



Norsk institutt for luftforskning
Norwegian Institute for Air Research

Inception report

Support in development and implementation of
Air Quality e-Reporting in West Balkan

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NILU report 21/2016

Contents

Summary	3
1 Background	4
1.1 The legislative back drop	4
1.2 Reporting data-flows	5
1.3 Reporting obligations specific to the West Balkan countries	5
2 The Project's Objective	5
3 Project plan	6
3.1 Description of work and deliverables	6
3.1.1 Task 1 – Project kick-off and scoping	6
3.1.2 Task 2 – IT-package development	6
3.1.3 Task 3 – IT-package deployment in the West Balkan beneficiary organisations	9
3.1.4 Task 4 - Initiating AQ e-Reporting data delivery	9
3.2 Time plan	10
4 Risks and Vulnerabilities	12
5 Overview of the Balkans Air Quality networks	13
5.1 Serbia	13
5.2 Albania	15
5.3 Bosnia and Herzegovina	16
5.4 FYROM	17
5.5 Kosovo	18
5.6 Montenegro	20

Summary

The Norwegian Institute for Air Research (NILU), 4sfera Innova SLU (4sfera) and EKONERG have been commissioned to develop a solution for Air Quality e-Reporting for the West Balkan countries.

The Balkans is a peninsula and cultural area in South-East Europe. It derives its name from the Balkan Mountains. These stretch from the eastern border of Serbia to the Black Sea. For the purposes of this report, the Balkans comprises the following countries. Serbia, Albania, Bosnia and Herzegovina, FYROM, Montenegro and Kosovo.

This document describes the solution, the time scale, responsibilities for all actors and the current, known infrastructure for each state. This includes development, installation and training of the solution.

Inception report

Support in development and implementation of Air Quality e-Reporting in West Balkan

1 Background

Following the adoption of Decision 2011/850/EU, DG Environment, the EEA and EIONET countries have now reached a critical juncture in the transition to a new air quality e-Reporting mechanism (AQ e-Reporting).

1.1 The legislative back drop

EU Member States are required to monitor and report air quality data under a number of EU legal instruments. This information is collated, analysed and disseminated by the European Environment Agency (EEA) supported by its European Topic Centre on Air Pollution and Climate change Mitigation (ETC/ACM).

The introduction of the Commission's Implementing Decision 2011/850/EU (AQ e-Reporting IPR) created a starting point to rationalize, modernise and streamline air quality data reporting.

A key feature of the changes under the new e-Reporting system compared with its predecessor is the introduction of a new mechanism for data transfer. Under the new e-Reporting system, data is to be transferred from Member States to the EEA in XML format. The XML schema and data model are based on the standards, concepts and principles mandated by the INSPIRE Directive.

The AQ e-Reporting IPR came into force on 1 January 2014 , two years after adoption of the decision during which time Member States undertook preliminary tasks and activities to prepare themselves for e-Reporting. In particular it was anticipated that Member States data infrastructure would require adaptation to allow:

- (1) Integration of data flows.
- (2) Data delivery that uses the defined transport mechanism (XML).

In recognition of the challenges that the new systems present to Member States and in order to manage and facilitate the transition, Member State reporting authorities, data providers, and the EEA's Operational services have worked together to ensure the transition to e-Reporting is implemented in an as effective manner as possible. The EEA will establish and operate the mechanism for sharing air quality information (e-Reporting) in line with the AQD IPR requirements.

1.2 Reporting data-flows

The AQ e-Reporting IPR integrates different air quality data-flows into the following groups:

- Data flow A – Reporting header & Competent Authority
- Data flow B – Information on zones
- Data flow C – Assessment regimes
- Data flow D – Assessment methods
- Data flow E1a – Primary validated data
- Data flow E2a – Primary Up-To-Date data
- Data flow F – Aggregated data (*Performed by EEA*)
- Data flow G – Attainment

Data flows H-K – Air quality plans & programmes (*Tool developed by JRC, Ispra*).

1.3 Reporting obligations specific to the West Balkan countries

Reporting obligations for West Balkan are restricted to data flows D (assessment methods), E1a (primary validated data) and E2a (primary Up-To-Date data).

