IMPLEMENTATION OF THE ACTION:

QUALITY IMPROVEMENTS OF THE AIR EMISSION ACCOUNTS AND EXTENSION OF PROVIDED TIME-SERIES

FINAL REPORT ON IMPLEMENTATION OF THE ACTION

GRANT AGREEMENT NO. 05122.2016.001-2016.277

SLOVAK REPUBLIC
SEPTEMBER 2018

Slovak Hydrometeorological Institute

Statistical Office of the Slovak Republic

STATISTICAL OFFICE OF THE SLOVAK REPUBLIC

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PART I:

DESCRIPTION OF ALL ACTIVITIES CONDUCTED, WITH AN OVERVIEW OF THE RESULTS AND THE DELIVERABLES PROVIDED

INTRODUCTION

Air protection is one of the important pillars of European environmental legislation. Air pollution is a major environmental risk to health, it causes respiratory problems and other diseases and affects well-being and quality of life. Lost working days or high costs of health care are also attributed to the consequences of bad air quality.

In recent two decades, there has been visible progress in this field. However, there are challenges in front of us in coming periods. In recent years, the heating activities in Slovak households, so called small combustion or domestic heating, have begun to play important role and significantly contribute to the air pollution. The interest of the Slovak Republic, as a part of European Union with common direction in the area of air protection policy, is to improve air quality, prevent premature deaths and various respiratory diseases and reduce the emissions of pollutants annually released into the air.

For the achievements of our common endeavours, the robust and quality information from the area of the environmental statistics are very desirable and necessary. Air Emission Accounts (AEA) are one of these statistics. AEA is the module in the **Regulation (EU) No 691/2011 on European environmental economic accounts, which was amended by the Regulation (EU) No 538/2014**. The Slovak Hydrometeorological Institute (SHMÚ) is responsible for technical preparation of this module, and in cooperation with the Statistical Office of the Slovak Republic (ŠÚ SR), the data are regularly reported to Eurostat.

In spite of the well-established annual reporting process, the Slovak Republic is aware of the need for better quality of data in particular fields - especially in households' heating. In order to further improvement, the Slovak Hydrometeorological Institute decided to apply for the Eurostat subvention grants for 2016, Objective: 05.1 - Provide environmental accounts and climate change-related statistics Modules (DTM): 05.1.21: Monetary environmental accounts; 05.1.22: Physical environmental accounts; 05.1.23: Climate change and other cross-cutting activities.

The Action: **Quality improvements of the air emission accounts and extension of provided time-series** was approved by the **grant agreement no. 05122.2016.001-2016.277** between **European Commission** represented by the **Eurostat** (Directorate E - Sectoral and regional statistics) and the **Slovak Hydrometeorological Institute as a coordinator** of the project and the one other beneficiary **the Statistical Office of the Slovak Republic**.

DESCRIPTION OF THE ACTION

1. OBJECTIVES OF THE PROJECT

The objectives of the project were set in line with the Eurostat priorities for 2016 and 2017. The focus of the project was on module Air Emission Accounts (the objective 05.1.22: Physical environmental accounts). The principal aim of the project was the improvement of data quality for households' reporting and thus the overall enhancement of AEA and awareness on AEA as high quality environmental statistics. The crucial point for further improvement was the obtaining of missing information. Therefore, the essential aspect and majority of time of the project was devoted to the field of the households' heating, especially the heating in the family houses with solid fuels as primary fuel heating. The second project target in light of improvement was to provide enlargement of time-series.

There were set two areas of general objectives with clear definition of the topics, which were necessary to improve during this project:

- **A.1 Major improvements of data quality for households**
  - *Enhanced quality of produced data on households*
  - *Statistics survey in households*
  - *Methodology/model upgrade for energy demand by implementation of results from survey*

- **A.2 Enlargement of provided data beyond the legal requirements**
  - *Providing consistent and more accurate time-series back to the base year (1990) for Air Emission Accounts – beyond the legal requirements*
  - *Dissemination of information and sustainable and consistent approach into the future*

2. PROJECT MANAGEMENT

2.1. Institutions involved in the project

The execution of the action was done through the Multi-Beneficiary Grant Agreement (MBGA). The roles of participated institutions in the context of the project were following:

<u>The major beneficiary and the coordinator of the project:</u>

The Slovak Hydrometeorological Institute

The SHMÚ was in charge of ensuring of coordination activities, specifically: the management of the project and coordination of all related activities, ensuring of the scope and meeting of project objectives and the final deadlines, arranging the coordination of working meetings and technical discussions and project team members, to share knowledge with the project team, monitoring of

conducted activities, monitoring of project progress, communication and reporting of the submissions to the Eurostat. The SHMÚ was further responsible for performing the professional activities in defined subtasks of individual working packages and elaboration of final documentation and dissemination of results.

The other beneficiary: **The Statistical Office of the Slovak Republic**

The active involvement of the ŠÚ SR in the project was indispensable due to the lack of necessary statistical data required for the improvement of the AEA. The ŠÚ SR was responsible for the cooperation with project management, preparation of the statistical survey, data collection in field, checking and validation of collected data, the ŠÚ SR was also involved in elaboration of final documentation

2.2. Human resources for the project

Two groups of the project team were established. The project team of the SHMÚ group consisted of **seven experts** of the Department of Emission and Biofuels including the project leader and supervisor, who were actively involved in working packages of the project. In comparison with planned human resources for the project, the number of experts has increased from five to seven experts. The change has been done due to the job termination of long-term experienced employee, who was included in the original matrix of experts.

The project team of the ŠÚ SR was consisted of **eight statisticians** (including the project manager) from Cross-sectional, General Methodology and Registers Section Department and the Section of Industrial Data Collection and Processing and Field Surveys. The Supervisor at the ŠÚ SR was not directly involved in the project team.

Project leader and coordinator: **Ivana Ďuricová**
Air Emission Expert at the Department of Emission and Biofuels, Air Quality Unit, SHMÚ.
Responsible for management of the project, its execution and professional project activities.

Supervisor of the project: **Janka Szemesová**
Head of the Department, Department of Emission and Biofuels, Air Quality Unit, SHMÚ.
Responsible for supervising and monitoring of the project and professional project activities.

Project team at the SHMÚ:
In the project team were involved other **five internal experts** of the Department of Emission and Biofuels. The roles and performed activities are described in *Annex I*.

Project manager at the ŠÚ SR: **Eva Šmelková**
Senior Statistician specializing in environmental statistics and accounts, Cross-sectional Statistics Department of the ŠÚ SR.
Responsible for management of the project at the ŠÚ SR and execution of defined activities.

Project team (ŠÚ SR):
In the project team of the ŠÚ SR were involved other **seven internal statisticians –** one statistician of Statistical Surveys and Methodology Department and six statisticians of Department of Field Surveys (in Banská Bystrica). The roles and performed activities are described in *Annex I*.

External interviewers (under contract):
Responsible for work in field - visiting of households and collecting data through face-to-face interview.

Subcontractor: **External expert for GHG emission inventory**
Slovak University of Technology in Bratislava, STU. External expert for GHG emission inventory – energy sector; consulting activities; methodology for converting of historical data emission data.

2.3. Time schedule of the project

The starting date of the project was the 1st February 2017. The project finished after 18 months, on the 31st July 2018. The planned duration of the project was achieved.

