*	bilateral	Development cooperation projects (Moldova, solar power plant)	MoE
	50	multilateral	EPTATF	MoFin
2016	286.5*	bilateral	Development cooperation project (Georgia, solar power plants)	MoE
	50	multilateral	EPTATF	MoFin
2017	618**	bilateral	Development cooperation projects (Mali, Georgia, solar power plants)	MoE
2018	800	bilateral	Development cooperation projects (India, Georgia, solar power plants)	MoE
2019	1600**	bilateral	Development cooperation projects (selection of projects ongoing)	MoE

* planned total project value, including beneficiary's own contribution

** preliminary figures

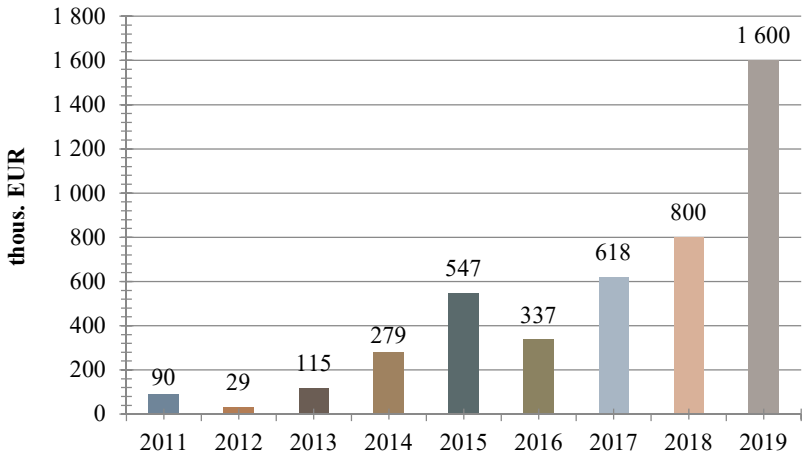

Figure 5-3. International climate finance provided by Lithuania (in EUR thous.)

Starting from 2018 Lithuania has voluntarily doubled its climate finance to developing countries and has intentions to mobilize 1 million EUR for climate financing from public and private sources annually till 2020.

International cooperation on training and capacity building

The EU-funded EU Twinning Program supports cross-border co-operation between institutions, strengthens the administrative capacity of the beneficiary countries and helps them implement the necessary reforms. EU Twinning project is an EU instrument for representatives from the public administrations of the EU Member States and Beneficiary Countries working together in order to transfer the know-how and good practices developed within the EU to beneficiary public administrations during implementation of the Twinning Project. Lithuania is participating in this programme since 2004. Lithuania has been awarded 100 the EU Twinning projects. According to the European Commission, Lithuania is one of the five most successful countries implementing the EU twinning projects. The other four countries are France, Germany, Spain and Austria.

Lithuania has participated in international cooperation measures listed in Table 5-2 below.

Table 5-2. International cooperation measures

Recipient country/region	Programme or project title	Description of programme or project
Serbia	Serbia's waste management system improvement	Specialists of the Ministry of Environment and the Environmental Project Management Agency will help Serbia to develop and improve its waste management system under the EU Twinning programme project intended to support the waste management policy. The European Commission has assigned 1.5 million EUR to this project. The Lithuanian experts will participate in the project together with their colleagues from Austria and Sweden. For two years they will help the Serbian Ministry of Agriculture and Environment to drawn up national and strategic waste management plans, upgrade legislation of this sector and determine economic instruments for ensuring its operation. The EU Twinning programme funded by the European Commission supports cooperation of sister institutions in different countries, enhances the administrative capacity of beneficiaries and helps to implement the necessary reforms.
Macedonia	Strengthening the capacities	Recognizing the need to improve the water quality management issues in the country, the EU, through the Instrument for Pre-Accession Assistance, is funding the Twinning Project *"Strengthening the capacities for effective implementation of the*

