## Annex B to the EEA CEIP technical report Inventory review 2008

**Belarusian contribution to EMEP:**

**Atmospheric Emission Inventory Guidebook Development: View from the NIS**

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CO-OPERATIVE PROGRAMME FOR MONITORING AND EVALUATION OF THE LONG RANGE TRANSMISSION OF AIR POLLUTANTS IN EUROPE
Task Force on Emission Inventories and Projections

National Academy of Sciences of Belarus
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# Atmospheric Emission Inventory Guidebook Development: View from the NIS

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**PREFACE**

Atmospheric Emission Inventory Guidebook – a joint production of multinational team – is a main methodological instrument for emission inventory in the CLRTAP region. It provides a common basis for emission inventory across the Europe; last years its application became more broad due to increase of a number of members of the CLRTAP (Central Asia). Since 1996 when first edition was issued Guidebook have been partially updated in the framework of TFEIP. But due to variety of sources of emission, necessity of provision of inventory of new pollutants (HM, POPs, PM) included in the CLRTAP and limited resources current level of the Guidebook chapters maintenance is different. Last year a process of the Guidebook restructuring and updating was launched.

Taking into account time restrains plans of restructuring and updating are very ambitious. It is very important to provide a regular testing of the process of its updating and restructuring to balance (harmonize) Guidebook from the view of:

a) applicability for emission inventory processes (taking into account real-life experience in view of current emission inventory practices in different countries);

b) level of accuracy of emission estimates which can be obtained using the Guidebook on the whole and different methodologies described in the Guidebook in particularly.

Such testing may allow to make process of the Guidebook updating more flexible.

In accordance with the work-plan of contribution to EMEP in-kind for 2007, an analysis of applicability of current Guidebook for emission inventory in the NIS, analysis of plans of the Guidebook restructure and a model chapter have been conducted. For these purposes experience of national emission inventory, preparation of expert estimates, emission sources testing was utilized.

Outline of this contribution was presented at the latest TFEIP meeting (22-24.10.2007, Dublin, Ireland).

# 1. Comments on methodological chapters of the updated Guidebook and a model chapter

Relations between principals of emission inventory

It should be taken into account that principals of emission inventory are complimentary. Thus within certain resources estimates can't be done simultaneously as accurate and complete as possible. They should be optimized according to certain criteria (priority). It will be useful to show in the Guidebook required level of accuracy, consistency, completeness and other and to show how to measure them. Certain guidelines will be useful. Implementation of harmonization of emission estimates can be a task of EMEP emission centre.

Simple and detailed methodology (current Guidebook), 3-tiers approach (updated Guidebook) and real-life emission inventory methods

Current Guidebook suggests 2 methodologies of emission inventory: simplified and detailed. First one is top-down with application of emission factors and statistics on a country level; second is mainly bottom-up with measurements. In practice in the current GB only simple approach is described in detail. New Guidebook according to plans will have 3 Tiers.

It will be interesting to estimate increase of accuracy against increase of labor cost while using Tier 2 or Tier 3 instead of Tier 1. This will also allow to assess the Guidebook as a source of emission estimates uncertainties.

Analysis of real-life methods of emission inventory in different countries and sectors for their distribution according to Tiers is necessary. Thus dozens of Guidelines are used for inventory in the NIS. In the in-kind report 2005 main of them are shown *(Kakareka et. al, 2006*). These Guidelines applicable at an enterprise level and can be treated as Tier 3 approach.

Key sources

New Guidebook will consider sources which emit 95 % of total mass of a certain pollutant as key-sources like within GHG inventory. This limit seems to be very high: it will be useful to consider as priority sources which emit 70–80 % of total pollutant mass. This will allow to reduce a number of key sectors significantly and save resources.

Sources of statistical information for emission inventory

According to plans of restructuring the Guidebook will contain description of methods of data collection, emission measurements. To be more useful the Guidebook should contain analysis of emission inventory systems in different countries.

It is also should show as a statistical sources not only international statistical editions but also main national statistical issues and statistical reporting formats where national emission experts can get data.

QA/QC procedures in application to emission inventories

Inventory experience shows that increase of the quality of inventory is possible if standard procedures of national emission data review (Stage 1, 2, 3) will be supplemented by regular intercomparison of independent emission inventories along with emission dispersion models intercomparison.

Sources classification

NFR classificator is rather inconvenient for inventory processes especially at a level of enterprise and lower because it is not process-oriented. It is mainly applicable for inventory reporting on a country level. Some difficulties arose also because emission factors are mainly in SNAP. It will be useful to discuss ways of updating of SNAP classificator and in future – new technology-based classificator harmonized with NACE like NOSE.

Emission factors database

Emission factors database (EFDB) is an effective tool for emission inventory compilers. Now it contains a few thousands emission factors mainly for combustion sector. Other sectors are supplied with emission factors to a lower extent. Emission factors are rather different. Problems arose when trying to get a necessary factor for calculation. Analysis of emission factors in the EFDB should be done with ranking their quality and showing their applicability depending on rank, region and technological specificity etc. This will allow to prioritize steps for their improvement.

Guidebook Model Chapter (Cement)

Large work was done to produce a common format for a Guidebook chapter. Of course it should be balanced from the point of view of volume, completeness and usefulness.

Splitting of emission from cement production into emission from combustion and from technological processes as suggested will cause additional problems. Thus heavy metals in emission from cement production are not obligatory from fuel combustion: they can be originated from additives to clinker. This is especially typical for mercury. If we suggest to divide total emissions onto emissions from fuel and from process we should propose two sets of emission factors. It should be taken into account that wastes can be co-fired in cement kilns so we should operate with emissions from wastes also.

It will be not really practical to treat as Tier 2 an inventory of emissions from production of different brands of cement – this can hardly been implemented in real-life inventory.

As Tier 3 approach for cement production an inventory by installations (stages of cement production) within a facility or at least inventory by facilities (bottom up approach) may be suggested.

It will be good if emission factors can be combined with abatement efficiency for emission inventory (for Tier 3 approach) but we need for this unabated emission factors like in RAINS. But the great problem of usage of emission factors approach on a facility level – the lack of unabated emission factors.

## 2. Testing of application of the Atmospheric Emission Inventory Guidebook methodology for EMEP emission inventory in the NIS (on an example of Belarus)

Most of the NIS countries widely use statistical emission data for reporting to EMEP (see in-kind report 2006). Statistical approach is bottom-up, recommended by EMEP – mainly top-down. So questions of comparability of results, general applicability of bottom-up approach for EMEP reporting and possibilities of combining of two approaches arise. These issues were tested on an example of Belarus, where EMEP emission inventory is based on combination of state emission reporting data and calculations using Guidebook methodology.

As it was shown *(Belarusian emission data…, 2007*) for the purposes of EMEP annual emission reporting in Belarus statistical emission data is collected and analysed *(Report on Pollutants…, 2007);* in parallel emission calculation by EMEP methodology (using emission factors from the Guidebook, EFDB, RAINS etc.) and production statistics (*Statistical Yearbook…, 2006)* is made for those sectors where emission factors were available (*Atmospheric Emission…, 2006; EFDB…, 2006; RAINS. Modelling…, 2002 etc)*.

### *Methodology of analysis*

On the first stage statistical emission data was processed. It should be stressed that the annual statistical report on air emissions considers only stationary sources; mobile sources (SNAP 07&08) emission estimates are based on top-down approach using data on consumption of fuel.

The data on emissions in annual reports includes data on annual emission of main pollutants ($SO_2$, CO, $NO_x$, hydrocarbons, NMVOC and VOC) and specific pollutants (since 2005 the list was enlarged to more than 90). Data on emissions of the main pollutants ($SO_2$, CO, $NO_x$, TSP) is given divided into emissions from fuel combustion and emissions from technological and other processes.

In 2005 some changes in statistical reporting and data summarizing in comparison with previous years were made: thus list of reported pollutants was extended. But in fact there is no statistical information about most of POPs as well as PM10 and PM2.5.