2 The Project's Objective

The objective of this project is to provide assistance to the West Balkan countries (Albania, Bosnia and Hercegovina, FYROM, Kosovo, Montenegro and Serbia) in order to implement e-Reporting mechanisms for **data flows D (assessment methods), E1a (primary validated data) and E2a (primary Up-To-Date data)** by:

1. Assist in developing local expertise and technical knowledge to establish and implement an AQ e-Reporting system.
2. Assist in the development of a national system for AQ e-Reporting for data flows D, E1 and E2a, including all data files and mechanism for data transfer as defined in the air quality implementing provisions (IPR) (2011/850/EU).
3. Develop a technical solution and ensure local expertise within the national institutions that will ensure the management and day to day operation of an e-Reporting system.

3 Project plan

3.1 Description of work and deliverables

Following a technical meeting between the team members and staff from EEA, the key support requirements have been identified in order to assist the West Balkan countries in developing an operational AQ e-Reporting IPR compliant system. These requirements have been identified and split into four main tasks.

3.1.1 Task 1 – Project kick-off and scoping

The following sub tasks will be carried-out by the team under this task:

1. A kick-off meeting will be arranged with EEA staff.
2. Review of documents from April 2015 workshop between EEA and West Balkan.
3. Arrange initial conference calls/webinars with the West Balkan countries.
4. Coordinate project activities with those carried out in the frame of other relevant EU projects.

3.1.2 Task 2 – IT-package development

Under this task the team will develop an IT package for AQ e-Reporting that can be deployed and operated locally within each country. The solution will be based on open source/freeware technology in order to be implemented and maintained by each country/institution.

The developed database will be compliant with e-Reporting schema including all necessary fields to report data flows D, E1a and E2a. As a starting point one will use the latest e-Reporting XMLs for West Balkan countries prepared using the AQUUI tool unless otherwise recommended by the consortium and EEA to accommodate any local needs.

The following sub tasks will be carried-out by the team under this task:

1. Standardised CSV (Comma Separated Values) templates to present AQ e-Reporting data in a standard format. The templates will be used to load data flows to the database and may be used to maintain the contents of the database thereafter. An example of the template format used to capture information on the AQD_Station element for the UK is provided in Table 1 below.
2. Develop a database that fulfils the project needs. The database framework will be PostgreSQL with PostGIS extension for supporting geographical objects to PostgreSQL.
3. Pre-populated metadata from Eionet vocabulary Air Quality Directive (AQD) e-Reporting.

To date, West Balkan countries have fulfilled obligations under the AQ e-Reporting IPR using the AQUUI tool. In order to ensure consistency with pre-reported data flows,

the team will prepare a suite of scripts to extract key information from the latest delivery's XML instance documents prepared by the West Balkan countries and loaded to the CDR. The extraction will not only include key air quality information, but also essential identifiers necessary for delivering valid e-Reporting XMLs to EEA, for instance reporting header information. The extraction will be done for all data-flows including D, E1a and E2a. For the countries where September 2015 was reported, one will use these data to initially populate a test environment database. For the countries where these data are not available, one will together with the country strive to collect required data for test purpose.

4. As part of the extraction process, intra-dataflow and inter-dataflow mappings (cross references) will be documented. This mapping is essential to a successful development of the system.
5. An HTTP API (Hypertext Transfer Protocol Application Programming Interface) for import of CSV files and export of XML and CSV files will be developed. Export of the data in CSV files will be done, so the countries will have the possibility for validating and checking the AQ metadata uploaded to the database. The XML files will be compliant with the "User Guide to XML & Data Model v3.2" (http://www.eionet.europa.eu/aqportal/guidelines/UserGuide2_AQD_XML_v3.2.0.pdf) and fulfil the quality checks in the document "Quality Assurance and Control rules for e-Reporting." The API will be developed by using the programming language Python using the Flask framework. The Python code will be annotated and commented to promote traceability, understanding and potential extendability.
6. Use of a command-line tool (for instance cCURL) for automatically transfer of E2a data.
7. Web GUI for manual upload and download of CSV files, additional to export of XML files.
8. Create documentation of the IT package, including database structure.

Create system specification for required web- and database servers (NB! infrastructure, including servers, is not covered by this offer).