The project was divided into five phases – five working packages – with defined specific content of the activities and time scale to fill the goals of the particular work objectives. The *Scheme 1* presents the planned activities divided into five working packages in graphic overview with time scale.

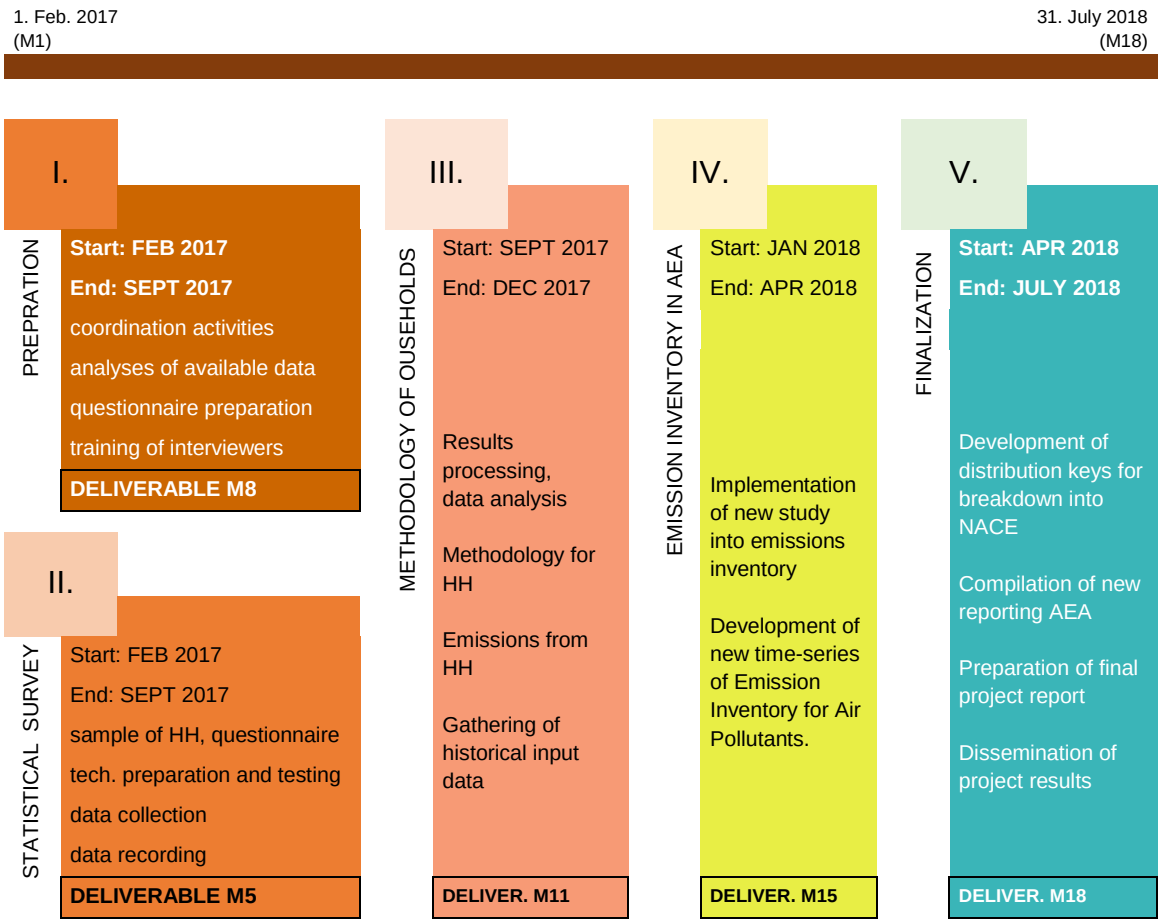
The phases of the project were:

- Phase I – Preparation;
- Phase II – Statistical survey;
- Phase III – Methodology of households;
- Phase IV – Emission inventory in AEA;
- Phase V – Finalization.

The first two phases were scheduled and conducted simultaneously. The justification for the same period was the participation of two institutions. The activities of project teams of the SHMÚ and the ŠÚ SR required close cooperation in preparation before statistical survey in field and joint elaboration of documentation that were used during the performance. The realization of the phase III was prolonged due to the difficulty of the topic, technical discussions for individual parameters and gathering of available data for all input auxiliary data. The realization of the phases IV and V were carried out in line with the planned activities.

Each phase resulted in one or more deliverables, which were submitted to Eurostat within the deadlines. The overview is provided in related chapters A.1 - Major improvements of data quality for households and A. 2 - Enlargement of provided data beyond the legal requirements. Final output documents are provided in Annexes of this report.

Scheme 1: The overview of the time schedule of project phases



3. IMPLEMENTATION OF THE PROJECT

This chapter provides detail information about conducted activities within the set objectives of the project. It is divided on two parts:

- Part A.1 – Major improvements of data quality for households
- Part A.2 – Enlargement of provided data beyond the legal requirements

This division is in line with the objectives of the project. Each part provides the information on brief summary, initial conditions and details about the performed project phases and results.

A.1 MAJOR IMPROVEMENTS OF DATA QUALITY FOR HOUSEHOLDS

Brief summary

The essential sub-tasks of this major part were the obtaining of new missing information from households to enable the progress in methodology of emission calculations. Therefore, the essential focus and majority of time of the project was devoted to the field of the households' heating, especially the heating in the family houses with solid fuels as primary heating fuel.

The general objectives of this project area were fully achieved. All planned activities were performed and results were available for further use. The *Table 1* provides a short overview. The overview of related working packages with realization timeframe and assessment is listed in the *Table 2*.

Table 1: The assessment of the general objectives achievement of the Part A.1: Major improvements of data quality for households

General objectives of the project: Part A.1	Planned	Implemented
Enhanced quality of produced data on households	☑	100%
Statistics survey in households	☑	100%
Methodology upgrade for energy demand by implementation of results from survey	☑	100%

Table 2: The assessment of the project phase's implementation related to the Part A.1: Major improvements of data quality for households

Project phases – WP	Realization	Deliverables	Date	Implem.
I – Preparation	Feb – Sept 2017	I-1 List and description of coordinated activities, the identification of project team and experts' roles	M8 ☑	100%
II – Statistical Survey	Feb – Sept 2017	II-1 Final questionnaire for survey II-2 Description of sample and methods for survey	M6 ☑	100%
III – Methodology of households	Sept 2017– Apr 2018	III-1 Brief description of methodology update	M11 ☑	100%
IV – Emission inventory in AEA	Jan – Apr 2018	IV-1 Brief description of methodology update and time-series	M15 ☑	100%

Initial situations and starting conditions before the action

The emissions related to the households' heating by solid fuels were calculated by the methodology established in 2002 by the interim study prepared by external contractor for the SHMÚ.[1] Therefore, the methodology was considered as obsolete and not suitable anymore to

[1] PROFING Company, Bilancia emisií malých zdrojov znečistenia ovzdušia v SR. Malé zdroje s tepelným výkonom do 0.3 MW. Bratislava, November 2003, Interim report

the current situation. The data from this study was used for regular AEA reporting in NACE categories concerning emissions from households.

The study was taking into account available historical data related to the period 1990 – 2002. The methodology for calculation of emissions was based on overall fuels consumption of natural gas, hard and brown coal and coke from available national statistics. Overall data on wood and solid fuels consumption in households were not available or not covered the overall total and were poor quality. Therefore, the estimations were based on the methodology of total energy demand (TED) of average household. However, devoted methodology with running time did not reflect any progress in the field of energy efficiency of new construction, small-scale combustions appliances, climate conditions and changes in energy demands of current households.