Recipient country/region	Programme or project title	Description of programme or project
	for effective implementation of the acquis in the field of water quality	*acquis in the field of water quality"*. The project duration is 21 months (May 2017 – January 2019) with a budget of 1.2 million EUR. The main beneficiary institutions are the Ministry of Environment and Physical Planning and the Hydrometeorological Service. The main EU member state partners are Environment Agency Austria (Umweltbundesamt), Ministry of Environment of the Republic of Lithuania and the National Institute for Public Health from The Netherlands. The project purpose is to strengthen the administrative capacities in the area of water management by implementing the appropriate EU acquis. In particular the project will assist the national authorities in drafting the Vardar River Basin Management Plan and in harmonising and implementing secondary legislation in the area of water monitoring and water permitting.
Georgia	Strengthening Sustainable Management of Forests in Georgia	The EU delegation in the Republic of Georgia notified that EU Twinning project *"Strengthening Sustainable Management of Forests in Georgia"* will be implemented by Lithuanian and Hungarian consortium. The proposal of Lithuanian-Hungarian consortium was selected against the proposals of Austrian-German consortium and Greece. This is the first Twinning project in Georgia, which will be implemented by Lithuania as a leading partner. Ministry of Environment of the Republic of Lithuania, State Forest Service of Lithuania and Ministry of Agriculture of the Republic of Hungary in cooperation with National Food Chain Safety Office of Hungary will enhance the capacity of the state forest institutions in order to prevent and combat illegal activities in the sector, ensuring the sustainable management of Georgian forests and harmonizing the Georgian forest regulatory framework to the EU standards and practices. Environmental Projects Management Agency will be responsible for the project administration management, while Central Project Management Agency will be responsible for the financial management of the project. This Twinning project will be implemented during 18 months period. The European Commission provides the budget of 840,000 EUR. As a Junior Leader, Lithuania has been participating in two other EU Twinning projects in Georgia. Lithuanian Standards Board with partner institutions from Germany were strengthening the Meteorology and Standards Infrastructure in Georgia in 2010-2012. Moreover, Lithuanian National Commission for Energy Control and Prices in cooperation with partners from Austria have been helping to develop Energy Market Regulatory System in Georgia since 2015. EU Twinning project is an EU instrument for representatives from the public administrations of the EU Member States and Beneficiary Countries working together in order to transfer the know-how and good practices developed within the EU to beneficiary public administrations during implementation of the Twinning Project. Lithuania is participating in this programme since 2004. Lithuania has been awarded 76 EU Twinning projects with the budget of 65.5 million EUR. According to the European Commission, Lithuania is one of the five most successful countries implementing the EU twinning projects in 2013-2015. The other four countries are France, Germany, Spain and Austria.
Moldova	Support to the Civil Service Modernization in the Republic of Moldova in line with EU	The Steering Committee of the EU-funded Twinning project *"Support to the Civil Service Modernization in the Republic of Moldova in line with EU best practices"* has gathered for the 7th quarterly meeting. The activities jointly carried out, reform agenda on public administration, building institutional capacity of the State Chancellery as a result of its reorganization process, as well as perspectives on the partnership framework were among the tackled subjects of the meeting. The Twinning project were analysed, such as: providing expertise in drafting

Recipient country/region	Programme or project title	Description of programme or project
	best practices	legislative and normative acts, organizing training programs for civil servants from the Republic of Moldova and others. In this regard, the execution of the planned budget was discussed, concluding the saved financial resources would enable the project to organize additional activities.
Macedonia	Strengthening capacities to effectively implement EU requirements in the area of nature protection in Macedonia.	State service for protected areas under the ministry of Environment, together with the Finnish state-owned enterprise "Metsähallitus" implement the project *"Strengthening capacities to effectively implement EU requirements in the area of nature protection"* in Macedonia. The project consists of four activities: preparation of management plans for natural protected areas, strengthening of capacities for the preparation of assessment studies, strengthening of capacities for the preparation of biodiversity monitoring methodologies and development of the National Biodiversity Monitoring Programme. Project started in the autumn of 2017, with a duration of 24 months. The Lead Project Leader is Finland, while Lithuania is the Junior Project Leader.

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Ministry of Environment webpage http://www.am.lt/VI/en/VI/index.php#a/534

National Interinstitutional Development Cooperation Action Plan for the period 2017-2019 approved by the Government Resolution No 937 on 21 September 2016 https://www.e-tar.lt/portal/legalAct.html?documentId=b079d53083e611e6b969d7ae07280e89

More information about the projects is provided in the webpage: http://am.lrv.lt/lt/veiklos-sritys-1/klimato-kaita/klimato-kaitos-programa

ABREVIATIONS	
BY	Base year
CHP	Combined heat and power
CRF	Common reporting format
CTF	Common tabular format
EPA	Environmental Protection Agency
EPTATF	Eastern Partnership Technical Assistance Trust Fund
ETS	Emissions Trading System
EU	European Union
EUA	European Union emission allowance
GDP	Gross domestic product
GHG	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ISPS Code	International Ship and Port Facility Security Code
JI	Joint Implementation
LULUCF	Land Use, Land-Use Change and Forestry
MMR	Monitoring Mechanism Regulation
MoA	Ministry of Agricultute
MoE	Ministry of Environment
NIR	National Inventory Report
NMVOC	Non-methane volatile organic compounds
NPP	Nuclear Power Plant
QA/QC	Quality assurance/ Quality control
RES	Renewable energy sources
SFS	State Forest Service
UCTE	The Union for the Co-ordination of Transmission of Electricity
UNFCCC	United Nations Framework Convention on Climate Change
WAM	Scenario with additional measures
WEM	Scenario with existing measures