Some source categories in the state emission inventory system are not fully covered: e.g. agriculture, waste management and disposal, domestic sector.

From the list of pollutants for mobile sources CO, $SO_2$, $NO_x$, $CH_x$, $SO_x$, Pb, TSP, and benz(a)pyrene are accounted. Exhaust emissions are accounted only.

The economy sectors classification scheme used for annul report on emissions (so-called OKONH) do not coincide with NFR and SNAP; thus additional information is necessary for distribution of emission by NFR. Therefore statistical emission data was converted from OKONH to SNAP classification scheme. Thus ‘statistical emission’ estimates by SNAP were obtained.

Accepted correlations between two classification systems are shown in the table 1. For this conversion a distributed emissions by emission from fuel combustion and emission from technological and other processes was used. Correlations of OKONH and SNAP were made up to SNAP level 2 or 3 depending on sector. It should be stressed that such reclassification of emissions can't be done without certain information loss. General drawback of statistical emission data for all pollutants due to such conversion – emissions of some categories (waste combustion, partially – solvents application) can hardly been extracted from total emissions and can be estimated very roughly.

Table 1 – Accepted correlation between OKONH and SNAP sectors for the distribution of $SO_2$, $NO_x$ CO and PM emission

| SNAP | OKONH code | OKONH sector |
|---|---|---|
| 0101&0102 | 11100 | Power industry (fuel combustion and technological processes) |
| 0103 | 11200 | Fuel industry (fuel combustion) |
| 0201 | 90000 | Housing and communal services (fuel combustion) |
| 0203 | 20000, 30000, 50000, 60000 | Agriculture, forestry, transport and communication, construction (fuel combustion) |
| 0301 | 12100, 12200, 13000, 14000, 15000, 16100, 16500, 17000, 18000, 19400, 19700 | Ferrous metallurgy, non-ferrous metallurgy, chemical and petrochemical industry, engineering industry and metal-working industry, wood industry, industry of construction materials, glass industry, light industry, food industry, printing and other (fuel combustion) |
| 0303 | 12100, 16100, 16500 | Ferrous metallurgy, industry of construction materials, glass industry (technological processes) |
| 0401 | 11200 | Fuel industry (technological processes) |
| 0402 | 14000 | Engineering industry and metal-working industry (technological processes) |
| 0403 | 12200 | Non-ferrous metallurgy (technological processes) |
| 0404& 0405 | 13000 | Chemical and petrochemical industry (technological processes) |
| 0406 | 15000, 17000, 18000, 19400, 30000, 50000, 60000, 90000 | Wood and paper industry, light industry, food industry, printing, forestry, transport and communication, construction, housing and communal services, and other (technological processes) |
| **07&08** | | Mobile sources |

On the second stage 'calculated emission' for main sectors was estimated using Guidebook methodology and other EMEP related issues (RAINS, EFDB, CEPMEIP etc.).

On the third stage both fluxes of information were combined for the best emission estimates; thus 'combined' estimates were obtained; it is assumed that 'combined emission' are preferable values for reporting to EMEP.

For the approximate estimation of 'input' of both approaches ('statistical' and EMEP-based 'calculated') in EMEP emission report values of by-sectors emissions in 'combined' estimates were summarized by approach and then divided by 'combined' total emission (by pollutant).

Comparison of emission estimates by two approaches and their comparative contribution into 'combined' results are shown below.

***Results***

$NO_x$

Results for $NO_x$ emission are given in the table 2.

Table 2 – $NO_x$ emission in Belarus by statistics, by estimation using EMEP methodology and combined, Gg

| Category | SNAP | Statistical emission | Calculated emission | Combined emission |
|---|---|---|---|---|
| **Energy production** | | **44.46** | **58.07** | **62.43** |
| | 0101 | 30.37 | 31.37 | 30.37 |
| | 0103 | 0.94 | IE | 0.94 |
| | 0201 | 5.78 | 0.49 | 5.78 |
| | 0202 | NE | 17.97 | 17.97 |
| | 0203 | 1.61 | IE | 1.61 |
| | 0301 | 5.76 | 8.24 | 5.76 |
| **Industry** | | **16.74** | **4.60** | **17.14** |
| | 0303 | 5.85 | 4.20 | 5.85 |
| | *030303* | *IE*[1] | *0.12* | *IE* |
| | *030311* | *1.69* | *2.27* | *1.69* |
| | *030312* | *IE* | *1.11* | *IE* |
| | *030315* | *2.73* | *0.36* | *2.73* |
| | *030319* | *IE* | *0.34* | *IE* |
| | *030326* | *1.43* | *NE* | *1.43* |
| | 0401 | 5.52 | NE | 5.52 |
| | 0402 | 0.88 | 0.40 | 1.28 |
| | *040207* | *IE* | *0.40* | *0.40* |
| | *040210* | *0.88* | *NE*[2] | *0.88* |
| | 0403 | 0.02 | NE | 0.02 |
| | 0404 | 2.18 | NE | 2.18 |
| | 0406 | 2.29 | NE | 2.29 |
| **Road transport** | | **107.10** | **63.92** | **63.92** |
| | 0701 | IE | 46.97 | 46.97 |
| | 0702 | IE | 1.42 | 1.42 |
| | 0703 | IE | 15.50 | 15.50 |
| | 0705 | IE | 0.03 | 0.03 |
| **Off-road transport** | | **IE** | **43.36** | **43.36** |
| | 0802 | IE | 9.44 | 9.44 |
| | 0805 | IE | 0.97 | 0.97 |
| | 0806 | IE | 31.91 | 31.91 |
| | 0807 | IE | 1.04 | 1.04 |
| **Wastes** | | **NE** | **1.95** | **1.95** |
| | 0909 | NE | 1.95 | 1.95 |
| **Stationary** | | ***61.20*** | ***64.62*** | ***81.52*** |
| **Mobile** | | ***107.10*** | ***107.28*** | ***107.28*** |
| **Total** | | **168.30** | **171.90** | **188.80** |

[1]- IE – included elsewhere

[2] - NE – not estimated

Differences in estimates for stationary combustion sectors (except 0202) between statistical and calculated results are mainly due to differences schemes of aggregations of energy and emission statistics.

Statistics account a lot of technological processes which are minor sources of the $NO_x$ emission.

Statistics do not account residential combustion, some categories of wastes combustion, open burning processes.

EMEP methodology allows to estimate such not-accounted sources as residential sector, to made more accurate and complete estimates of emissions for mobile sources, but does not allow to estimate some minor technological processes in chemistry, wood processing and some others.

On the whole emission totals by two methods are rather close (differences about 2%) (figure 1). Statistical data with minor additions can be used for reporting for stationary sources.

EMEP reporting for $NO_x$ can be based on statistics with distribution by SNAP and NFR; EMEP methodology should be used for unaccounted sectors (domestic, open burning) and for mobile sources for obtaining of harmonized with other countries results with necessary level of sector split. Taking into account these reasons in final estimates statistical data comprise 32%, and calculated – 68%.