No other necessary and sufficiently detailed information on households in the field of heating were neither recorded since 2003, nor planned to be included in some studies or surveys. Update of the study was not possible due to the lack of new input data. Additionally, in the recent years, the small combustion in households has begun to play very important role in the air pollution of the Slovak Republic and the need for proper data has graduated.

PHASE I – Preparation

Realization: February – September 2017

Main goals and results

During the preparation phase I, the main goals - coordination activities, detailed analysis of the current situation and preparation of the statistical survey were fully achieved within the planned timeframe of the project.

The deliverable of this working package: *I-1 List and description of coordinated activities, the identification of project team and experts' roles* was submitted on time.

Team assembling

The project team of two groups was assembled. The project team of the SHMÚ group consisted of seven experts of the Department of Emission and Biofuels. One subcontractor was participated in the project. The project team of the ŠÚ SR group was consisted of eight statisticians and external contractors - interviewers for field survey. More information is provided in the *Chapter 2.2* Human resources for the project.

The coordination activities

All necessary coordination activities were performed by the project management to ensure the continuing work on the project. Several coordination meetings were carried out between beneficiaries, and also with the other institutions (Centre for Sustainable Alternatives – CEPTA (NGO); Slovak Environment Agency – SAŽP). The conducted meetings were very beneficial and resulted to following actions, which contributed to successful project activities.

The cooperation with non-governmental organization CEPTA resulted to the consultations and their participation in refinement of final questionnaire. In addition, the SAŽP participated in the consultations. The SAŽP did the trial test of filling prepared questionnaire as one household heating with solid fuel to search for inconsistencies and further refinement.

The cooperation with the SAŽP was particularly helpful, because the SAŽP provided the incentives for the interviewed households in form of set of three booklets from the series focused on environmental education in Slovak households:

Zelená domácnosť alebo konajme 3E - ekonomicky, environmentálne, eticky[2]
(Green household or act 3E – economically, environmentally, and ethically)

1. časť - **Pohľad na slovenskú domácnosť/Podiel domácností na zaťažení životného prostredia** (The Overview on Slovak household/The Share of Households on the Pollution of Environment);
2. časť - **Hospodárenie v domácnosti** (Household Management);
3. časť - **Zelená domácnosť a rady ako byť 3E** (Green Household and Hints How to Be 3E).

On the other hand, the performance of survey was beneficial for specific group of households because the activity contributed to their environmental awareness. The activity brought about the direct contact of households with information focused on environmental issues related to household's economy, how to save the energy, news, environmental education and provided advice in the given materials.

Study on background papers and available data regarding the individual heating
The research and collection of information on individual heating was necessary for preparation of questionnaire and for methodology. Numbers of internal cooperation activities and discussions were also made with our experts for the air quality modelling at the Department of Air Quality. The interest to use new specific data has led to cooperation with their foreign partners and obtaining of the Czech detailed emission factors for air pollutants on different small combustion appliances and various fuel types.

Research on the historical data
Research on historical industrial activities, technologies, appropriate emission factors and available auxiliary data have been continuously performed in duration of the project.

Questionnaire preparation
(Joint phase SHMÚ – ŠÚ SR)

Several meetings have been carried out in order to discuss the technical issues necessary for the survey preparation. During the first discussions, the sample had been defined precisely according to requirements of primary heating conditions of solid fuel on interest group of households.

Consequently, the process of questions creation started. The preparation of final questionnaire was time demanding in knowledge research on combustion appliances in households and creation the questions that are precise and usable, but on the other side, the households are able to answer them. The refinement of questionnaire was made in several rounds between the SHMÚ and the ŠÚ SR. The first proposal defined the estimated number of questions and the topic of questions. The following proposals and feedbacks specified questions in deeper details, defined and optimized the expected ranges of answers and refurbish and restructured questions for the best logical sequence for shortening of interview duration.

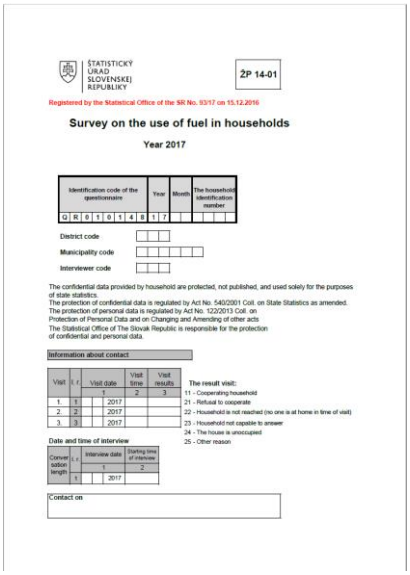
[2] English mutation of the materials is not available

Some discussions with experts from the ŠÚ SR were focused on the possibilities of involving already collected information from Census SODB2011 for verification of the current status. The discussions resulted to the incorporation of few questions in the software application for interview with the provided information from Census SODB2011 that could be rewritten.

Final Questionnaire - ZP 14-01
(Joint phase SHMÚ – ŠÚ SR)

Questionnaire ZP 14-01 was available in electronic form (interviewers recorded respondents answers in the questionnaire on tablet) and also in paper form (in case it was not possible to use tablet). Questionnaire contains four sections:

- General information: identification information, information about visit of household, date and time of interview, contact on households.
- Part A – Information on house: 17 questions regarding house description and technical parameters of house.
- Part B – Information on housing units: 10 questions regarding household total energy use, heating of indoor spaces, consumption and purchasing of solid fuels, garden machinery.


STATISTICKÝ ÚRAD SLOVENSKEJ REPUBLIKY

ZP 14-01

Registered by the Statistical Office of the SR No. 93/17 on 15.12.2016

Survey on the use of fuel in households

Year 2017

Identification code of the questionnaire | Year | Month | The household identification number

Q R 0 1 0 5 4 8 1 7

District code

Municipality code

Interviewer code

The confidential data provided by household are protected, not published, and used solely for the purposes of state statistics.
The protection of confidential data is regulated by Act No. 540/2001 Coll. on State Statistics as amended.
The protection of personal data is regulated by Act No. 122/2013 Coll. on Protection of Personal Data and on Changing and Amending of other acts
The Statistical Office of The Slovak Republic is responsible for the protection of confidential and personal data.

Information about contact

Visit	Ir. r.	Visit date	Visit time	Visit results
			2	3
1.	1	2017		
2.	2	2017		
3.	3	2017		

The result visit:
11 - Cooperating household
21 - Refusal to cooperate
22 - Household is not reached (no one is at home in time of visit)
23 - Household not capable to answer
24 - The house is unoccupied
25 - Other reason

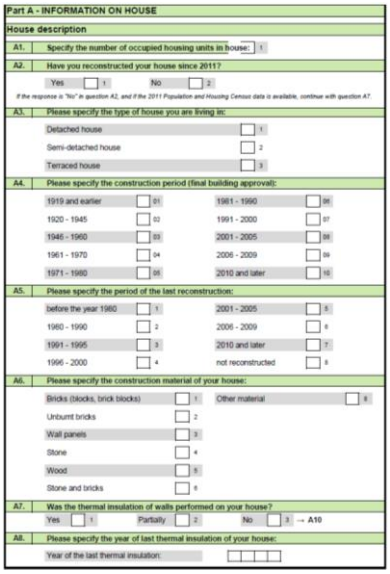
Date and time of interview

Conversation length	Ir. r.	Interview date	Starting time of interview
		1	2
	1	2017	

Contact on

Figure 1: ZP 14-01: General part

- Part C – Information on heating devices: divided in 5 main types of heating devices, questions were focused on technical characteristics of heating devices and on fuel consumption for heating.