CHEMICAL FORMULAS	
CH_4	Methane
CO_2	Carbon dioxide
HFCs	Hydrofluorocarbons
N_2O	Nitrous oxide
NF_3	Nitrogen trifluoride
PFCs	Perflurocarbons
SF_6	Sulphur hexafluoride
VOC	Volatile organic compounds

UNITS OF MEASUREMENT	
CO_2 eq.	CO_2 equivalent
^oC	Degree Celsius
GWh	Gigawatthour
ha	Hectare
kg	Kilograms
km^2	Square kilometres
kt	Kilotonnes
ktoe	Kilotonne of oil equivalent
Mt	Million tonnes
MW	Megawatt
%	Per cent
PJ	Petajoule
thous.	Thousand
toe	Tonnes of oil equivalent
TJ	Terajoule
TWh	Terawatt hours

ANNEX I. Overview on CTF tables provided with the fourth Lithuania's Biennial Report

CTF Table No	Reporting elements
CTF Table 1	Emission trends
CTF Table 2	Description of quantified economy-wide emission reduction target
CTF Table 3	Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects
CTF Table 4	Reporting on progress
CTF Table 4(a)II	Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
CTF Table 4(b)	Reporting on progress
CTF Table 4	Reporting on progress
CTF Table 4(a)II	Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
CTF Table 4(b)	Reporting on progress
CTF Table 5	Summary of key variables and assumptions used in the projections analysis
CTF Table 6(a)/(c)	Information on updated greenhouse gas projections under a 'with measures' scenario and under a 'with additional measures' scenario
CTF Table 7	Provision of public financial support: summary information CTF Table 7(b) Provision of public financial support: contribution through bilateral, regional and other channels

ANNEX II List of key categories in Lithuanian greenhouse gas inventory

IPCC Category	GHG	Identification criteria
1.A.1 Energy industries - Other fossil fuels	CO_2	T1
1.A.1 Energy industries - Solid fuels	CO_2	T1
1.A.1 Energy industries - Biomass	N_2O	T2
1.A.1 Energy industries - Biomass	CH_4	T2sub*
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO_2	L1,T1,T2
1.A.1.a Public electricity and heat production - Liquid Fuels	CO_2	L1,T1, T2
1.A.1.b Petroleum refining - Liquid Fuels	CO_2	L1,T1
1.A.1.c Manufacture of solid fuels and other energy industries - Gaseous fuels	CO_2	T1sub*
1.A.2 Manufacturing industries and construction - Gaseous fuels	CO_2	L1,T1
1.A.2 Manufacturing industries and construction - Liquid fuels	CO_2	T1,T2
1.A.2 Manufacturing industries and construction - Solid fuels	CO_2	L1,T1
1.A.3.b Road transportation	CO_2	L1,T1,T2
1.A.3.c Railways	CO_2	L1, T1
1.A.4 Other sectors-Biomass	CH_4	L1,L2,T1,T2
1.A.4 Other sectors-Biomass	N_2O	L2sub, T2sub*
1.A.4 Other sectors-Gaseous fuels	CO_2	L1,T1
1.A.4 Other sectors-Liquid fuels	CO_2	L1,T1, T2
1.A.4 Other sectors-Liquid fuels	N_2O	T1
1.A.4 Other sectors-Peat	CO_2	T1sub*
1.A.4 Other sectors-Solid fuels	CO_2	L1,T1,T2
1.A.4 Other sectors-Solid fuels	CH_4	T2sub*
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH_4	L1,T1
2.A.1 Cement Production	CO_2	L1,T1
2.A.2 Lime Production	CO_2	T1
2.A.4 Other process use of carbonates	CO_2	T1
2.B.1 Ammonia Production	CO_2	L1,T1
2.B.2 Nitric Acid Production	N_2O	L1,T1
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	L1,T1, T2
3.A.1 Enteric Fermentation - Cattle	CH_4	L1,L2,T1,T2
3.B.1.1 Manure Management - Cattle	CH_4	L1
3.B.1.3 Manure Management - Swine	CH_4	T1
3.B.2 Manure Management - Cattle	N_2O	L1sub*
3.B.2 Manure Management - Indirect N_2O Emissions	N_2O	L2, T1,T2
3.D.1.1 Direct N_2O Emissions From Managed Soils - Inorganic N Fertilizers	N_2O	L1,L2,T2
3.D.1.2 Direct N_2O Emissions From Managed Soils - Organic N Fertilizers	N_2O	L1, T2
3.D.1.3 Direct N_2O Emissions From Managed Soils - Urine and dung	N_2O	L1,L2,T1,T2
3.D.1.4 Direct N_2O Emissions From Managed Soils - Crop Residues	N_2O	L1,L2