Table 1: Example template for capturing AQD Station element information

EOI_code	Station_name	start_date	enddate	Latitude	Longitude	Altitude	Area Type
GB0048R	Auchencorth Moss	23/01/2003	00/00/0000	55.79216	-3.2429	260	Rural
GB0091R	Banchory	07/02/2003	06/01/2014	57.07663	-2.53489	130	Rural
GB0855A	Beacon Hill	13/11/2003	13/03/2014	52.72199	-1.23229	186	Rural
GB0567A	Belfast Centre	01/01/2008	00/00/0000	54.59965	-5.92883	10	Urban
GB0985A	Chadwell St Mary	01/01/2008	00/00/0000	51.48196	0.370213	30	Urban
GB0853A	Cockley Beck	02/04/2003	16/01/2014	54.40349	-3.16137	220	Rural
GB0854A	Cwmystwyth	13/03/2003	00/00/0000	52.35244	-3.80532	260	Rural
GB0886A	Detling	01/10/2004	00/00/0000	51.30794	0.58265	182	Rural
GB0002R	Eskdalemuir	17/05/1983	00/00/0000	55.31531	-3.20611	255	Rural
GB0036R	Harwell	27/08/2008	00/00/0000	51.57108	-1.32528	126	Rural
GB0017R	Heigham Holmes	21/08/2003	00/00/0000	52.72715	1.614805	5	Rural
GB1009R	Inverpolly	27/02/2003	03/01/2014	58.03138	-5.07221	245	Rural

The figure below is simplified, but gives a relatively good overview of the main operational features.

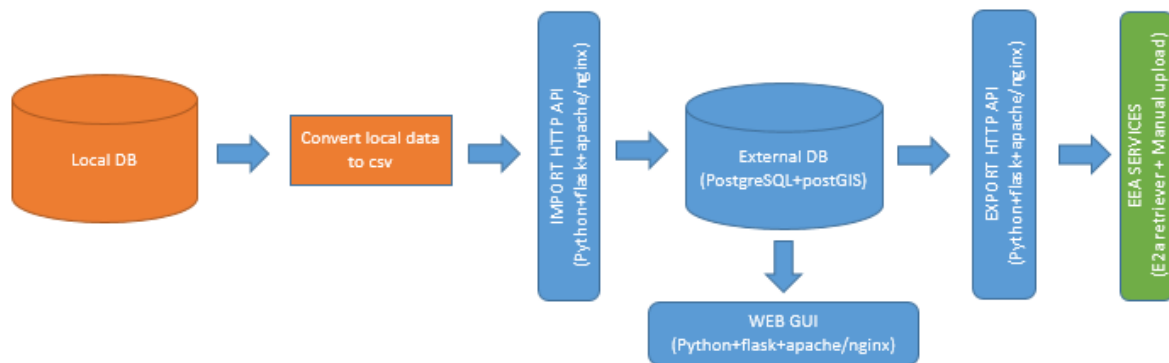


Figure 1: Business workflow of the AQ e-Reporting system

Installation

3.1.3 Task 3 – IT-package deployment in the West Balkan beneficiary organisations

As part of the team, EKONERG, a local and leading Croatian consulting company in the power/energy sector and environmental protection field, will work closely with the six national AQ and IT technical experts, including in-country visits where appropriate. The team will further carry-out:

1. Installation and configuration in each country.
2. On-site operational integration testing in each country.
3. Providing necessary and sufficient training in each country.
4. Create a holistic technical documentation of the integration of the IT package in each country.
5. Provide guidance manuals on the use of the IT package in each country.

The IT-software package will be run on a server in each country. This will require a web server and a database server. This can be combined in a single box. It is recommended that each country has a web server running either Linux or Windows.

3.1.4 Task 4 - Initiating AQ e-Reporting data delivery

Our approach to fulfilling the mandatory requirements under the AQ e-Reporting IPR is based on the provision of on-going support to the West Balkan countries in the medium term. We have specified a program of support that recognizes the need to accommodate local requirements which may not be fully captured by the AQUi software and the West Balkan countries' requirement to implement database deliverables in their environments. These aspects and our experience suggest that the acceptance testing tasks will be an iterative process.

