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Report for the Stage 3 *ad-hoc* review of emission inventories submitted under the UNECE LRTAP Convention:

STAGE 3 REVIEW REPORT

KAZAKHSTAN

CONTENT

INTRODUCTION

The mandate and overall objectives for the emission inventory review process under the LRTAP Convention is given by the UNECE document '*Updated methods and procedures for the technical reviews of air pollutant emission inventories reported under the Convention*'[1] – hereafter referred to as the 'Review guidelines 2018'.

1. Paragraph 7 (c) of the 'Review guidelines 2018' defines that stage 3 reviews may be annual centralized reviews or ad hoc reviews. Paragraph 18 of the 'Review guidelines 2018' further specifies that such ad hoc reviews could, for instance, focus on specific source sectors, specific pollutants such as heavy metals or persistent organic pollutants, gridded and projections data, or on other areas as requested by the Implementation Committee and that where appropriate, ad hoc reviews could be conducted in line with the present Methods and Procedures for the In-depth (Stage 3) review.

2. At its seventh joint session in September 2021 the Steering Body and the Working Group approved the plan to perform (in 2022) an in-depth review of $PM_{2.5}$ emissions from residential heating and road transport, with a special focus on the topic of '*condensable particulate matter*' and a follow-up review of the implementation of recommendations given as part of the review carried out in 2021. The Parties reviewed in 2021 are Kazakhstan, Liechtenstein, Monaco and Montenegro.

3. Particulate matter can exist as solid or liquid matter (the "filterable" portion) or as gases (the "condensable" portion). Condensable particulate matter is vapour phase at stack conditions, but condenses and/or reacts upon cooling and dilution upon discharge into ambient air to form solid or liquid PM. All condensable PM is assumed to be in the $PM_{2.5}$ size fraction[2]. The inclusion of the condensable component of $PM_{2.5}$ emissions can have a big impact on the emission estimate for certain sources[3].

4. This ad-hoc review, has assessed $PM_{2.5}$ emission estimates with a special focus on the topic of '*condensables*' for the years 2000 to 2020. Further, for Kazakhstan the implementation of all findings from the in-depth review 2021 have been assessed for all pollutants covered by LRTAP Convention and its protocols (SO_2, NOx, NMVOC, NH_3, plus PM_{10} $PM_{2.5}$, BC, 3 HMs and POP_S) for the time series years 1990 – 2020.

5. This report covers the results of the stage 3 centralised review (ad hoc review) 2022 of the UNECE LRTAP Convention of Kazakhstan coordinated by the EMEP emission centre CEIP acting as review secretariat. The review took place between April and June 2022 and was performed as desk review with an in person meeting between 30 of May 2022 and 3 June 2022. The following team of nominated experts from the roster of experts performed the review.

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[1] Decision 2018/1 adopted by EB: *Updated methods and procedures for the technical review of air pollutant emission Inventories reported under the Convention*. ECE/EB.AIR/142/Add.1
https://unece.org/fileadmin/DAM/env/documents/2018/Air/EB/ECE_EB.AIR_142_Add.1-1902937E.pdf

[2] Condensable Particulate Matter Definition | Law Insider

[3] For more technical details please refer to the EMEP/EEA Guidebook (https://www.eea.europa.eu/publications/emep-eea-guidebook-2019) or the report 'How should condensables be included in PM emission inventories reported to EMEP/CLRTAP?' https://emep.int/publ/reports/2020/emep_mscw_technical_report_4_2020.pdf

Follow-up review of the implementation of findings from the 2021 in-depth review

Energy: Ivana Dukic, Laureta Dibra

Transport: Martina Toceva

Industrial Processes and Product Use: Mirela Poljanac

Agriculture: Andjelka Radosavljevic

Waste: Enkeleda Shkurta

6. Kristina Saarinen, Jeroen Kuenen and Ben Richmond were the lead reviewers. The review was coordinated by Sabine Schindlbacher (EMEP Centre on Emission Inventories and Projections - CEIP).

7. The review was performed on the basis of CLRTAP emission data officially reported by Kazakhstan, due by 15 February 2022 for emission inventories. The Informative Inventory Reports (IIR), reported due 15 March 2022 under the CLRTAP, informed the review.

8. The emission inventory of Kazakhstan was received on 10 February 2022 and thus by the deadline of 15 February. The Informative Inventory Report was received on 14 March 2022 and thus by the deadline of 15 February. The emission inventory was also resubmitted twice before the review, on the 14 March, and 30 March.

RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

1.A.4.b.i Residential: stationary

9. Kazakhstan uses a Tier 1 methodology for calculating $PM_{2.5}$ emissions from '1A4bi – Residential: stationary'. As '1A4bi – Residential: stationary' is a key category, the ERT recommends Kazakstan to use a least a Tier 2 method for calculating emissions from '1A4bi – Residential: stationary' in line with Reporting Guidelines' paragraph 21[1]

10. The activity data is taken from the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan (http://prtr.ecogosfond.kz/, https://oos.ecogeo.gov.kz/, https://ecokadastr.kz/), Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (https://stat.gov.kz/). According to national statistics for 2020, the main type of fuel consumed in the domestic market in this sector is coal. The ERT notes that the activity data is not described transparently enough in the Informative Inventory Report. The ERT recommends the Party to collect more accurate data on fuel use for national circumstances (e.g. different types of fuels, types of biomass, different types of combustion appliances) and to incorporate the information in the inventory for the next submissions.