IPCC Category	GHG	Identification criteria
3.D.1.6 Direct N_2O Emissions From Managed Soils - Cultivation of organic soils	N_2O	L1,L2,T1,T2
3.D.2.1 Indirect N_2O Emissions From Managed Soils - Atmospheric deposition	N_2O	L2
3.D.2.2 Indirect N_2O Emissions From Managed Soils - Nitrogen leaching and run-off	N_2O	L1, L2
4.A Forest land, Emissions and removals from drainage and rewetting	CO_2	L1,L2,T1,T2
4.A.1 Forest land remaining forest land - carbon stock change in biomass	CO_2	L1,L2,T1,T2
4.A.1 Forest land remaining forest land - net carbon stock change in dead wood	CO_2	L1
4.A.2 Land converted to forest land - carbon stock change in biomass	CO_2	L1,L2,T1,T2
4.A.2 Land converted to forest land - net carbon stock change in litter	CO_2	L1,L2,T1,T2
4.B Cropland, Emissions and removals from drainage and rewetting	CO_2	L1
4.B Cropland	N_2O	L1, L2, T2
4.B.2 Land converted to cropland - net carbon stock change in mineral soils	CO_2	L1,L2,T1,T2
4.B.2 Land converted to cropland - carbon stock change in biomass	CO_2	L1,L2,T1,T2
4.C.2 Land converted to grassland - net carbon stock change in mineral soils	CO_2	L1,L2,T1,T2
4.D.1 Wetlands remaining wetlands -net carbon stock change in organic soils	CO_2	L1,L2,T1,T2
4.E.2 Land converted to settlements	CO_2	L1,L2,T1,T2
4.G Harvested wood products	CO_2	L1,L2,T1,T2
5.A Solid Waste Disposal	CH_4	L1,L2,T2
5.B Biological treatment of waste	CH_4	T2sub*
5.D Wastewater Treatment and Discharge	CH_4	L1,T1,T2

**Lsub, Tsub denote the categories that were identified by level and trend assessment for a subset without LULUCF when compared to Approach 1*
Abbreviations:
L1, T1 – approach 1 (level and trend) assessment
L2, T2 - approach 2 (level and trend) assessment

ANNEX III Response to the review recommendations of Lithuania's Third Biennial Report

Recommendation	Lithuania's response
Reporting in CTF table 2(b) the base year for each gas in accordance with its target (i.e. 1990 for CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) (see issue 1 in table 3);	The base year for each gas in the BR4 indicated as 1990.
Including in CTF table 2e(I) only the relevant information related to the market-based mechanisms established under the Convention (see issue 2 in table 3);	-
Providing correct and consistent information on its mitigation actions in the textual part of the BR and in the tables (see issue 1 in table 5);	Taking into account the recommendation Lithuania has improved the transparency of its reporting by providing correct and consistent information on its mitigation actions in the textual part of the BR4 and in the CTF table 3.
Providing information on the estimated mitigation impact of its mitigation actions in CTF table 3 or providing clear explanations as to why this may not be possible due to its national circumstances (see issue 2 in table 5);	In the 2018-2019 period, the National integrated energy and climate plan for the period 2021 and 2030 have been prepared. Thus, new additional measures to reach 2030 gials were suggested by the sectoral institutions, consultant companies and other institutions. In the BR4, we present measures identified in a newly adopted plan. The effects of almost all measures reported in previous BRs were reestimated based on data provided from sectoral institutions as well as after evaluation of historical information. The effects of additional measures were evaluated using various methods: tax-related were estimated by the consultants who reviewed different experiences of other countries, based on strategic goals sectoral experts identified the possible metadata/parameters which were reestimated to GHG emissions using IPCC2006 guidelines. Some parametres of suggested measures were discussed in special expert groups.
Providing information related to the use of notation keys and values in CTF table 4 and reporting in CTF table 4 only the relevant information related to the marketbased mechanisms established under the Convention (see issue 1 in table 7);	-
Clearly indicating the year used as a starting point for its projections (see issue 2 in table 11).	The base year for the projections in the BR4 is 2017, it is clearly indentified in the text.