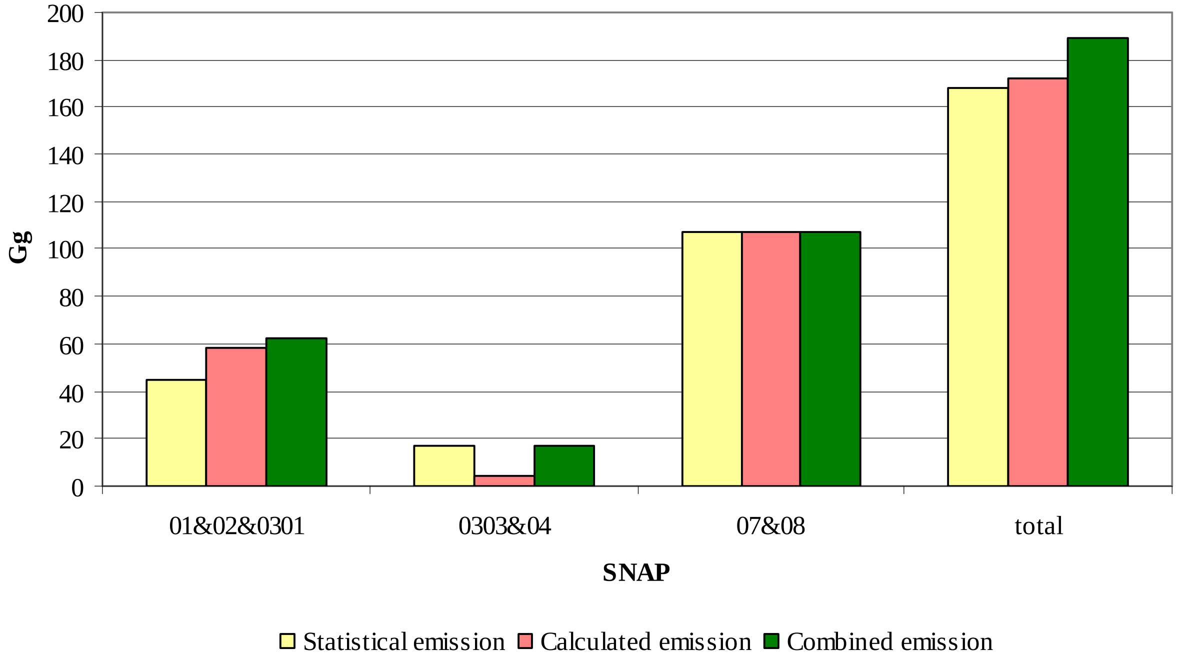


Figure 1 – Statistical versus calculated emission data for $NO_x$ in EMEP emission inventory

<u>$SO_2$</u>

Results of estimation of $SO_2$ emission are given in the table 3.

Like for $NO_x$ statistics do not account residential sector. But residential sector is not a significant source of $SO_2$ emission in Belarus.

Generally statistics allow to estimate technological $SO_2$ emissions with better accuracy than using the Guidebook.

Table 3 – $SO_2$ emission in Belarus by statistics, by estimation using EMEP methodology and combined, Gg

| Category | SNAP | Statistical emission | Calculated emission | Combined emission |
|---|---|---|---|---|
| **Energy production** | | **43.83** | **59.51** | **46.83** |
| | 0101 | 23.75 | 37.72 | 23.75 |
| | 0103 | 0.77 | IE | 0.77 |
| | 0201 | 9.00 | 1.12 | 9.00 |
| | 0202 | NE | 3.00 | 3.00 |
| | 0203 | 3.23 | IE | 3.23 |
| | 0301 | 7.08 | 17.67 | 7.08 |
| **Industry** | | **43.95** | **34.88** | **43.95** |
| | 0303 | 0.76 | NE | 0.76 |
| | 0401 | 35.90 | 34.88 | 35.90 |

Table 3 – cont.

| Category | SNAP | Statistical emission | Calculated emission | Combined emission |
|---|---|---|---|---|
| | 0402 | 0.28 | NE | 0.28 |
| | 0403 | 0.003 | NE | 0.003 |
| | 0404 | 5.28 | NE | 5.28 |
| | 0406 | 1.73 | NE | 1.73 |
| **Road transport** | | **1.5** | **0.34** | **0.34** |
| | 0701 | IE | 0.28 | 0.28 |
| | 0702 | IE | 0.01 | 0.01 |
| | 0703 | IE | 0.05 | 0.05 |
| | 0705 | IE | 0.002 | 0.002 |
| **Off-road transport** | | **IE** | **0.05** | **0.05** |
| | 0802 | IE | 0.01 | 0.01 |
| | 0805 | IE | 0.004 | 0.004 |
| | 0806 | IE | 0.04 | 0.04 |
| | 0807 | IE | 0.001 | 0.001 |
| **Wastes** | | **NE** | **0.28** | **0.28** |
| | 0909 | NE | 0.28 | 0.28 |
| **Stationary** | | ***87.78*** | ***94.67*** | ***91.06*** |
| **Mobile** | | ***1.5*** | ***0.39*** | ***0.39*** |
| **Total** | | **89.28** | **95.06** | **91.45** |

On the whole estimates by two methods are rather close (Figure 2). In final estimates statistical data comprise 96%, calculated – 4%. EMEP reporting can be based on statistics with account of missed sources.

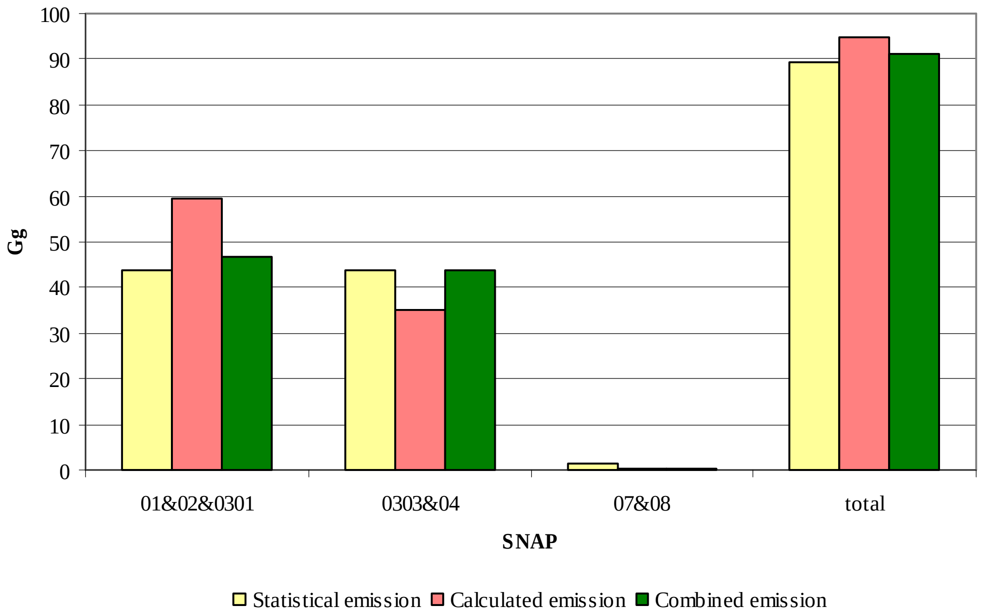


Figure 2 – Statistical versus calculated emission data for $SO_x$ in EMEP emission inventory

PM

Particulate matter is most widely occurred component in emission. Most sectors emit particulate and any estimation is not full.

Only TSP is accounted by statistics and can be compared with calculated results. Comparative emission values for TSP are given in the table 4. Estimation of TSP was made using the GB, RAINS and EFDB.

Table 4 – TSP emission in Belarus by statistics, by estimation using EMEP methodology and combined, Gg