11. The activity data for Kazakhstan do not include collected wood, i.e. wood directly harvested from the forest outside formal market activity. The ERT encourages the Party to collect data of collected wood for national circumstances and to incorporate the information in the inventory for the next submissions.

12. Kazakhstan has not stratified the total fuel consumption for each fuel type into different appliance types e.g. boilers, stoves in a consistent and complete manner. The ERT recommends that Kazakhstan collect data on national circumstances by describing the fuel consumption for each type of appliance and to incorporate the information in the inventory for the next submissions.

13. Kazakhstan uses the EMEP/EEA Guidebook 2019 for the compilation of its emissions from this category only for year 2019.

14. The emission factors do not include the condensable component of $PM_{2.5}$ emissions (Table 1). During the review week the Party did not provide information on the inclusion of the condensable component of PM for sector 1A4bi.

Table 1: Inclusion of condensables per fuel type

Fuel Type	Includes the condensable component of $PM_{2.5}$ emissions
Biomass	No
Coal	No
Liquid	No
Gaseous	No

15. The ERT notes that the time series is not consistent. The time series 1990-2018 are not consistent for pollutants PM_{10}, $PM_{2.5}$, and TSP. For years 1990, 1995, 2000, 2005, 2010-2018 the notation key "NE" is used and for other years notation key "NA" is used. The ERT recommends Kazakhstan to recalculate the time series with consistent methods for the next submission and to correct the notation keys where appropriate.

16. Kazakhstan did not submit a gridded emission dataset and therefre in the IIR it is not specified how the $PM_{2.5}$ emissions from domestic combustion are spatially distributed. The ERT recommends Kazakhstan to submit a gridded emission dataset and include this information in the IIR to improve transparency.

17. Kazakhstan lists the following planned improvements for future submissions in their 2022 IIR:

- To complete the verification of the initial data presented in the report for 1990-2018 and recalculate the key indicators of the energy sector in accordance with the requirements of EEA Report No. 13/2019.

The ERT commends Kazakhstan for their improvement plans and recommends implementing them as soon as possible.

1.A.3.b.i-iv Road transport exhaust emissions

15. Kazakhstan´s transport sector emissions are calculated using Guidebook emission factors. The IIR does not describe the calculation of transport emissions transparently**.**

16. The activity data is taken from official statistics, bulletin "Б-09-02-Г (2020) - Қазақстан Республикасындағы көлік өнімдері және көрсетілген қызметтері (қатынас түрлері бойынша) туралы.

17. The $PM_{2.5}$ emissions from road transport exhaust do include the condensable component of $PM_{2.5}$ emissions.

18. The ERT notes that the method is not documented transparently in the IIR. The ERT recommends Kazakhstan to include further information on the methods applied to calculate the transport emissions in the IIR, documenting emission factors, activity data and assumptions underlying the estimates as well as the choice of notation keys in the next IIR submissions.

19. The time series is not consistent. The ERT recommends Kazakhstan to recalculate the time series with consistent methods to the next submission.

20. Kazakhstan lists the following planned improvements for future submissions in their 2022 IIR:

- By the end of the analytical review, it is planned to complete the verification of the initial data presented in the report for 1990-2018 and recalculate the key indicators of the energy sector in accordance with the requirements of EEA Report No. 13/2019.

The ERT commends Kazakhstan for their improvement plans and recommends implementing them as scheduled.

21. In addition the ERT recommends implementing the following:

- The ERT strongly recommends Kazakhstan to include information on recalculations based on planned improvements, as stated

- The ERT recommends Kazakhstan to improve the collection of national transport statistics data, enabling the migration to a higher Tier method. It is recommended for the Party to calculate emissions from road transport by using a model, either COPERT, or HBEFA and include this in future submissions.

FOLLOW-UP REVIEW OF THE IMPLEMENTATION OF THE FINDINGS FROM PREVIOUS REVIEWS

22. Kazakhstan was reviewed in-depth in 2021. The review resulted in a number of recommendations. The ERT commends Kazakhstan for implementing several of the recommendations from the last review and also noted with appreciation that several of the items that were not implemented are on the improvement plan. The ERT notes that the following findings are not fully implemented (see Table 1) and recommends Kazakhstan to implement these findings in the next submission.

Table 1: Findings from the 2021 review that have not or only been partially implemented