Part A - INFORMATION ON HOUSE

House description

A1. Specify the number of occupied housing units in house:

A2. Have you reconstructed your house since 2011? Yes No

A3. Please specify the type of house you are living in: Detached house; Semi-detached house; Terraced house

A4. Please specify the construction period (final building approval): 1919 and earlier; 1920 - 1945; 1946 - 1960; 1961 - 1970; 1971 - 1980; 1981 - 1990; 1991 - 2000; 2001 - 2005; 2006 - 2009; 2010 and later

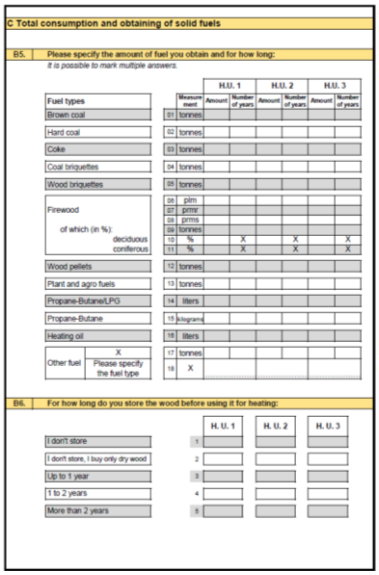
A5. Please specify the period of the last reconstruction: before the year 1980; 1980 - 1990; 1991 - 1995; 1996 - 2000; 2001 - 2005; 2006 - 2009; 2010 and later; not reconstructed

A6. Please specify the construction material of your house: Bricks (blocks, brick blocks); Unburnt bricks; Wall panels; Stone; Wood; Stone and bricks; Other material

A7. Was the thermal insulation of walls performed on your house? Yes; Partially; No → A10

A8. Please specify the year of last thermal insulation of your house: Year of the last thermal insulation:

Figure 2: ZP 14-01: Part A


C Total consumption and obtaining of solid fuels

B5. Please specify the amount of fuel you obtain and for how long:

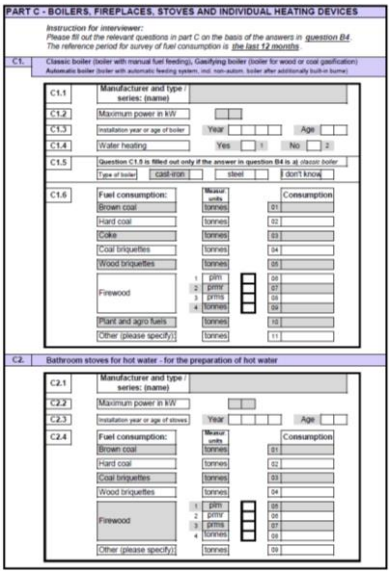
It is possible to mark multiple answers.

Fuel types	Measurement	H.U. 1 Amount	H.U. 1 Number of years	H.U. 2 Amount	H.U. 2 Number of years	H.U. 3 Amount	H.U. 3 Number of years
Brown coal	tonnes						
Hard coal	tonnes						
Coke	tonnes						
Coal briquettes	tonnes						
Wood briquettes	tonnes						
Firewood	pim						
	prms						
	tonnes						
of which (in %): deciduous	%	X		X		X	
coniferous	%	X		X		X	
Wood pellets	tonnes						
Plant and agro fuels	tonnes						
Propane-Butane/LPG	liters						
Propane-Butane	kilograms						
Heating oil	liters						
Other fuel: Please specify the fuel type	tonnes						
	X						

B6. For how long do you store the wood before using it for heating:

	H.U. 1	H.U. 2	H.U. 3
I don't store			
I don't store, I buy only dry wood			
Up to 1 year			
1 to 2 years			
More than 2 years			

Figure 3: ZP 14-01: Part B


PART C - BOILERS, FIREPLACES, STOVES AND INDIVIDUAL HEATING DEVICES

Instruction for interviewer:
Please fill out the relevant questions in part C on the basis of the answers in question B4.
The reference period for survey of fuel consumption is the last 12 months.

C1. Classic boiler (boiler with manual fuel feeding), Gasifying boiler (boiler for wood or coal gasification)
Automatic boiler (boiler with automatic feeding system, incl. non-autom. boiler after additionally built-in burner)

C1.1 Manufacturer and type / series: (name)
C1.2 Maximum power in kW
C1.3 Installation year or age of boiler: Year / Age
C1.4 Water heating: Yes / No
C1.5 Question C1.5 is filled out only if the answer in question B4 is at *classic boiler*
Type of boiler: cast-iron / steel / don't know
C1.6 Fuel consumption:

Fuel consumption:	Measur. units	Consumption
Brown coal	tonnes	01
Hard coal	tonnes	02
Coke	tonnes	03
Coal briquettes	tonnes	04
Wood briquettes	tonnes	05
Firewood	1 pim	06
	2 prmr	07
	3 prms	08
	4 tonnes	09
Plant and agro fuels	tonnes	10
Other (please specify):	tonnes	11

C2. Bathroom stoves for hot water - for the preparation of hot water

C2.1 Manufacturer and type / series: (name)
C2.2 Maximum power in kW
C2.3 Installation year or age of stoves: Year / Age
C2.4 Fuel consumption:

Fuel consumption:	Measur. units	Consumption
Brown coal	tonnes	01
Hard coal	tonnes	02
Coal briquettes	tonnes	03
Wood briquettes	tonnes	04
Firewood	1 pim	05
	2 prmr	06
	3 prms	07
	4 tonnes	08
Other (please specify):	tonnes	09

Figure 4: ZP 14-01: Part C

Guidance for interviewers
(Joint phase SHMÚ – ŠÚ SR)

Bearing in mind that drafted questionnaire included some very technical questions, thus it was quite difficult and required more time to pass all questions. It was necessary to prepare the supporting tool with information for interviewers. The Guidance for interviewers was elaborated by the SHMÚ and the ŠÚ SR.

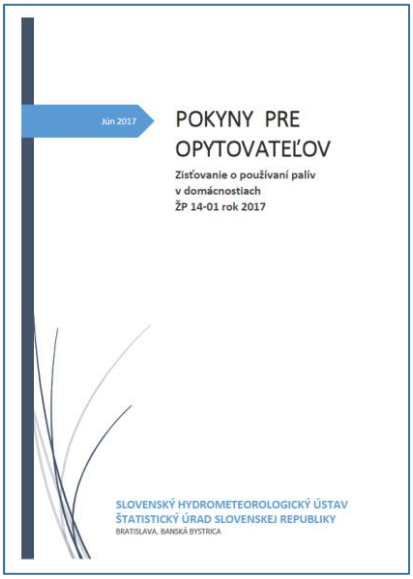


Figure 5: Guidance for interviewers

The Guidance was divided into following parts:

- Introduction explained the purpose of the survey, object of the survey, method of processing collected data and specification of the responding units.
- Schedule included the dates and deadlines for milestone activities (training courses, delivery of questionnaires, duration of field survey, delivery of continual monitoring reports on the status of the survey, final data delivery).
- Training, guidance and forms contained several technical information on training for interviewers.
- General part was focused on competences of the ŠÚ SR and the SHMÚ, brief description of the questionnaire parts, and the manners and rules for contact with the responding unit.
- Statistical survey provided the information on filling the questionnaire: part A, part B and part C. These parts involved the set of detailed instructions for interviewers to properly fill the individual questions according to the answers of household. It also contains the definition and brief explanations for some group of local heating appliances. The list of appliances of the most spread and most common heating appliances at the market was included in the annex of the guidance.
- Final provisions Information on prevention and protection of confidential household's data.