| Category | SNAP | Statistical emission | Calculated emission | Combined emission |
|---|---|---|---|---|
| **Energy production** | | **11.31** | **21.32** | **21.32** |
| | 0101 | 0.15 | 7.54 | 7.54 |
| | 0102 | IE | 0 | 0 |
| | 0103 | 0.64 | IE | IE |
| | 0201 | 5.96 | 3.77 | 3.77 |
| | 0202 | NE | 8.45 | 8.45 |
| | 0203 | 2.50 | IE | IE |
| | 0301 | 2.06 | 1.56 | 1.56 |
| **Industry** | | **30.49** | **9.00** | **32.38** |
| | 0303 | 6.68 | 7.95 | 8.28 |
| | *030303* | *IE* | *0.14* | *0.14* |
| | *030311* | *3.54* | *4.63* | *4.63* |
| | *030312* | *IE* | *2.79* | *2.79* |
| | *030315* | *0.30* | *0.39* | *0.39* |
| | *030326* | *2.84* | *NE* | *0.33* |
| | 0401 | 2.24 | NE | 2.24 |
| | 0402 | 4.15 | 0.18 | 4.33 |
| | *040207* | *IE* | *0.18* | *0.18* |
| | *040210* | *4.15* | *NE* | *4.15* |
| | 0403 | 0.004 | NE | 0.004 |
| | 0404 | 3.76 | NE | 3.76 |
| | 0405 | NE | 0.11 | 0.11 |
| | 0406 | 13.66 | 0.76 | 13.66 |
| **Road transport** | | **34.20** | **7.93** | **7.93** |
| | 0701 | IE | 0.05 | 0.05 |
| | 0702 | IE | 3.28 | 3.28 |
| | 0703 | IE | 4.60 | 4.60 |
| **Off-road transport** | | **IE** | **5.45** | **5.45** |
| | 0802 | IE | 1.09 | 1.09 |
| | 0806 | IE | 4.24 | 4.24 |
| | 0807 | IE | 0.12 | 0.12 |
| **Agriculture** | | **NE** | **8.63** | **8.63** |
| | 1001 | NE | 0.90 | 0.90 |
| | 1009 | NE | 7.73 | 7.73 |
| | *100901* | *NE* | *0.74* | *0.74* |
| | *100902* | *NE* | *1.46* | *1.46* |
| | *100903* | *NE* | *2.52* | *2.52* |
| | *100907* | *NE* | *3.01* | *3.01* |
| **Stationary** | | ***41.80*** | ***38.95*** | ***62.33*** |
| **Mobile** | | ***34.20*** | ***13.38*** | ***13.38*** |
| **Total** | | **76.00** | **52.33** | **75.71** |

On the whole EMEP estimated emission values are lower than statistical (Figure 3). Thus, stationary sources emission by statistics was 41.8 Gg, by EMEP – 38.95 Gg. Mobile sources emission according to statistics was 34.2 Gg, by EMEP calculation – 13.38 Gg.

Emissions from fuel combustion depend significantly on accepted fuels distribution among sectors because of difference of abatement level and emission factors.

Statistics account a lot of sources which can't be estimated using other methods, especially in metal-cutting, wood-processing, light, food and some other branches of industry. From the other hand statistics do not allow to estimate emissions from residential sector, open burning processes, most sectors in agriculture and construction.

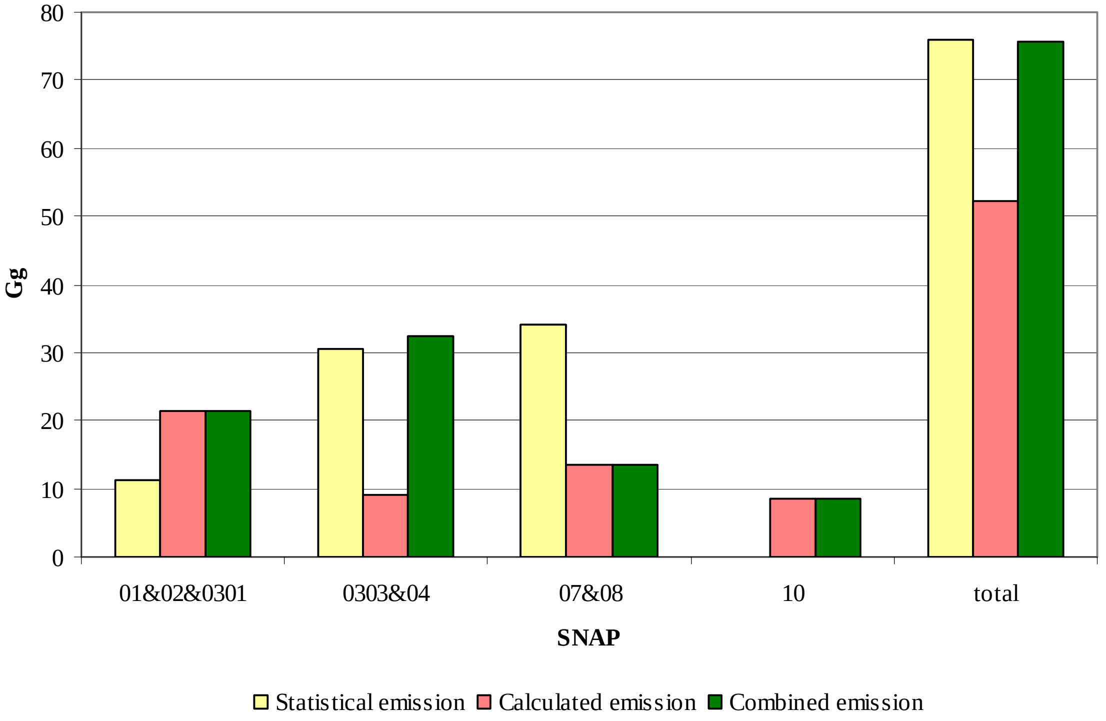


Figure 3 – Statistical versus calculated emission data for TSP in EMEP emission inventory

Regarding mobile sources emission it can be concluded that statistics overestimate PM emission from vehicles.

In final estimates statistical data comprise 32 %, and calculated – 68 %. It can be said that emissions from all combustion processes, contact processes and mobile sources were re-estimated using RAINS and GB due to necessity to harmonize estimates with estimation of PM10 and PM2.5.

It can be recommend for EMEP reporting to use the GB methodology for PM. Among the reasons – the necessity to estimate PM10 and PM2.5 emissions which can't be estimated by statistics. Statistics can be used for verification of results and accounting minor sources.

***NMVOC***

Comparative emission values for NMVOC are given in the table 5.

Table 5 – NMVOC emission in Belarus by statistics, by estimation using EMEP methodology and combined, Gg

| Category | SNAP | Statistical emission | Calculated emission | Combined emission |
|---|---|---|---|---|
| **Energy production** | | **NE** | **19.01** | **19.01** |
| | 0101 | NE | 1.99 | 1.99 |
| | 0201 | NE | 0.23 | 0.23 |
| | 0202 | NE | 16.38 | 16.38 |
| | 0301 | NE | 0.41 | 0.41 |
| **Industry** | | **50.47** | **57.20** | **50.47** |
| | 0401 | 42.82 | 57.20 | 42.82 |
| | 0404 | 7.65 | NE | 7.65 |
| **Solvent and other product use** | | **21.06** | **37.31** | **58.37** |
| | 0601 | 13.29 | 35.68 | 48.97 |
| | *060108* | *IE* | *35.68* | *35.68* |
| | *060109* | *13.29* | *IE* | *13.29* |
| | 0603 | 0.91 | NE | 0.91 |
| | 0604 | 6.86 | 1.63 | 8.49 |
| | *060406* | *6.62* | *IE* | *6.62* |
| | *060408* | *NE* | *1.63* | *1.63* |
| | *060402* | *0.24* | *NE* | *0.24* |
| **Road transport** | | **214.30** | **46.12** | **46.12** |
| | 0701 | IE | 39.22 | 39.22 |
| | 0702 | IE | 0.19 | 0.19 |
| | 0703 | IE | 2.95 | 2.95 |
| | 0705 | IE | 3.76 | 3.76 |
| **Off-road transport** | | **IE** | **5.89** | **5.89** |
| | 0802 | NE | 1.11 | 1.11 |
| | 0805 | NE | 0.03 | 0.03 |
| | 0806 | NE | 4.61 | 4.61 |
| | 0807 | NE | 0.14 | 0.14 |
| **Stationary** | | ***71.53*** | ***113.52*** | ***127.85*** |
| **Mobile** | | ***214.30*** | ***52.01*** | ***52.01*** |
| **Total** | | **285.83** | **165.53** | **179.86** |

Main sectors of NMVOC emission – solvents application, mobile sources, oil refinery, stationary fuel combustion (due to wood burning).

Statistics account NMVOC from oil refinery, solvents application in numerous branches of industry. But it is difficult to divide them by SNAP or NFR sectors and distinguish emissions from technological processes and from solvents application. Not all solvents are accounted (in agriculture, construction, domestic sector). Statistics do not account NMVOC from fuels combustion, some sectors in waste management and combustion. NMVOC emission from mobile sources seems overestimated (Figure 4).