Sector **Aviation**	NFR Category **1A3a**	Pollutant(s) **All**	Category (TCCCA) **Completeness, Consistency**	TC or RE: **No**
Recommendation text from 2021: For aviation, the ERT noted inconsistencies across the time series regarding emissions data for all pollutants and liquid fuels activity data. The set of pollutants considered is not consistent across the time series and consumption data are not always reported, consequently leading to inconsistencies in implied emission factor values. The same consumption values have been reported from 1990 to 2015, for 2016 there is a noticeable difference with respect to 2015, mainly regarding International LTO consumption. In 2017 and 2018 fuels data are not reported. For 2019, only pollutants for which Tier 1 default emission factors are available in the Guidebook 2019 have been estimated (NOx, CO, NMVOC, SOx estimated on the basis of fuel consumption data in tonnes, ref. Table 3.3 of GB 2019). The same values have been assigned to LTO and Cruise, for each pollutant, for both domestic/International; fuel consumption being specified only for LTO. For previous years, the set of estimated pollutants included NOx, CO, NMVOC, SOx, $PM_{2.5}$, TSP, benzo(a) pyrene, benzo(b) fluoranthene, Indeno (1,2,3-cd) pyrene. BC and HM emissions have not been estimated. Taking into account that, according to the Guidebook 2019, for the estimation of heavy metals, the Tier 1 methodology is sufficient, as emissions of these pollutants depend only on fuel and not on technology, while the emissions of PM depend on the aircraft and the payload (for instance in the 2019 Guidebook, if national PM emission factors are available, BC fraction of PM (f-BC) are suggested). The Party answered that estimates reflect available national information and that it is necessary to analyse the availability of basic statistics to revise aviation emissions for the previous years. Party responded that if possible, the estimates will be revised for the 2020 update. The ERT strongly recommends Kazakhstan to harmonise the aviation emissions estimations, also in terms of completeness, consistency between emissions estimations and reported fuels data, over the years of the historical timeseries, on the basis of the 2019 EMEP/EEA air pollutant emission inventory guidebook, and to update the relevant sections of the IIR accordingly.				
Recommendation text for 2022: The ERT noted the same issue with the fuel consumption inconsistency. The same amount of fuel consumption is reported for the period 1990-2015 and a notable increase in fuel consumption for 1A3ai(i) is reported in 2016. Moreover, the fuel consumption for the period 2017-2018 is not estimated and in the period 2019-2020 the amounts are reported in tons instead of TJ.				

Since there was no response to the raised question during the ERT review process, the ERT strongly recommends the Party to harmonise the aviation emissions estimations, also in terms of completeness, consistency between emissions estimations and reported fuels data, over the years of the historical timeseries, on the basis of the 2019 EMEP/EEA air pollutant emission inventory guidebook, and to update the relevant sections of the IIR accordingly.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Aviation	**1A3ai**	**CO**	**Accuracy, Transparency**	**No**

Recommendation text from 2021: The ERT noted that CO emissions from International aviation show large variability over the years, both for LTO and cruise. In particular, 2019 values are much higher than the values of the previous years. The Party responded that data for domestic and international aviation flights for 2019 are taken from national statistical reports and estimates calculated according to the Guidebook Tier 1 methodology, while data and calculations for the previous years were not updated, but that will be done for next submission. The ERT thanks the Party for their response and strongly recommends Kazakhstan to follow up on their intent, revising and harmonising the estimates on the basis of the EMEP/EEA air pollutant emission inventory guidebook and to update the relevant sections of the IIR accordingly.

Recommendation text for 2022: The ERT has noted the same remark related to the CO emission variability in the time series and that the Party did not implement the previous recommendations. Since there was no response to the raised question during the ERT review process, the ERT strongly recommends Kazakhstan to revise and harmonising the estimates on the basis of the EMEP/EEA air pollutant emission inventory guidebook and to update the relevant sections of the IIR accordingly.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Road Transport	**1A3b**	**PM**	**Completeness, Transparency**	**No**

Recommendation text from 2021: The ERT noted that Kazakhstan estimated only $PM_{2.5}$ emissions. According to the Guidebook 2019, it is assumed that all PM mass emission factors are assumed to correspond to $PM_{2.5}$, as the coarse fraction (PM_{10}-$PM_{2.5}$) is considered negligible, namely $PM_{2.5}$=PM_{10}=TSP. The ERT strongly recommends Kazakhstan to report in next submissions also PM_{10} and TSP, in addition to $PM_{2.5}$. Moreover, in the 2019 EMEP/EEA Guidebook, Tier 1 BC fractions of PM for vehicle category are proposed. The ERT encourages Kazakhstan to also estimate BC. The ERT recommends Kazakhstan to update the relevant sections of the IIR accordingly for next submission, also including information if the estimates of exhaust Particulate Matter emissions from road transport elaborated for the different years take into account both filterable and condensable material.

Recommendation text for 2022: The ERT noted that the Party did not implement the S3 review recommendation from 2021 and did not report PM_{10} and TSP emission estimations. Moreover, the Party did not implement the previous encouragements related to including BC as a fraction PM. Since there was no response to the raised question during the ERT review process, the ERT recommends Kazakhstan to update the relevant sections of the IIR accordingly for next submission, also including information if the estimates of exhaust Particulate Matter emissions from road transport elaborated for the different years take into account both filterable and condensable material.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Road Transport	**1A3b**	**Heavy metals**	**Completeness**	**No**

Recommendation text from 2021: The ERT noted that exhaust emissions of Heavy Metals from road transport are estimated only for Pb in the inventory. Exhaust Heavy Metals emissions from road transport, being fuel consumption dependant, have emission factors for all heavy metals and vehicle categories presented in the EMEP/EEA 2019 Guidebook. The presented factors also take into account the impact of engine wear. The reference to the heavy metal emission factors for all vehicle categories in ppm/wt fuel is Table 3-78, 2019 EMEP/EEA air pollutant emission inventory guidebook 2019 – Update Oct. 2020.
The ERT strongly recommends Kazakhstan to complete for the next submission exhaust Heavy Metals emissions estimations from road transport, on the basis of the 2019 EMEP/EEA air pollutant emission inventory guidebook and to update the relevant sections of the IIR accordingly.