Key aspects of the support include:

1. Sub-tasks to ensure consistency between all data-flows. It is essential that the created XML maintains the identifiers (Local-IDs) used to support the relationships between different parts of the e-Reporting data model. These links are used to support concepts such as internal cross-referencing, 'deliver-once/reuse-many' and facilitate data integrity across XML data flows.

The relationships make use of unique identifiers for each data object with identity or spatial objects with identity. The identifiers to be used will be the *INSPIREID* element: separate feature types (AQD_SamplingPoint, AQD_Zone, AQD_Station, ...) defined in the XML schema are all related to each other. For example an AQD_SamplingPoint is measuring a specific location (AQD_Station) using a specific method (AQD_SamplingPointProcess) and could be used for compliance belonging to a specific AQD_Zone.

2. The team will assist in ensuring that the generated XML files conform to the e-Reporting data model and schema as defined in the AQ Portal <http://www.eionet.europa.eu/aqportal>. The latest version to implement is <http://dd.eionet.europa.eu/schemas/id2011850eu-1.0/AirQualityReporting.xsd>. Generated XML will be checked and validated against the relevant schema when developed and prior to their submission to EEA.
3. The full data specifications supporting data flows are set out by the e-Reporting schema and UML model and support INSPIRE compliance. The new data model organizes some of the meta-information around the concept of SamplingPoints instead of monitoring stations like in the current NRT and Airbase. The team will assess those data elements that have to be added to the data exchange system in order to transform monitoring information based on stations, to monitoring information based on SamplingPoints, as required.
4. The team will also assist the West Balkan countries in ensuring that XMLs created fulfil with QA checks performed in CDR and described here <http://www.eionet.europa.eu/aqportal/qaqc>

Extra technical assistant not specified in the tasks above

In addition to the specified tasks identified, the team will provide specific technical assistance throughout the development. Our team's experience gained from similar projects has identified that such technical assistance will be needed in several aspect of the development. In order to ensure that the assistance meets EEA's requirements, it is envisage that the assistance will be flexible depending on EEA's requirements during 2016.

The team anticipates to provide assistance in the following areas:

- Assistance in the adaptation of scripts to the West Balkan countries' environment.
- Implementation of database locally.
- Local-id management.
- Validation of produced xml files.
- Technical assistance of any other aspects during development.
- Support on content clean-up of historical meta-data in AQUI db tool.

3.2 Time plan

The key deliveries and inputs identified between the team and experts from EEA will be delivered in 2016 according to the GANTT diagram below.