EMEP methodology allows to account NMVOC emission from stationary fuel combustion, domestic sector. It allows also to get more complete estimates of emissions from solvents use. Thus for assessment of NMVOC emission from 0601 data on import and export of dyes and varnishes, expert estimates of average content of volatile part in dyes produced in Belarus were used. But there is a lack of statistical data (for instance, application of different types of solvents by sectors).

The problem of double counting excluding exists also.

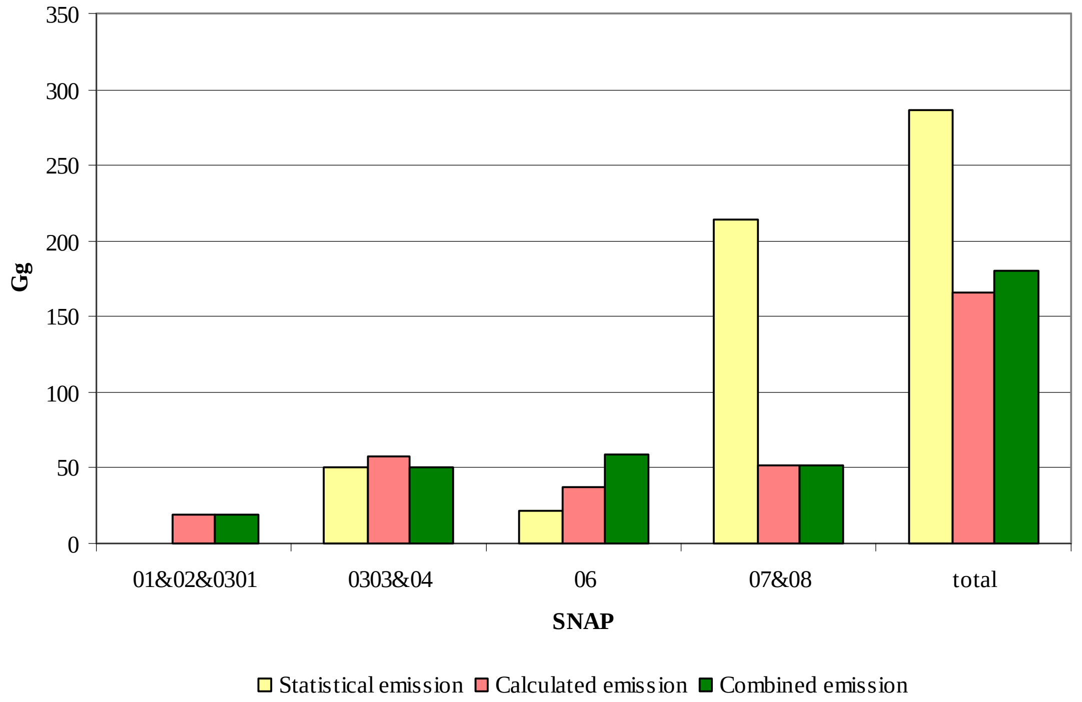


Figure 4 – Statistical versus calculated emission data for NMVOC in EMEP emission inventory

In final estimates statistical data comprise 40% (technological emissions, solvents use). Calculated emissions share is about 60% (fuel combustion, solvents use, mobile sources). It is impossible now to get rather complete estimates of NMVOC emission using statistical or EMEP approach. It can be recommended to use both approaches (statistical and calculation) for EMEP reporting.

$NH_3$

Comparative emission values for $NH_3$ are given in the table 6.

Table 6 – $NH_3$ emission in Belarus by statistics, by estimation using EMEP methodology and combined, Gg

| Category | SNAP | Statistical emission | Calculated emission | Combined emission |
|---|---|---|---|---|
| **Energy production** | | **0.03** | **0.03** | **0.05** |
| | 0101 | 0.03 | 0.01 | 0.03 |
| | 0201 | IE | 0.004 | 0.004 |
| | 0202 | NE | 0.02 | 0.02 |
| | 0301 | IE | 0.003 | 0.003 |
| **Industry** | | **4.82** | **NE** | **4.82** |
| | 0303 | 0.02 | NE | 0.02 |
| | 0401 | 0.10 | NE | 0.10 |
| | 0402 | 0.10 | NE | 0.10 |
| | 0404 | 1.74 | NE | 1.74 |
| | 0406 | 2.86 | NE | 2.86 |
| **Road transport** | | **NE** | **0.02** | **0.02** |
| | 0701 | NE | 0.002 | 0.002 |
| | 0702 | NE | 0.01 | 0.01 |
| | 0703 | NE | 0.01 | 0.01 |

Table 6 – cont.

| Category | SNAP | Statistical emission | Calculated emission | Combined emission |
|---|---|---|---|---|
| **Off-road transport** | | **NE** | **0.01** | **0.01** |
| | 0802 | NE | 0.002 | 0.002 |
| | 0805 | NE | 0.001 | 0.001 |
| | 0806 | NE | 0.004 | 0.004 |
| | 0807 | NE | 0.0001 | 0.0001 |
| **Wastes** | | **NE** | **10.34** | **10.34** |
| | 0904 | NE | 6.12 | 6.12 |
| | 0910 | NE | 4.22 | 4.22 |
| **Agriculture** | | **2.79** | **118.45** | **118.45** |
| | 1001 | 0.03 | 23.97 | 23.97 |
| | 1009 | 2.76 | 94.48 | 94.48 |
| | *100901* | *IE* | *37.77* | *37.77* |
| | *100902* | *IE* | *30.13* | *30.13* |
| | *100903* | *IE* | *16.57* | *16.57* |
| | *100905* | *IE* | *0.02* | *0.02* |
| | *100906* | *IE* | *0.83* | *0.83* |
| | *100907* | *IE* | *9.16* | *9.16* |
| **Stationary** | | ***7.64*** | ***128.82*** | ***133.66*** |
| **Mobile** | | ***NE*** | ***0.03*** | ***0.03*** |
| **Total** | | **7.64** | **128.85** | **133.69** |

A lot of sources of ammonia emission in industry are accounted by statistics. But statistics do not account main ammonia sources in agriculture – manure management and fertilizers application (Figure 5). This can be done using the GB. Calculated data are about 17 times higher than statistical. So in final estimates statistical data comprise only about 6%, calculated – 94%.