Recommendation text for 2022: The ERT noted the same remarks as in the previous S3 Review. The Party has reported only Pb for the whole reporting period 1990-2020. Since there was no response to the raised question during the ERT review process, the ERT will give the same recommendation to the Party to use the Tier 1 default emission factors for HM prescribed in the 2019 EMEP/EEA air pollutant emission inventory guidebook and calculate the remaining heavy metal emissions for the next reporting cycle.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Road Transport	**1A3b**	**PAHs**	**Completeness**	**No**

Recommendation text from 2021: PAHs emissions have been estimated but totals PAHs have not always been reported for exhaust emissions from road transport. The ERT strongly recommends Kazakhstan to report for next submission also total PAHs emissions estimations from road transport, on the basis of the 2019 EMEP/EEA air pollutant emission inventory guidebook and to update the relevant sections of the IIR accordingly.

Recommendation text for 2022: The Party has partially implemented the recommendations from the previous Review. The Party has calculated the total PAHs for 2019 and 2020, as suggested in the previous Review, however the PAH emissions are not reported for the period 1990-2018. The ERT encourages the Party to improve the inventory and calculate the total PAH emissions for the period 1990-2018.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Road Transport	**1A3biii**	**SOx**	**Completeness**	**No**

Recommendation text from 2021: The ERT noted that SO_x emissions from heavy duty vehicles and buses show large variability in the emission values over the time series. The reported emissions for 2019 (estimated on the basis of fuel sold) has a different order of magnitude compared to the values of the previous years. Kazakhstan responded that the

fuel quantity is obtained from the 2019 statistical bulletin "Fuel Balance of the Republic of Kazakhstan", which details fuel consumption for all types of GCEA activities and that this detail is not available for previous years.

Kazakhstan explained that the analysis of the data of previous years was not carried out and that they aim to update the data. It is necessary to analyse the availability of basic statistics for calculating emissions for previous years. The ERT strongly recommends Kazakhstan to perform for next submission this analysis, and if necessary, revising the estimates, according to the EMEP/EEA 2019 Guidebook and to update the relevant sections of the IIR, providing documentation on the recalculations.

Recommendation text for 2022: The ERT noted that recalculation of the SO_x emissions from road transport has not been carried out for the period 1990-2018. Since there was no response to the raised question during the ERT review process, the ERT strongly recommends the party to analyse the availability of basic statistics for calculating emissions for previous years and if necessary, revise the estimates, according to the EMEP/EEA 2019 Guidebook and to update the relevant sections of the IIR, providing documentation on the recalculations.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Road Transport	**1A3bv**	**NMVOC**	**Completeness**	**No**

Recommendation text from 2021: The ERT noted that NMVOC emissions from Gasoline evaporation have been estimated only for 2019, on the basis of fuel sold. Kazakhstan explained that for previous years it is necessary to perform an analysis of available data first. The ERT strongly recommends Kazakhstan to perform this analysis for next submission, elaborating and reporting the estimates for all years, according to the 2019 EMEP/EEA air pollutant emission inventory guidebook and to update the relevant sections of the IIR.

Recommendation text for 2022: The ERT noted that NMVOC emissions from Gasoline evaporation have been estimated for 2019 and 2020, but not for the remaining period (1990-2018). Since there was no response to the raised question during the ERT review process, the ERT will give the same recommendation as in the previous Stage 3 Review Report and strongly recommend the Party to improve the completeness of the inventory in the next reporting cycle by calculating NMVOC emissions from 1A3bv for the full time series.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Road Transport	**1A3bvi, 1A3bvii**	**PM, PAHs**	**Completeness**	**No**

Recommendation text from 2021: The ERT noted that non exhaust emissions from road transport have been estimated only for 2019 and only for $PM_{2.5}$, PM_{10}, TSP. In the EMEP/EEA 2019 Guidebook, BC fractions, and brake and tyre debris-bound PAH emission factors are also listed. The ERT strongly recommends Kazakhstan to complete the estimations for all years for next submission, according to the EMEP/EEA air pollutant emission inventory guidebook and to update the relevant sections of the IIR.

Recommendation text for 2022: The ERT noted that non-exhaust emissions from road transport have been estimated only for 2019 and 2020. Since there was no response to the raised question during the ERT review process, the ERT strongly recommends Kazakhstan to complete the estimations for all years for the 2023 submission, in line with the EMEP/EEA 2019 Guidebook and to update the relevant sections of the IIR.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Railways	**1A3c**	**CO, PM**	**Accuracy Transparency**	**No**

Recommendation text from 2021: The ERT noted that CO emissions from railways show large variability over the years, showing, in particular a dip in 2016. $PM_{2.5}$ and PM_{10} emissions from railways also show large variability, in particular low values have been estimated from 2010 to 2018, and the 2019 estimate is much higher than 2018 value. BC emissions from railways also show large variability, in particular a dip has been found in emissions in 2017. Kazakhstan explained that the fleet of diesel locomotives has been increasing annually since 2008 and the freight turnover of rolling stock has increased in 2019. To improve calculation of emissions from railway transport, it is necessary to introduce statistical reporting not only regarding mileage, but also concerning fuel consumed. The ERT strongly recommends Kazakhstan to follow up on this intent, updating the estimations according to the EMEP/EEA 2019 Guidebook. The ERT also recommends including this issue in their planned improvements in their IIR and to update all the relevant sections in the IIR.