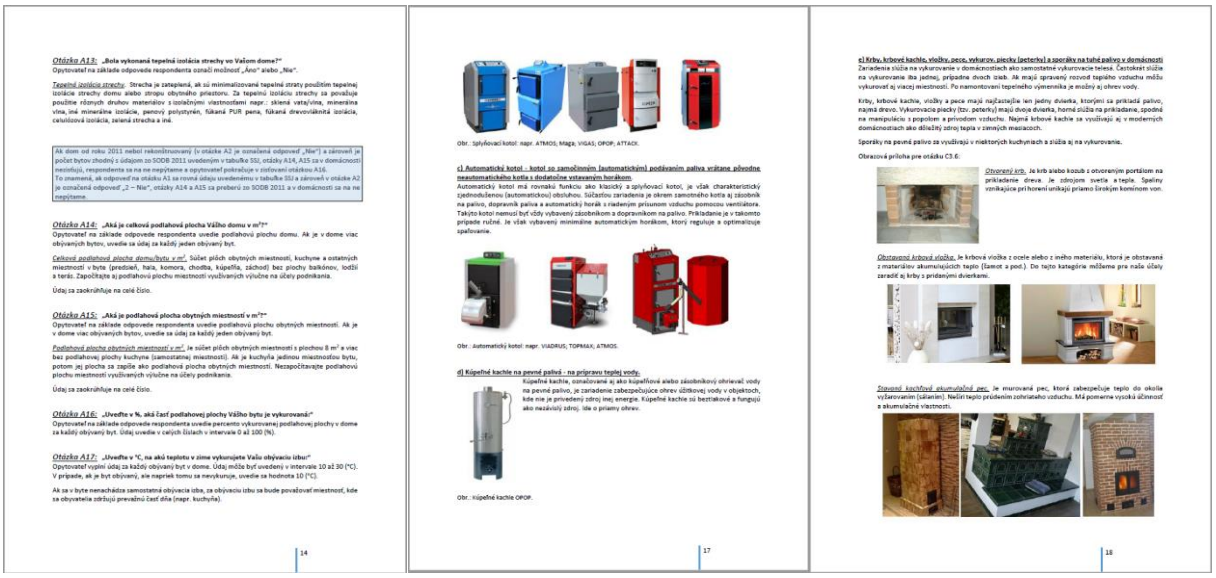


Figure 6: Previews on the Guidance for interviewers

Training course for interviewers
(Joint phase SHMÚ – ŠÚ SR)

The training courses for interviewers were conducted closely to the beginning of the field survey. Trainings were scheduled for two days, on the 21st and 22nd June 2017, for two separate groups of interviewers. The first course was organized in Banská Bystrica for the group of interviewers responsible for middle and eastern regions of the Slovak Republic. The second training was taking place in Bratislava for the interviewers of western regions. The printed forms of Guidance and questionnaire for every interviewer were delivered before the course in order to their preparation of comments and questions. The Guidance and the questionnaire were explained in form of presentation and discussed with interviewers during the training days. The focus was on the explanation of how to properly process and fill each part of the questionnaire according to the answers of household with regard of logic and relations among of some questions and use of Guidance as the help tool for clarification of potential difficulties. The Guidance was assessed in feedback of interviewers as very helpful.

Letters for households
(Joint phase SHMÚ – ŠÚ SR)

The letter addressed to households selected for survey was advised to prepare from the long-term experiences of the ŠÚ SR. The aim of the letter was to inform the household on the date of the survey in their household, reasoning and purposes of the planned data collection. The contact on the particular interviewer was included in the letter for the case that household was willing to participate at survey but preferred different date or time for interview. A small table, where the household was kindly asked to prepare some technical information on combustion appliances in advance for shortening of interview duration, was included in the letter. It also contained the brief information on adverse effects of particulate matters emissions, which are rising from combustion of solid fuels.

The letters were sent to households before the field survey. In addition, the majors of the cities and villages selected in the sample have been approached for cooperation during the statistical survey and disseminate the information via usual practices, for instance by advertisement at official information board table, websites, local radio etc. The vast majority of the municipal/village offices cooperated with the ŠÚ SR very well with the spreading of information by the abovementioned manners. In a very few cases, the assistance of the office was difficult and only in range of their obligations. For instance the spreading of the information about the survey execution by the local radio was performed only once and for the repetition was required the fee.

PHASE II – Statistical Survey

Realization: February – September 2017

Main goals and results

The defined goals of preparation and conduction a sample statistical survey focused on the households with individual heating (data collection in the field) were achieved.

The deliverables of this working package: *II-1 Final questionnaire for survey; II-2 Description of sample and methods for survey* were submitted on time.

Statistical survey on the use of fuels in households (ZP 14-01) is an ad hoc survey designed for a specific purpose of obtaining information on energy use, solid fuels consumption and heating appliances in households. Collected data/information are used for estimating/ modelling data on air emissions produced by households, which are necessary for compilation of the Air Emission Accounts for the Slovak Republic. It is a standalone one-off statistical survey conducted within the pilot study.

Questionnaire ZP 14-01 was available in electronic form (interviewers recorded respondents answers in the questionnaire on tablet) and also in paper form (in case it was not possible to use tablet).

Distribution of tasks and responsible institutions

The Statistical Office of the Slovak Republic

- Cross-sectional Statistics Department
  - Coordination of preparation of the statistical survey
  - Printing and distribution of questionnaires ZP 14-01
  - Publishing the information on the statistical survey ZP 14-01 on the website of the Statistical Office of the SR
  - Checking and validation of collected data

- Statistical Surveys and Methodology Department
  - Selection of the sample for the statistical survey
  - Weighting of collected data

- Department of Field Surveys (in Banská Bystrica)
  - Technical preparation of the survey – creating and testing application software (APV) for the statistical survey and testing the questionnaire ZP 14-01
  - Preparation of technical documentation regarding survey – guidance for data collection in field, technical documentation on application software
  - Managing the survey – contracting of interviewers, supervising interviewers
  - Organizing the training of interviewers
  - Providing methodological support for interviewers
  - Checking, editing and validation of collected data
  - Uploading the final dataset on the ŠÚ SR server
  - Elaborating the evaluation report on statistical survey ZP 14-01

The Slovak Hydrometeorological Institute

- Department of Emission and Biofuels
  - Elaboration of the guidance for interviewers in cooperation with the ŠÚ SR
  - Training of interviewers (as lecturers)
  - Providing the methodological guidance in case of unclear issues

The conducted activities and their duration are presented in the *Table 3.*

Table 3: Timetable of the statistical survey

Tasks	Timetable
Sample selection for the survey	March - May 2017
Technical preparation including creating an application software (APV) and testing the questionnaire	March - June 2017
Training of interviewers	21.06.2017, 22.06.2017
Conducting of the survey – data collection in the field	01.07.2017 - 31.08.2017
Monitoring – Information on the status of the survey	03.08.2017, 21.08.2017, 05.09.2017
Conclusion of the survey, uploading dataset on the ŠÚ SR server	07.09.2017
Checking and editing collected data, data validation	September 2017
Weighting of collected data	September 2017
Deadline for submission of outputs of the statistical survey to the Slovak Hydrometeorological Institute	30.09.2017

Technical preparation including creating an application software
The drafted Questionnaire ZP 14-01 was tested by statisticians of the Department of Field Surveys of the ŠÚ SR. Testing was focused on verification of comprehension of response options in terms of methodology, checking the completeness and accuracy of questions and texts in questionnaire, checking the range for individual items in questionnaire and verification of inter-modules checks in questionnaire.