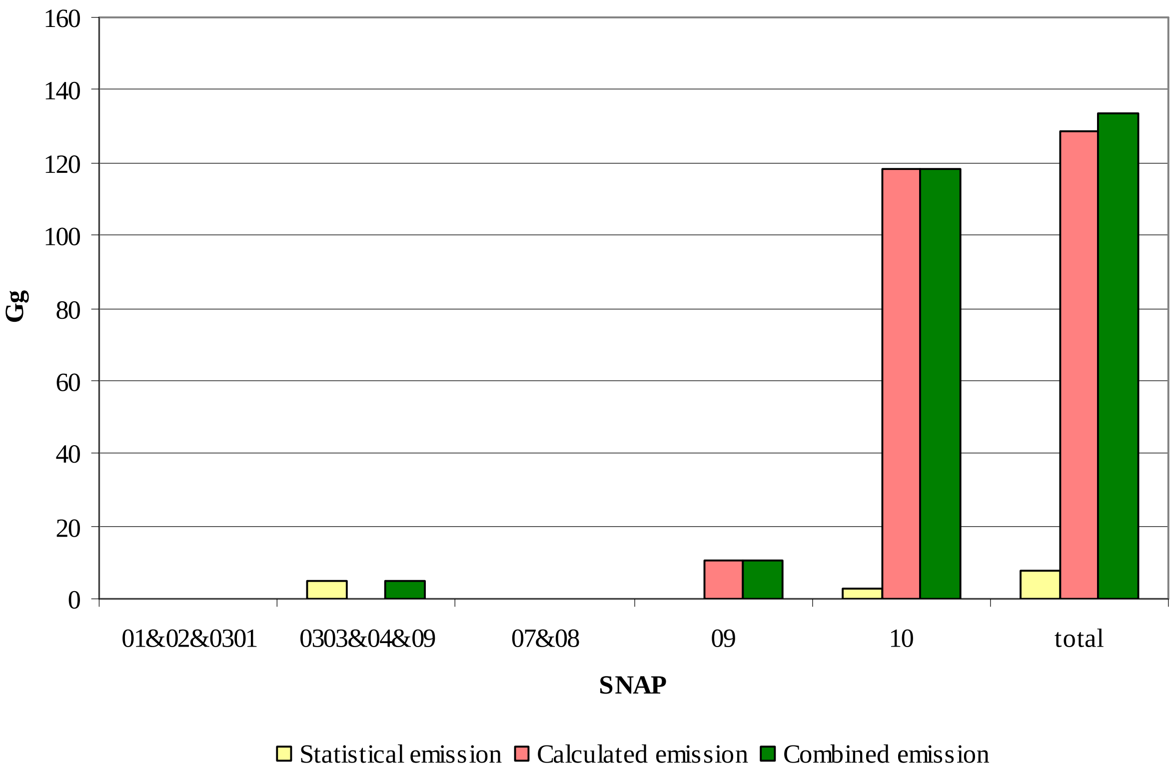


Figure 5 – Statistical versus calculated emission data for $NH_3$ in EMEP emission inventory

It can be recommended to use the GB methodology for $NH_3$ reporting; statistical data should be supplementary.

### *Lead*

Comparative emission values for lead are given in the table 7.

According to statistics lead is emitted from SNAP sectors 0303, 0402, and 0406 (more than 99%). Other sectors provide negligible amount of lead.

Calculated lead emission is about 15.7 times higher than statistical (Figure 6). In final results share of statistical data is about 6 % only. Similar picture is typical for emissions of most other heavy metals: statistics account only small share of total heavy metal emissions. For mercury there is no statistical data on emission.

Table 7 – Lead emission in Belarus by statistics, by estimation using EMEP methodology and combined, Gg

| Category | SNAP | Statistical emission | Calculated emission | Combined emission |
|---|---|---|---|---|
| **Energy production** | | **NE** | **2.98** | **2.98** |
| | 0101 | NE | 1.70 | 1.70 |
| | 0201 | NE | 0.17 | 0.17 |
| | 0202 | NE | 0.40 | 0.40 |
| | 0301 | NE | 0.71 | 0.71 |
| **Industry** | | **3.94** | **44.37** | **48.31** |
| | 0303 | 3.64 | 25.72 | 29.36 |
| | *030303* | *IE* | *0.93* | *0.93* |
| | *030311* | *IE* | *23.35* | *23.35* |
| | *030315* | *IE* | *1.44* | *1.44* |
| | *030326* | *3.64* | *NE* | *3.64* |
| | 0401 | 0.002 | NE | 0.002 |
| | 0402 | 0.15 | 18.65 | 18.80 |
| | *040207* | *IE* | *18.65* | *18.65* |
| | *040217* | *0.15* | *NE* | *0.15* |
| | 0404 | 0.01 | NE | 0.01 |
| | 0406 | 0.14 | NE | 0.14 |
| **Road transport** | | **NE** | **2.20** | **2.20** |
| | 0701 | NE | 0.46 | 0.46 |
| | 0702 | NE | 0.98 | 0.98 |
| | 0703 | NE | 0.76 | 0.76 |
| **Off-road transport** | | **NE** | **0.97** | **0.97** |
| | 0802 | NE | 0.24 | 0.24 |
| | 0805 | NE | 0.08 | 0.08 |
| | 0806 | NE | 0.63 | 0.63 |
| | 0807 | NE | 0.02 | 0.02 |
| **Wastes** | | **NE** | **2.22** | **2.22** |
| | 0902 | NE | 2.22 | 2.22 |
| | 090202 | NE | 2.22 | 2.22 |
| | 090207 | NE | 0.0001 | 0.0001 |
| **Other** | | **NE** | **0.05** | **0.05** |
| | 1103 | NE | 0.05 | 0.05 |
| **Stationary** | | ***3.94*** | ***49.62*** | ***53.56*** |
| **Mobile** | | ***NE*** | ***3.17*** | ***3.17*** |
| **Total** | | **3.94** | **52.79** | **56.73** |

For lead and other heavy metals the GB methodology should be treated as the recommended. But statistical data should be accounted, especially for contact processes where heavy metals are used or produced.

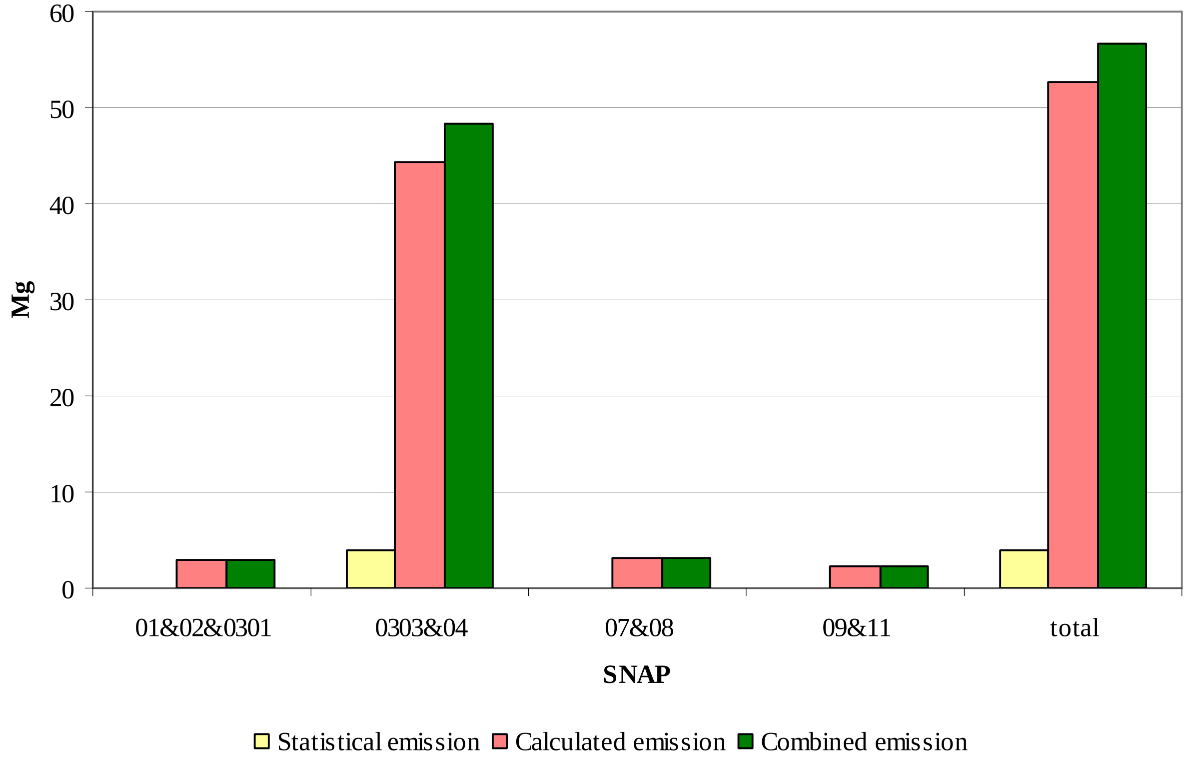


Figure 6 – Statistical versus calculated emission data for lead in EMEP emission inventory

Figure 7 illustrates shares of statistical and calculated data in preliminary EMEP emission report of Belarus.

Generally EMEP emission inventory results exceed state inventory data. Thus for ammonia statistical data comprise only 4% of EMEP emission data, for lead – 6%. For most of POPs (dioxins/furans, PCB, HCB), PM10 and PM2.5 there is no state emission data.