Recommendation text for 2022: The ERT noted the same issue and noted that same figure is reported as "fuel sold" in the period 1990-2015 and that no fuel activity is reported for the years 2017 and 2018. Despite this, the emissions are not identical. Since there was no response to the ERT's question, nor was there a description of the method used to calculate emissions, the ERT could not make an assessment and has to rely on the previous recommendations. As such, the ERT recommends the Party to include an improvement plan to harmonise the estimates for the entire railways time series, also with regard to the possibilities of rationalising and improving national statistical data collection.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Solvents	**2G**	**All relevant**	**Completeness**	**No**

Recommendation text from 2021:
For 2019 there are only emissions reported for 2D3g -Chemical products and 2D3i - Other solvent use estimated. Emission estimates for 2D3a - Domestic solvent use including fungicides, 2D3d -Coating applications and 2D3f - Dry cleaning are only estimated from 1990 until 2018 and reported as "NE" for 2019. Emissions from 2D3e - Degreasing, 2D3h -Printing and 2G -Other product use are not estimated over the whole time series. The ERT strongly recommends Kazakhstan to estimate and report all emissions for activities that exist in the country for the whole time series for which default methods exist in the EMEP/EEA Guidebook.

Recommendation text for 2022:
In the last year review, the ERT raised the question on missing emissions for category 2G for the whole time series. The ERT notes that this issue is not resolved, and emissions are still not calculated. In the 2022 IIR, Kazakhstan provides information stating that the calculation of emissions from the production of cigarettes and shoes cannot be added to the estimates since these products are taken into account terms of units rather than mass.

The ERT notes that according to the Tier 2 methodology provided in the EMEP/EEA 2019 Guidebook, activity data required to estimate emissions from the use of shoes is annual number of sold pairs of shoes. For tobacco combustion, the quantities of cigarettes and cigars used in tonnes per year should be combined with assumptions provided in the 2019 Guidebook (footnotes of Table 3-15 of Chapter 2G) that one cigarette contains 1 g of tobacco and one cigar contains 5 g of tobacco. Kazakhstan was asked for an explanation why emissions were not calculated by using Tier 2 emission factors provided in the 2019 Guidebook (Tables 3-15 and 3-16 of the 2019 Guidebook).

During the review week Kazakhstan did not respond. The ERT recommends Kazakhstan to include an item on the improvement plan regarding the collection of required statistics for activities contained within sector 2G for the whole time series. The ERT also recommends the Party to calculate of all relevant pollutants and report them transparently in the NFR tables and IIR for the next submission in 2023.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Energy	**1A2d, 1B1a, 1B2aiv**	**NH3, Cr, Cu, Ni**	**Transparency**	**No**

Recommendation text from 2021:
The ERT noted in the NFR tables, 2019 emissions of NH_3, Cr, Cu and Ni were labelled as confidential in the sectors 1A2d, 1B1a and 1B2aiv but no explanation was provided as to why. During the review week Kazakhstan responded that for these sectors a Tier 2 methodology was used, based on data from facilities and calculated according to national methods or obtained because of industrial environmental control. Many companies mark their emissions for these sources as confidential. In the next IIR, the Party plans to provide all data to fully comply with the 2019 EMEP/EEA Guidance methodology. In addition, Kazakhstan provided an updated NFR table for 2019 and in this file the estimates are no longer reported as confidential.
The ERT recommended that the Party reports emissions for all years and subsectors in the next submission.

Recommendation text for 2022:
The ERT noted in NFR table 2020 that NH_3 for the sector 1A2d is labelled as NE, and NH_3, Cr, Cu, Ni for the sector 1B1a are labelled as NA.
The ERT encourages Party to clarify this matter and to provide additional information on this subject with activity data used for emission calculations and to clarify use of notification keys, since that NH_3, Cr, Cu and Ni were previously labelled as confidential for the sectors 1A2d, 1B1a and 1B2aiv. The Party had also stated that they plan to provide all data in a single tier 1 calculation format in order to fully comply with the 2019 Guidance methodology, The ERT recommends the Party to follow up on this intent.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Waste	**5A**	**All**	**Transparency**	**No**

Issue: The ERT notes that the Party does not provide any information about the activity data, EFs and methodology in the IIR 2021. Kazakhstan reported that it is planned to provide the information in the next submission of the IIR. The ERT recommends the Party implement a detailed explanation of the methodology, EFs and activity data source in the next submission of the IIR.

Recommendation text for 2022: The ERT recommends that Kazakhstan improve documentation in the IIR by providing information on the methodology used to estimate emissions from sector 5A in its IIR.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Waste	**5B2**	**NH_3**	**Transparency**	**No**

Issue: The ERT notes that Kazakhstan reports NH3 emissions from category 5B as NE (not estimated) even when there is a Tier 1 method for this category in EMEP/EEA Guidebook 2019. There is no information in the Kazakhstan 2021 IIR as to why the category is reported as NE. The Party responded that technologies for aerobic and anaerobic digestion in Kazakhstan have only just begun to be implemented and there are no statistical data to be used to estimate emissions.