For ensuring a high quality and accuracy of collected and recorded data, the automatic error checks were defined and built in the application software. The Excel file with description of individual errors - type of error, definition of error, error message text was elaborated. Errors were defined as SIGNAL (informative) and HARD (critical errors). Detection of error triggered a window with an error indication message. In case of signal error, it was possible to suppress error (button Suppress). In case of hard error, the “Suppress” button was not active, so it was not possible to use it. It was necessary to correct hard errors, without correction it was not allowed to move to next question.

An application software (APV) - Blaise software installed on tablets was used as technical instrument for data collection (for data recording, processing and editing). Blaise is a computer-assisted interviewing system and survey processing tool, which supports the process of both data collection and data processing. Technical documentation on APV – manual on APV, instruction for installation of APV, guidance for data recording was elaborated and available for interviewers.

Sample selection for the survey

Sample selection was carried out by expert of the Statistical Surveys and Methodology Department of the ŠÚ SR. Houses that complied with specific criteria were selected from the 2011 Population and Housing Census database by applying consecutive filters. The criteria for selecting the sample were the following:

- Occupied house;
- Type of house from the set {detached house, terraced house, semi-detached house};
- Type of heating from the set {house central heating, storey heating, individual heating device};
- Solid fuel as an energy source, used for heating housing unit within the house.

Total size of the sampling frame after applying filters was 185 736 houses and determined gross sample size was 2 100 houses.

Table 4: Stratification at the level of regions of the SR, sample size in particular strata is proportional to number of houses

Strata	1	2	3	4	5	6	7	8	SR total
Sample Size	28	98	252	189	483	483	336	231	**2 100**

Houses included in the sampling frame consisted of maximum 3 housing units. Sample file contained information on each housing unit in a house that met the abovementioned criteria. If particular housing units in house did not meet specified criteria, then they were not included in the sample.

Performed sample selection was random, stratified, two-stage:

- First stage: The respective number of municipalities was selected in each stratum (region) on the base of unequal probability (proportional to the number of houses in sampling frame) with replacement.
- Second stage: k*7 houses were sampled in each selected municipality, where „k“ equals the number of selections of particular municipality in the first stage.

Sample selection was performed by using software R.

Data collection

Statistical survey was conducted in the field through personal interviewing in selected households. The face-to-face interview mode was used in the survey. Interviewers personally visited selected households and recorded answers of respondents in the questionnaires (on tablet). The personal face-to-face interviewing was chosen as the survey method to ensure the highest rate of response. Some inhabitants (mainly older) are not enough familiar with online questionnaires and do not trust the phone survey. Advantage of chosen face-to-face interview was that it was possible to ask follow-up questions for clarifying unclear issues and interviewers were able visually check and verify some parameters of house (for example construction material of house, thermal insulation of walls etc.).

The promotional environmental education materials from the SAŽP, which were provided to interviewed households had positive impact on the households and increased the credibility of the survey.

Table 5: The overview of surveyed households by regions

Region (NUTS 3)	Number of selected households (sample)	Number of households with completed questionnaire	Number of non-responding households*
1. Bratislavský	28	21	7
2. Trnavský	119	87	32
3. Trenčiansky	231	170	61
4. Nitriansky	189	141	48
5. Žilinský	483	364	119
6. Banskobystrický	483	352	131
7. Prešovský	336	245	91
8. Košický	231	169	62
SR total	**2 100**	**1 549**	**551**

**Non-responding households* - household refused to cooperate, household was not reached, household was not capable to answer questions (only persons not able to cooperate for the reason of old age, mental disability, health issues are living in HH), house was unoccupied.

Data recording and creation of the data set

The guidance for data recording was elaborated and available for interviewers. Data recording and processing was performed by using Blaise software (in tablets) modified for the specific purpose of statistical survey ZP 14-01. Subsequently after checking and validation of data, the datasets in excel file format were created.

Weighting of collected data

Since conducted statistical survey was a sample survey, it was necessary to calculate the weight of individual statistical units (housing units). Calculated weights indicate the number of housing units (from the total number of housing units in the SR) that the particular survey housing unit represents. The basis for calculation of final weights was the probability of selection of each housing unit. The inverse probabilities, adjusted for non-response, formed the initial weights for calibration. It was undertaken by CALIF tool – https://github.com/SO-SR/Calif.

Output of the survey

Output of the survey are the following datasets in excel file format:

- Dataset 1 - ZP_14-01_part_AB: information on house (section A of the Questionnaire), data on total energy use, data on heating of indoor spaces, data on consumption and purchasing of solid fuels (section B of the Questionnaire);
- Dataset 2 - ZP_14-01_part_C: information/data on heating devices (section C of the Questionnaire).

PHASE III – Methodology of households

Realization: September 2017 – April 2018

Main goals and results

During the third phase, the main goals of methodological improvements for households were achieved. The timing of the phase III was prolonged up from December 2017 to April 2018 due to the difficulty of the topic, technical discussion for individual parameters and gathering of available data for all inputs and auxiliary data, but also due to the heavy load of permanent work[3]. The work on the methodology was continual due to the more technical difficulties with obtaining and calculations of auxiliary parameters.

The deliverable of this working package: *III-1 Brief description of methodology update* was submitted on time.

Results processing and data analysis

The final data from the statistical survey in good quality were obtained from the ŠÚ SR after the performance of the field survey. Data were analysed a processed for the purpose of use in the methodology.

Development and update of methodology and implementation of new gained data

The update of the methodology was performed and new total household's energy demand was determined and verified with the new input data. Project team of the SHMÚ developed a new methodology. External expert was contracted during the phase III only for the consulting activities for methodology.

Several options for manner of methodology improvement for emissions from households heating have been considered. The endeavours for harmonisation with Air Quality Modelling methodologies input data was not fully possible. This approach was only partially implemented. The international EMEP/EEA Guidebook[4] for compilation of air pollutants requires the historical time-series data of specific type of fuel used, but improved data from the survey relates only to one year. Because of the inaccurate historical data on households fuel use registered by the Statistical Office of the SR and the absence of any other relevant source, it was concluded that the most reliable and accurate estimate of fuel consumption of wood is based on the principle of total energy demand (TED) per m^2 of occupied area in the household sector.

The attention was focused on the reassessment and update of the all input and auxiliary data, development of new time-series and most importantly the implementation of new gathered information and elements as climate factors, new standards for constructed houses, new age structure of houses, new structure of heating appliances, new emission factors, etc.