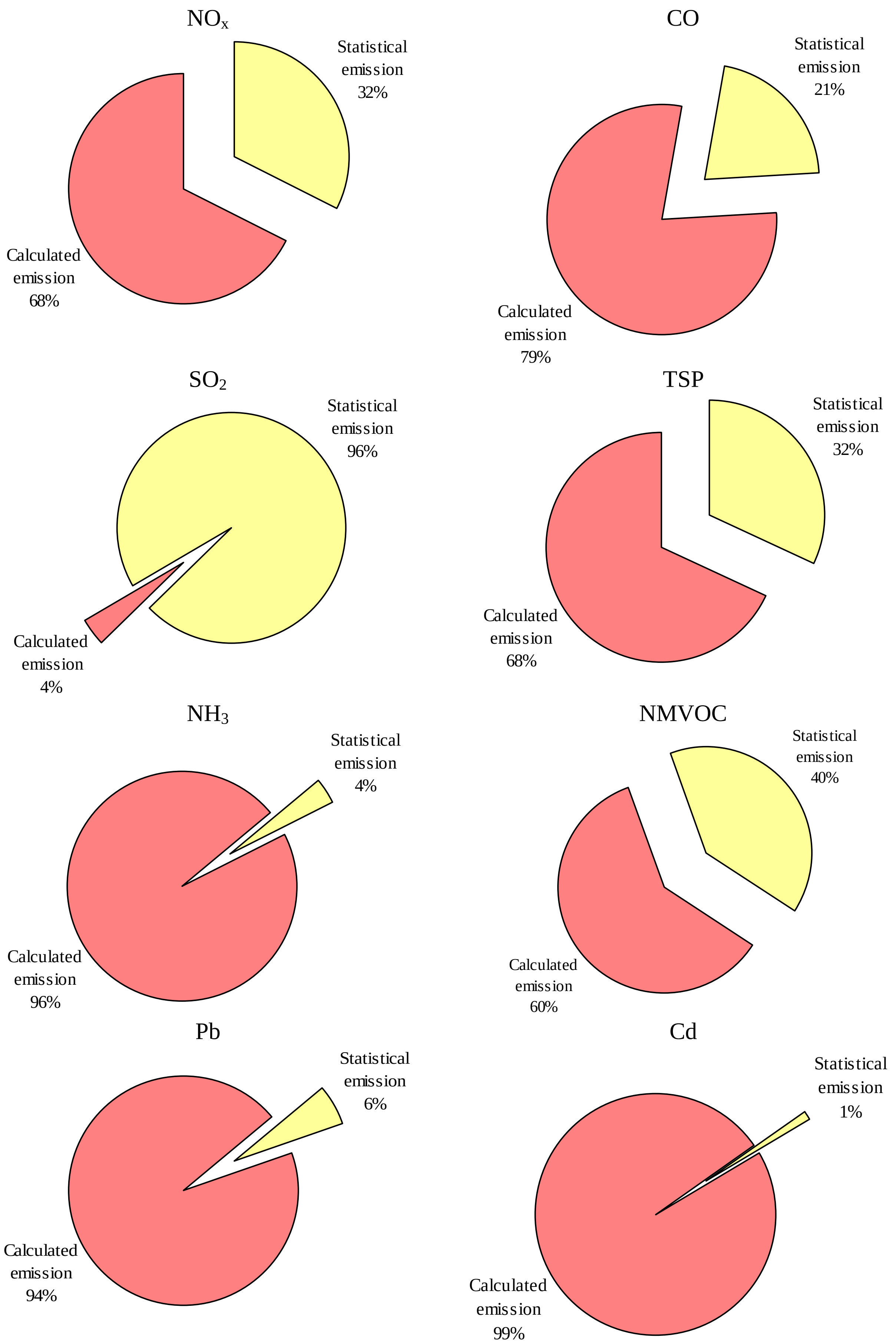


Figure 7 – Shares of statistical and calculated data in EMEP emission inventory (by volume of emission)

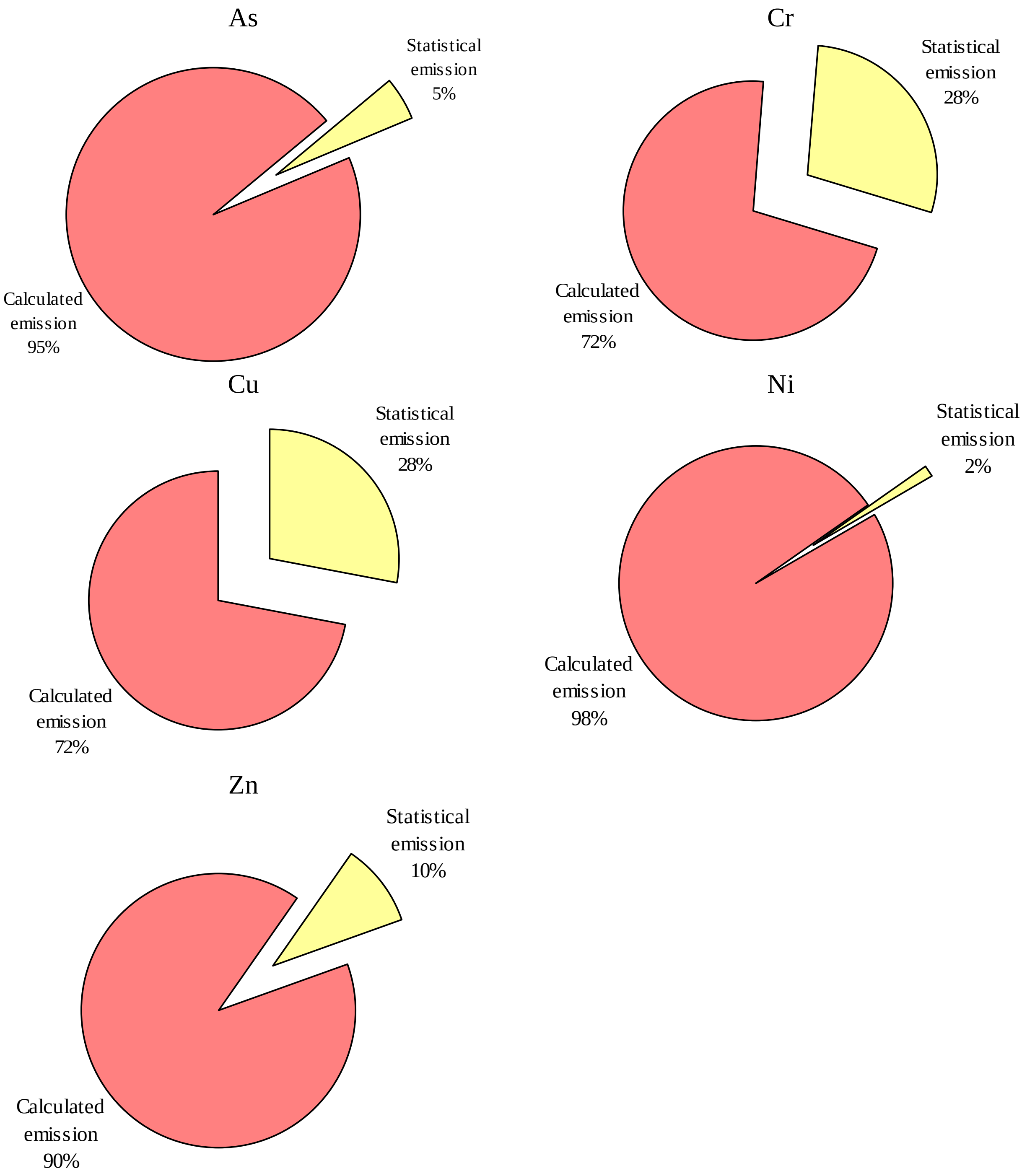


Figure 7 – Shares of statistical and calculated data in EMEP emission inventory (by volume of emission) (continue)

It was also made draft estimate of shares of statistical and calculated data in emission report by number of SNAP sectors (Figure 8). Generally calculated data allows to estimate more SNAP sectors, than statistical, especially for heavy metals.