Recommendation text for 2022: In the 2022 IIR there is no information presented for emissions of NH3 for (5B1) Biological treatment of waste – Composting and (5B2) Biological treatment of waste - Anaerobic digestion at biogas facilities because the party notes that technologies for aerobic and anaerobic digestion are in their infancy in Kazakhstan. Currently, the NE notation key is reported in the NFR tables. The ERT recommends Kazakhstan to make calculations for sector 5B2 – 'Biological treatment of waste - Anaerobic digestion at biogas facilities' now that the technology has started to be used within the territory.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Waste	**5C1b**	**All**	**Transparency**	**No**

Issue: The ERT notes that Kazakhstan reports the emission of air pollutants only for the year 2019 in the category 5.C.1.b.i in this submission. No information about the activity data and methodology were identified in the IIR to confirm as to whether an incineration plant started operating in 2019. The Party responded that incineration of solid waste in open landfills is prohibited. Information on the amount of waste directed to incineration with energy extraction is taken from the statistical indicators of 2019. The ERT considered that further clarification is needed and asked if there was no incineration data of industrial waste before 2019. The Party responded that they plan to check the availability of the activity data pre 2019 and if available include the calculation in the 2022 submission. The ERT recommends the Party to check the availability of the activity data and report emissions from this category as well as a detailed explanation in the next submission.

Recommendation text for 2022: In the IIR there is no activity data presented and no information about methodology used. The NFR tables do not present emissions for all years for sector 5C1bi (Industrial waste incineration) – many years are labelled as 'NE'. The ERT recommends the Party to use the EMEP/EEA 2019 Guidebook methodology to report emissions for all relevant years and provide a detailed explanation of analysis data and methodology.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Waste	**5C1biii**	**All**	**Transparency**	**No**

Issue: The ERT notes that Kazakhstan reports emission data from category 5C1biii from the year 2006 onwards, but no explanation is provided in the 2020 IIR. Kazakhstan responded that they are preparing to implement the information on activity data in the next submission. For the question of methodology explanation, the Party sent updated values for 2019 only and responded that they used methodology from EMEP/EEA Guidebook 2019 for calculating emissions for 2019. Kazakhstan plans to implement the explanation in the next submission. The ERT recommends the Party to use EMEP/EEA Guidebook 2019 methodology for all reported years and provide a detailed explanation of activity data and methodologies used in the next submission of NFR tables and IIR.
Recommendation text for 2022: For category 5C1biii (Clinical waste incineration), the NFR tables present data for most pollutants, however the methodology is not described in IIR. The ERT recommends that the Party use methodology for all reported years and provide a detailed explanation of activity data and methodologies used.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Waste	**5E**	**All**	**Accuracy**	**No**
Issue: The ERT notes that Kazakhstan reports emissions for this category as Not Occurring (NO) even when there is Tier 2 methodology available in the EMEP/EEA Kazakhstan 2021 Page 41 of 42 Guidebook 2019. This category includes activities such as sludge spreading, cars/houses/industrial/apartment building fires. It is expected that some of these activities occur in Kazakhstan. Information on fires is mostly accessible through national fire and emergency offices. The Party responded that the availability of the data has to be checked first. The ERT recommends Kazakhstan investigating the availability of the data and provide a schedule of the implementation of this matter in the next submission.				
Recommendation text for 2022: The ERT notes that Kazakhstan reports emissions for this category as NO (Not Occurring) in the NFR tables for all years except 2020, where NE (Not Estimated) is reported. The ERT recommends Kazakhstan to use consistent notation keys across the time series, and if emissions from sector 5E are 'NE', to include this in the IIR and make efforts to estimate emissions from this sector.				

23. During the follow up review, the ERT noted that there were the following notable issues (see Table 2). The ERT recommends Kazakhstan to implement these findings in the next submission.

Table 2: New findings from the 2022 review

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Transport	**1A3b**	**All**	**Completeness, Accuracy, Transparency**	**No**
Issue: The ERT noted an inconsistency in the reported fuel activity data. The fuels are reported in different units across the reporting period. Moreover, activity vehicle data and				

mileage is reported for 2019 and 2020 in the NFR reporting table where the fuels should be reported.

Recommendation text for 2022: The ERT strongly recommends the Party to implement appropriate QA/QC procedures and to correct the fuel consumption reported in the NFR Tables by following the EMEP/EEA air pollutant emission inventory guidebook guidance. Additionally the Party is encouraged to include the vehicle fleet activity data and mileage in the IIR and not in the NFR reporting table in the next reporting cycle.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Industrial Processes	**2A, 2B, 2C, 2H**	**All relevant**	**Completeness, Accuracy**	**No**

Issue:
The ERT commends Kazakhstan for the efforts made to submit missing emissions and relevant activity data in NFRs tables. However, the ERT notes in the NFR tables for 2011, pollutant emissions are reported with notation keys or unreasonably low values although the relevant activity statistics are reported for each of the category. The ERT finds this issue as a possible error that maybe occurred during the manipulation of emissions data for 2011. Kazakhstan was asked for an explanation and correction the possible error in the next submission and to provide information on improvements/corrections in their IIR. During the review week Kazakhstan did not respond.