[3] Bearing in mind the all activities of project team members - employees of the Department of Emissions and Biofuel - beginning of preparation processes for development of National strategies for emission reduction related to the Directive 2016/2284, active participation on Clean Air Dialogue of the Slovak Republic with European Commission, participations in Low carbon strategies development, recently new annual review processes for the emission inventory under NECD and implementation of the final recommendations.

[4] EMEP/EEA air pollutant emission inventory guidebook 2016; Technical guidance to prepare national emission inventories, 1.A.4 Small combustion 2016 https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-4-small-combustion-2016/view

Determination of the total households' energy demand

The revision and development of the new total energy demand in time-series was performed by the project team of SHMÚ. The TED was determined in several steps. Required input data are specified in the *Table 6*. The improvement of the energy demand was crucial because it reflects the dynamics of the energy need during the time periods. The energy need is continuously changing in time due to the ageing of buildings, reconstructions, new techniques and requirement for new modern construction materials. Detailed information on methodology equations and calculations for determination of TED is provided in *Annex III.*

Table 6: The necessary input data for compilation of TED

Input data for compilation of TED:
Number of households
Share of households with connection to central heat supply (heating distribution network – district heating)
Share of flats with individual heating
Average living area of housing units
The age structure of housing units
Reconstructions of housing units
Average energy demand for heating and hot water preparation
Number of heating degree days – climate factor

Compilation of emissions from households

The other essential aspect obtained from the survey was the availability of new data on appliances use structure, which were encompassed into calculation. The derived structure of heating appliances according to fuel types is presented in *Table 7.*

Table 7: The resulting structure of heating appliances according to fuel type expressed in % from the statistical survey related to the heating period of 12 months (2016/2017)

Fuel type / Type of heating appliance	Brown coal	Hard coal	Coke	Coal briquettes	Wood briquette, pellets	Wood	Other
Underfired boiler	52.8	48.4	48.4	73.6	43.8	47.4	46.4
Overfired boiler	35.3	27.3	27.3	19.8	18.0	14.0	50.3
Gasification boilers	3.8	4.3	4.3	3.4	4.2	7.2	-
Automatic boilers	1.7	6.3	6.3	-	18.3	2.2	-
Conv. stoves, fireplaces	6.5	13.7	13.7	3.3	11.7	27.5	3.3
Modern stoves	-	-	-	-	4.1	1.7	-

The calculation of emissions was based on fuels consumption of natural gas, hard and brown coal and coke from available national statistics. The wood consumption was updated in comply with the implementation of revised TED. The compilation of emissions was performed by use of the EMEP/EEA Guidebook emission factors and country specific emission factors for air pollutants. Country specific factors were obtained in the cooperation with air quality modellers' team (Air Quality Department, SHMÚ); throughout their active participation in the project *LIFE Integrated Project: Implementation of Air Quality Plan for Małopolska Region – Małopolska in a healthy atmosphere*.[5] Emission factors were measured and provided by the Czech Republic participated at the project, specifically for purposes of households' heating in division of nominal heat output and low heat output for various types of small combustion appliances.

[5] https://powietrze.malopolska.pl/en/life-project/; participation of the SHMÚ in LIFE IP Małopolska: implementation of regional model CMAQ for forecasting and air quality assessment in SR, ČR and south PL

The emission factors were provided in detailed division of 8 fuel types and 4 types of the heating appliances. More information is available in the *Annex IIIa.*

Table 8: The overview of the fuel types and appliances types

The fuel types:	Types of the heating appliances $EF_{SPECIFIC}$:
Wood dry / wet	Over-fire boiler
Wood Briquettes & Pellets	Under-fire boiler
Hard Coal	Gasification boiler
Brown coal	Automatic boiler
Coal Briquettes	**Additional types of the heating appliances EF_{GB2016}:**
Coke	
Natural gas	Fireplaces, stoves, masonry/built-in tile stoves
Fuel oil	Modern masonry/built-in tile stoves and pellets stoves

Gathering of historical input data for all sector activities

Before the submission of grant application, the historical time-series of air pollutants emission inventories in NFR structure, which are the base for the AEA submission, were missing. Only the old estimations of national totals were available for the Slovak Republic for air pollutants. The information have been continuously gathering. However, statistics for the period 1990 – 2000 are not available due to the insufficient collection of data in that time in the Slovak Republic. Therefore, where necessary the extrapolation or expert judgement is applied.

PHASE IV – Emission inventory in AEA

Realization: January – April 2018

Main goals and results

The defined goals - implementation of new study into emission inventory, the development of emission inventory time-series since base year 1990 in the phase IV were achieved.

The deliverable of this working package: *IV-1 Brief description of methodology update AEA and time-series* was submitted on time.

Modelling of missing historical inputs and estimations

During the fourth phase, the development of new time-series in NFR structure was planned. This task have been continuously prepared since the very beginning from the time that grant application was submitted due to the workload and requirement of other usage. Modelling of historical emissions into the emission inventory was performed to be available for further use as the base for the AEA and harmonization for enlarged time-series. The compilation of emissions from households has been conducted on the base of the updated methodology at the phase IV. Thus the new household's data have not been yet reported in the emission inventories. But they will be used in the future submissions of air pollutants emission inventories under the NECD in order to harmonisations.

Development of emission inventory time-series since base year 1990

The development of method for adaptation of prepared historical time-series was included in the scheduled of the finalization phase, but initial work has started in the working package IV, as the baseline for this task as well as the goal of preparation of following deliverable of working package.

A.2 ENLARGEMENT OF PROVIDED DATA BEYOND THE LEGAL REQUIREMENTS

Brief summary

The general objectives of this project area for enlargement of provided time-series were fully achieved. All planned activities were performed and results are available for further use. The short overview is presented at the *Table 9*. The assessment of related working packages with realization is provided in the *Table 10.*

The sub-tasks of part A.2: Enlargement of provided data beyond the legal requirements were following: development of the method for adaptation historical time-series and breakdown into NACE distribution for all relevant air pollutants and greenhouse gases, preparation of enlarged AEA templates, dissemination of results and elaboration of methodological and technical reports.

Table 9: The assessment of the general objectives achievement of the Part A.2: Enlargement of provided data beyond the legal requirements

General objectives of the project: Part A.1	Planned	Implemented
Providing consistent and more accurate time-series back to the base year (1990) for Air Emission Accounts – beyond the legal requirements	☑	100%
Dissemination of information and sustainable and consistent approach into the future	☑	100%

Table 10: The assessment of the project phase's implementation related to the Part A.2: Enlargement of provided data beyond the legal requirements

Project phases – WP	Realization	Deliverables	Date	Implem.
V - Finalization	April – July 2018	V-1 Methodological project report included in technical report V-2 AEA templates 1990 - 2016	M18 ☑	100%

Initial situations and starting conditions before the action

In the initial situation at the time of project application, the regular reporting of module Air Emission Accounts according to the Regulation (EU) No 691/2011 on European environmental economic accounts was already established. The SHMÚ was annually preparing the report and in cooperation with the ŠÚ SR reports were delivered to the Eurostat. The only user of AEA was Eurostat.

The historical time-series of emission inventories in NFR structure were not elaborated before the grant application. All the improvements that were proposed were aiming to increase the interest in use of AEA by other national institutions and public. Therefore, the goal of dissemination at website of the SHMÚ was also suggested.