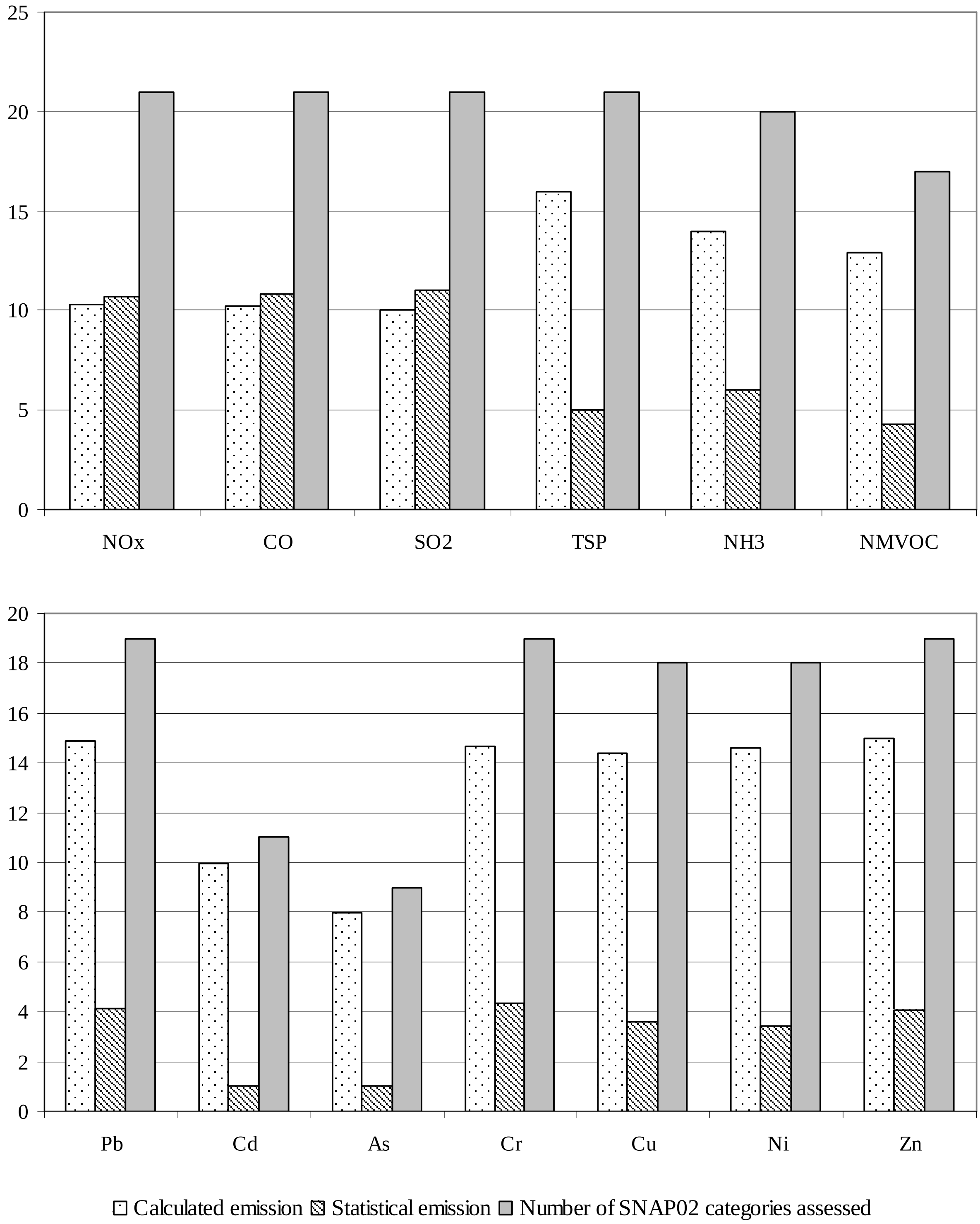


Figure 8 – Shares of statistical and calculated data in EMEP emission inventory (by number of SNAP sectors)

***Discussion***

Problems with using statistical data for EMEP reporting:

– statistical information for all pollutants do not contain data for domestic sector, open burning processes, very scarce information for agriculture, information for mobile sources is not detailed;

– redistribution from OKONH to SNAP and NFR lead to increase of uncertainties of emission data; this uncertainties are lowest for national totals, and increase depending on the level of classification and number of sectors among which data should be distributed;

– when the bottom-up approach is applied all emissions of enterprises of certain sector are summarized, including those which are not belong to key technology (for instance “Cement industry” emissions contains not only emissions from cement production, but from other processes at enterprises which belong to this sector);

Problems with using the top down approach and the Guidebook:

– top down approach is efficient when a number of accounted sectors is rather small; amount of work increase greatly with the increase of accounted sectors;

– application of top down approach is limited also by availability of emission factors and production statistics; thus the Guidebook and other emission inventory guidelines do not provide with emission factors full list of processes;

– top down approach do not account specificity of enterprises in technologies, abatement, operation regimes, fuels and raw materials, changes from year to year etc. So estimates will be smoothed and generally less accurate compared with using bottom up.

Top down against bottom up:

– bottom up approach – more simple, easy for use at a country with state emission statistics; results are more suitable for space distribution of emission, for analysis of trends at a enterprise level. A lot of pollutants can be accounted which are not accounted by emission reports;

– top down provide methodologically more good results in comparable (required) format; it rather convenient for use if a limited number of sectors are accounted, amount of work significantly increase with increase of number of accounted sectors. Results are smooth and good for deriving national trends; accuracy of such estimates rapidly decrease from top to down (EMEP domain – national – regional – point source).

Application of both (bottom up and top down) approaches for deriving of most complete and accurate estimates are optimal.

**Conclusions and recommendation**

***From experience of the Guidebook application in the NIS***

Positive features of the Guidebook:

– Guidebook suggests common methodological basis for emission inventory on a country level;
allows to fill gaps in statistical emission data;

– apply common source classification;

– Guidebook is most effective for emission inventory of pollutants which are not reported by enterprises like POPs, PM10 and PM2.5; HM and ammonia emission data can be significantly improved using the GB.

Shortcomings:

– Guidebook do not account current emission reporting statistics, emission inventory procedures and existing emission estimation guidelines in the NIS; so difficulties arise when it is necessary to combine different types of data for EMEP emission inventory;

– it has some gaps (metal-cutting industry, building materials industry etc.);

– accuracy of estimates for main pollutants using the Guidebook sometimes lower compared with estimates obtained using traditional (top down) method or statistical data;

– it does not account other aspects of emission regulation system (emission permits, emission limits etc).

***View on the Guidebook development from the NIS***

Application of the GB in the NIS for emission inventory now is limited. This is due the rather low level of importance of EMEP emission reporting, traditional state emission reporting system based on bottom-up approach.

Applicability of the Guidebook at the level of enterprise which is the main inventory level in the NIS is rather small. Only some of the latest emission guidelines in the NIS refer the Guidebook especially on inventory of heavy metals and POPs *(Methodical recommendation…, 2004a, b)*. Special Guidebook-based guidelines applicable at this level are necessary.

For promotion of the GB usage in the NIS real-life methods of emission inventory applied in these countries should be investigated. Description of emission inventory systems by regions should be included in the Guidebook or in its supplements. Experience of the GB application in these countries should be analysed.

To provide uniform basis for inventory of emissions Europe-wide Tier 2 emission factors in the Guidebook should became region-specific as planned. For this it is necessary to include (or assimilate) information on real distribution of technologies and control strategies and accordingly region-specific emission factors.

Guidebook user's experience should be taken into account and real case procedures of emission inventory compilation.

On the whole the Guidebook can't be a single instrument for national emission inventory compilers. It should be supplemented by other editions both international and national. So relations with national emission reporting guidelines should be regulated.

It is necessary to provide more wide usage of the Guidebook methodology in the NIS. For these purposes steps both from EMEP and countries to be made.

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