Recommendation text for 2022:
The ERT recommends Kazakhstan to revise and correct the emission calculation of emissions of relevant pollutants for categories 2A, 2B, 2C, 2H for the year 2011 for the 2023 submission. The ERT also recommends the Party to introduce additional emission data QA/QC for the Industrial processes sector (e.g. graphical analysis of emissions by category) in order to identify the time series inconsistencies more easily and thus improve the accuracy of the reported data.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Solvents	**2D3a,d,f,g,i**	**NMVOC**	**Accuracy**	**No**

Issue:
The ERT commends Kazakhstan for the efforts made to submit emissions in the NFR Tables for the whole time series. However, the ERT notices that for the year 2011, NMVOC emissions are missing for 2D3d, 2D3f, 2D3g and 2D3i (i.e. the notation keys NO, NE are used), although activity data are submitted. Additionally, emissions for sector 2D3a are unreasonably low when compared to adjacent years. Kazakhstan was asked for an explanation, but did not respond during the review week.

Recommendation text for 2022:
The ERT recommends Kazakhstan to revise and correct NMVOC emission calculations for categories 2D3a, 2D3d, 2D3f, 2D3g, 2D3i for the year 2011 for the 2023 submission. The ERT also recommends the Party to introduce additional emission data QA/QC for the Industrial processes sector (e.g. graphical analysis of emissions by category) in order to identify the time series inconsistencies more easily and thus improve the accuracy of the reported data.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Agriculture	**3Da4, 3Db, 3Dd**	**All**	**Transparency**	**No**

Issue: The ERT notes that in the IIR, Kazakhstan have tables stating where the notification keys NE and IE were used. Kazakhstan does not have a table listing the categories where the NA notification key is used. For categories 3Da4, 3Db and 3Dd in the NFR tables it is written that they are NA.

Recommendation text for 2022: The ERT recommends Kazakhstan to make a table in its IIR in the next submission, which will show which are all the categories with the NA notification key in order to be transparent with the NFR tables.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Agriculture	**3F**	**All**	**Completeness**	**No**

Issue: The ERT notes that Kazakhstan used the notification key 'IE' for sector 3F in the NFR tables, and in the IIR in Table 5 it is stated that emissions are included in category 1A4ci. In Table 4 of the Party's IIR, it is stated that emissions from category 3F are 'NE' because the burning of agriculture residues within the field are prohibited by law.

Recommendation text for 2022: The ERT recommends Kazakhstan to harmonize NFR tables and the IIR to clarify whether these emissions are IE and if so, include information within the IIR as to where these emissions are included. However if emissions within 3F are NE, the ERT encourages Kazakhstan to detail in its IIR which law prohibits the burning of agricultural residues in the fields.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Agriculture	**3B1b**	**NOx, NMVOC, SOx, NH_3, $PM_{2.5}$, PM_{10}, TSP**	**Accuracy**	**No**

Issue: Emissions of NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10} and TSP show a 65% decrease in 1997 when compared to 1990, and a 24% decrease compared to 1996, emissions continue to decrease further until 2001. From 2001 onwards, emissions then increase again, however the ERT note that there is no documentation contained within the IIR to explain these trends in emissions.

Recommendation text for 2022: The ERT recommends Kazakhstan to explain in more detail in its IIR, the trend of emissions of NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10} from sector 3B1b.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Energy	**1A1a, 1A1b, 1A1c, 1A2a, 1A4bi,1A4bii, 1B1a, 1B2c**	**SOx, NOx, NMVOC, CO, PMs, PAHs, HCB**	**Transparency**	**No**

Issue:
The ERT noted in the Key Source analysis presented in Table 2 in the IIR that for the pollutants SO_x, NO_x, NMVOC, CO, PMs, PAHs, HCB the sectors 1A1a, 1A1b, 1A1c, 1A2a, 1A4bi, 1A4bii, 1B1a, 1B2c are Key Categories. It is not clear, however, what Tier method was used to calculate the emissions. The ERT notes that for Key Sources a Tier 2 or 3 method should be used to estimate emissions.

Recommendation text for 2022:
The ERT encourages Kazakhstan to provide information in the IIR regarding the methodology Tier that was used to calculate the emissions for the 2023 submission.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Waste	**5D1**	**NH_3, NMVOC**	**Transparency**	**No**

Issue: The ERT notes that there is no information presented regarding activity data, emission factors and the methodology used in the calculation of emissions in the 5D1 category in the 2020 IIR. Kazakhstan responded that this information will be provided in the next submission of the IIR. The ERT recommends the Party to provide all the information about activity data, emission factors and methodology for the whole time series in the next submission of the IIR.

Recommendation text for 2022: In the IIR there is very limited information about methodology, EFs and calculations. The ERT recommends Kazakhstan to provide data and information regarding category 5D1.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Waste	**5D1**	**NH_3**	**Accuracy**	**Yes**

Issue:
Kazakhstan has reported NH_3 emissions occurring from latrines within sector 5D3, these should be reported in sector 5D1 in line with Table 3-2 in chapter 5D of the EMEP/EEA 2019 Guidebook.
Additionally, in Kazakhstan's calculations of emissions from latrines, the NMVOC factor from Table 3-1 appears to have been used rather than the NH_3 factor found in Table 3-2, leading to reported national NH_3 emissions being substantially higher than expected. The ERT found that this issue impacts Kazakhstan's National Total such that a Technical Correction was calculated. Further details of this can be found in Annex I of this report.