PHASE V – Finalization

Realization: April –July 2018

Main goals and results

The goals of the final phase included the compilation of the new reporting AEA and preparation of technical report including the methodological report and dissemination of project results.

The deliverable of this working package: *V-1 Methodological project report included in technical report* represents Part I of this report*; V-2 AEA templates 1990 – 2016* represent the *Annex V* of this report (sent as a separate excel file). The submission has been performed within the timeframe of the project deadline.

This part of the project granted by the EUROSTAT was focused on providing consistent and more accurate time-series back to the base year (1990) for Air Emission Accounts in the area of air pollutants and greenhouse gases. The detailed information on air pollutants are provided in the *Annex IV - Chapter A.2-1* and for the greenhouse gases are provided in the *Annex IV - Chapter A.2-2*. This approach is beyond the legal requirements of the Regulation (EU) No 691/2011 on European environmental economic accounts (AEA regulation) and appropriate delegated acts.

The enlargement of provided data was performed in line with the updated and improved methodology for CRF (NFR) to NACE Rev. 2 classification. Separate chapters describe mapping of the activity data in appropriate NACE Rev. 2 categories including several references and remarks.

The Slovak Republic is using the inventory-first approach for AEA reporting. Due to national circumstances, both inventories (air pollutants and GHG) are based on consistent background (activity data), used consistent databases and assumptions. These inventories are reported under international requirements and national reduction targets.

Emission inventories as well as AEA reporting are prepared by the experts of the Department of Emissions and Biofuels of the Slovak Hydrometeorological Institute. This is basis for the consistent and harmonized reporting of the Slovak Republic in this area.

The development of method for adaptation of prepared historical time-series and the breakdown into NACE distribution for all relevant pollutants and gases

Compilation of AEA according to key distribution

Preparation of final templates for selected years

All defined "actions to be done" in the plan were carried out in the frame of the project. The overlap of the work action in the transport sector has been identified and recognized with the task from Working Group for AEA in the 2017 for the preparation of the self-assessment of the method. The assigned task had led to the strong progress in the transport sector during the year 2017 even though it was originally planned for the year 2018.

The actions were divided into several parts - chapters - dealing with particular sectors. The overview of chapters is shown in the *Table 11* and all detailed information and description of the methodology is presented in the *Annex IV - PART A.2: Enlargement of Provided Data beyond the Legal Requirements.*

Table 11: The overview of the methodological parts for AEA calculations

Chapter	Name
A.2-1	General Methodological Improvement in the Area of Air Pollutants
A.2-1-1	Air Pollutants Emissions in Energy*
A.2-1-2	Air Pollutants Emissions in Industrial Processes and Product Use
A.2-1-3	Air Pollutants Emissions in Agriculture
A.2-1-4	Air Pollutant Emissions in Waste Sector
A.2-2	General Methodological Improvement in the Area of Greenhouse Gases
A.2-2-1	GHG Emissions in Energy*
A.2-2-2	GHG Emissions in Industry
A.2-2-3	GHG Emissions in Agriculture
A.2-2-4	GHG Emissions in Waste

*Includes the transport sector

Dissemination of the results

The final step for the successful implementation is the dissemination of project output data. The promotional process has started in early stages due to the fact, that the results of the project were very important in several areas, especially for the decision makers at the level of the ministry, the preparation of the national strategies and the national plans for reduction targets, the international reporting and no less important as the background information for the building–up of the public awareness in the area of air protection.

Dissemination with the regular working partners

The information on the successful grant award was communicated with the Slovak Environment Agency who has the role of focal point in the area, the intermediary with the professionals, the affiliated organizations of the Ministry of Environment as well as the public.

Dissemination at the professional field

The first results and information were shared with professional field at the annual International Conference Air Protection 2017, which has taken place from 22nd to 24th November 2017. The project, its focus and objectives, expected final outputs were presented. Moreover, the first initial results from collected data at the survey were presented.

Figure 7: The Proceedings

The contribution prepared by the representatives of project team was published in the proceedings from the conference[6]. The Abstract of the published contribution is provided in the *Annex VI.* The presentation of the final results of the project and the new AEA templates are planned at this year conference.

The final percentage distribution of households appliances structure obtained from the survey was very desirable and have been provide to the Project Ce1101 Uniform

[6] Ďuricová, I. , Zemko, M., Jalšovská, M. (2017). Emissions from households. *In Proceedings of the International Conference Air Protection 2017*. Kongres STUDIO, spol. s r. o., 2017. (page 82-85). ISBN 978-80-89565-30-6.

Approach to the Air Pollution Management System for Functional Urban Areas in Tritia Region / Air Tritia[7].

Dissemination for the public

The brief information on the project and progress in the AEA data will be included in the special update of the annual yearbook Air pollution in the Slovak Republic that is regularly published at the beginning of the year at the webpages of the SHMÚ. This update will be published up to December of the year 2018.

The subtask of preparation of materials and information on the webpages has been carried out. The information on the project and resulting data are disseminated at the SHMÚ webpage Emissions.

Information about the project results will be disseminated via The News Agency of the Slovak Republic (TASR) in short press conference, which will take place on the 22nd October.

[7] https://www.interreg-central.eu/Content.Node/AIR-TRITIA.html

4. DELIVERABLES AND FINAL OUTPUTS

All planned deliverables defined in the project were submitted to Eurostat and the planned actions were implemented in duration of this project. The final resulting documentation and deliverables II-1 and II-2 are provided in Annexes of this report.

The *Final Report on Implementation of the Action* including the financial statement and involvement of the beneficiary represents this report. The report was delivered up to 60 days after the closing date of the action in comply with the grant agreement.

The overview of reported documentation and annexes are shown in the *Table 12* below.

Table 12: The overview of reported documentation and attached annexes

Project phases – WP	Deliverable / Annex	Name
I – Preparation	M8 ☑	I-1 List and description of coordinated activities, the identification of project team and experts' roles
	I	Final List and description of coordinated activities, the identification of project team and experts' roles
II – Statistical Survey	II, M6 ☑	II-1 Final questionnaire for survey II-2 Description of sample and methods for survey
III – Methodology of households	M11 ☑	III-1 Brief description of methodology update
	III	Description of methodology for households' heating
IV – Emission inventory in AEA	M15 ☑	IV-1 Brief description of methodology update and time-series
	IV	Description of methodology for historical years of AEA
V - Finalization	M18 ☑	V-1 Methodological project report included in technical report
	V	V-2 AEA templates 1990 - 2016
60 days after the closing date of the action	M20 ☑ VII, VIII, IX	Final implementation report of the action (September 2018) VII – Final financial statement of the project VIII – Detailed budget and calcul. of coordinator contribution IX – Detailed budget and calculation of co-partner contribution

The successful implementation of goals of the action has led to improvement of the quality of emission inventories for households and methodology upgrade with the good perspective for future work in this area.

Further use will be applied in many areas: using the data for policy makers and long-term plans for emissions regulation particularly in households or in energy sector especially for the preparation of the National strategies for emission reduction, using the data for the fulfilment of international commitments of the Slovak Republic and especially for the public awareness rising.

5. SUSTAINABILITY OF THE ACTION

The continuity and sustainability of the project goals is ensured by the successful implementation of new data and updated methodology into compilation process for inventory and module AEA, which are established and annually reported.