Recommendation text for 2022: The ERT recommends Kazakhstan to adopt the calculated Technical Correction in its 2023 submission in sector 5D1, and include information in the IIR detailing the method used to calculate emissions from the sector. The notation key 'NA' should be used for all pollutants in sector 5D3 in the NFR Tables.

Sector	NFR Category	Pollutant(s)	Category (TCCCA)	TC or RE:
Waste	**5D2**	**NMVOC**	**Consistency, Completeness, Transparency**	**No**

Issue: The ERT notes that Kazakhstan reports the emission of NMVOC in category 5.D.2 using notation key IE, but no explanation in which category these data are included is available. Also, no information on methodology and activity data is included in the 2020 IIR. Kazakhstan confirmed that the emissions are reported in category 5.D.1 as the national statistics does not provide information if the wastewater treated was industrial or domestic. The ERT recommends Kazakhstan to include this information in the next submission of the IIR.				
Recommendation text for 2022: The ERT notes that Kazakhstan has not updated Table 5 in the IIR to reflect that 5D2 emissions are included within 5D1 as recommended previously. The ERT recommends to update the information in Table 5 in the next submission, together with any additional required information for sector 5D2.				

REVISED ESTIMATES AND TECHNICAL CORRECTIONS CONSIDERED AND/OR CALCULATED BY ERT

24. In the Appendix of the 'EMEP/UNECE Review Guidelines 2018[4]' it is stated that if the ERT considers that emissions are significantly under- or overestimated, then during the review, the Party is invited to submit "Revised Estimates" that address the issue raised. Should the Party decline to do this, or should it not be possible to agree on the quantification of the Revised Estimates, then the ERT may calculate a "Technical Correction" in the absence of an updated emission estimate being provided by the Party itself. The threshold for significance for a technical correction for the in-depth review in 2022 was set at 2% of the national total, i.e. findings identified which result in an over- or under-estimate of emissions of more than 2% of the national total can result in a Technical Correction. The methods for calculating the Technical Corrections are set up in the "Review Guidelines 2018" and use the EMEP/EEA Emission "Inventory Guidebook" as a reference for methods and emission factors.

25. The ERT calculated one technical correction, this was sent to Kazakhstan who agreed with the ERTs calculations, as such, the technical correction is now deemed to be a revised estimate. Kazakhstan sent zero revised estimates that were accepted by the ERT. The ERT recommends Kazakhstan to consider the Technical Corrections and Revised Estimates in their next inventory submission. Details of the Technical Corrections and Revised Estimates presented in Table 1 are included in ANNEX I TECHNICAL CORRECTIONS AND REVISED ESTIMATES.

Table 2 Summary of revised estimates and technical corrections identified by ERT for country

Number	NFR category (s)	Pollutants	Year(s)	RE/TC quantified (yes/no)	Contribution to national total (%)
RE1-KZ-2022-5D1	5D1	NH_3	All	Yes	+4.1% (2005)

[4] https://www.ceip.at/fileadmin/inhalte/ceip/3_review/advance_version_ece_eb.air_142_add.1.pdf

LIST OF MATERIALS PROVIDED TO ERT

1. Kazakhstan Stage 2 S&A report
2. Kazakhstan Stage 1 report 2022
3. Kazakhstan IIR 2022
4. NFR19 Annex_I_Emissions_1990-2020_Kazakhstan_en_30.03
5. Stage 3 RR from year 2021

ANNEX I TECHNICAL CORRECTIONS AND REVISED ESTIMATES

26. The ERT calculated one technical correction, and this has been accepted by Kazakhstan, hence the ERT now deem this to be a revised estimate. Kazakhstan has sent zero revised estimates that have been accepted by the ERT. Detailed related information is provided separately in the one Excel file:

- RE1-KZ-2022-5D1.xlsx

Table 3: Revised Estimates calculated by the ERT

Revised Estimate for NH_3 emissions in 5D1 Domestic Waste Water			
Year	Original estimate (kt)	Revised Estimate received from MS (kt)	Difference between original estimate and Revised Estimate (kt)
2005	NE	9.44	+9.44
2010	NE	8.73	+8.73
2015	75.06	8.03	-67.03
2016	73.94	7.89	-66.06
2017	73.65	7.86	-65.80
2018	70.14	7.48	-62.66
2019	63.92	6.82	-57.10
2020	66.93	7.14	-59.79

Table 4: Effect of the Technical Corrections and Revised Estimates on the National Total and National Total for compliance

Year	National Total (kt)[5]	National Total for Compliance (kt)[6]	Sum of Revised Estimates and Technical Corrections (kt)	National Total including Revised Estimates and Technical Corrections (kt)	National Total for Compliance including Revised Estimates and Technical Corrections (kt)
2005	223.44	223.44	+9.44	232.88	232.88
2010	256.88	256.88	+8.73	265.61	265.61
2015	351.31	351.31	-67.03	284.28	284.28
2016	365.70	365.70	-66.06	299.64	299.64
2017	383.10	383.10	-65.80	317.30	317.30
2018	400.11	400.11	-62.66	337.45	337.45
2019	401.26	401.26	-57.10	344.16	344.16
2020	413.36	413.36	-59.79	353.57	353.57

[5] Line 141 in Annex I to the reporting guidelines (NFR table)
[6] Line 152 in Annex I to the reporting guidelines (NFR table)