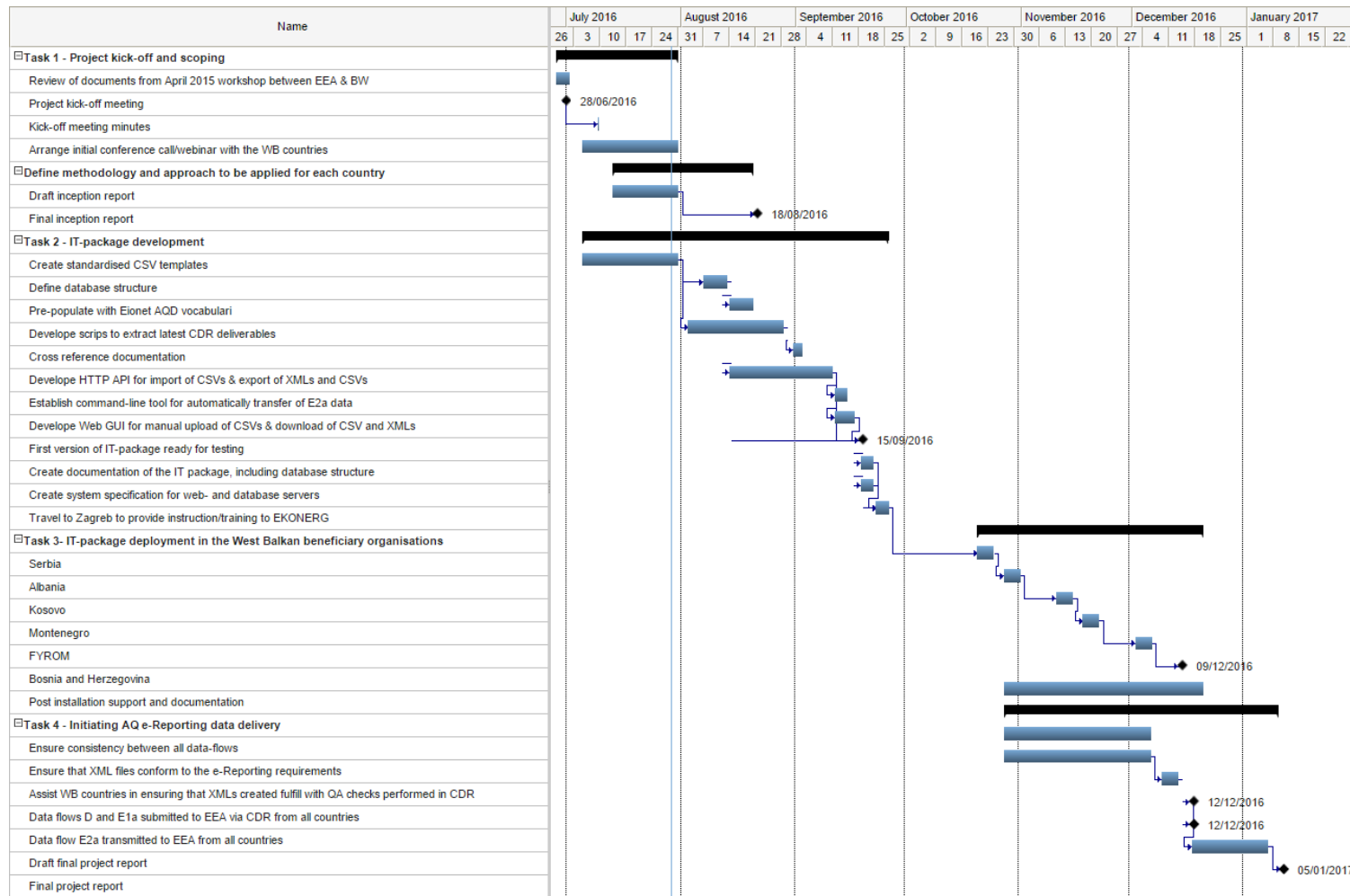


Figure 2: Project GANTT diagram

4 Risks and Vulnerabilities

There are a number of potential risk factors related to the completion of the project.

1. **Availability:** A potential obstacle to progress within the project is the availability of team members. This is due to the timing of the project which has started during the traditional summer vacation period for the participating institutions.

Mitigation: NILU will keep staff members available for the entirety of the vacation period, from July - September, thereby reducing the risk of the project stalling, or losing focus. This is not the case regarding the participating states however, as several experts working in the concerned institutes are effectively unavailable during August.

2. **Insufficient IT resources:** Another potential issue is the server hardware for hosting the solution for e-Reporting. Each participating state must have available suitable servers for hosting the software solution. In some cases, this is currently unclear if suitable resources are available. In addition, those project members that rely on a third party to provide their technical infrastructure further complicate the equation, as it becomes necessary to coordinate with two parties, instead of just one.

Mitigation: To simplify the deployment and maintenance, one will strive to make the IT software package as light as feasible, and use of easy use freewares, for instance Curl (<https://curl.haxx.se/>) will be considered.

3. **Possible lack of technical capacities:** To succeed it is crucial that the countries have relevant technical competence. Based on input from the countries, there may be some challenges for some of the countries.

Mitigation: The IT solution package will be documented and projects team members will provide training.

4. **Lack of commitment:** It is essential that the countries themselves feel ownership of the system. In the future they will need to maintain the IT solution package themselves.

Mitigation: Involving them at all stages and develop ownership of the new system.

5. **Country's specific situation** – further described in section 5.
 - FYROM: System already in place.
 - Bosnia and Herzegovina: Collaboration with 2 entities.
 - Montenegro: Take into account existing ongoing relevant project.
 - Albania: System hosted outside the beneficiary.

Mitigation: Deployment phase will be country specific.

5 Overview of the Balkans Air Quality networks

The following is an overview of the systems in place for data collection of air quality measurement data. It is by no means definitive, and is intended largely to give a basic idea of the current situation in each country. This will likely be updated as more information becomes available. Some of the data has been supplied by the countries themselves.

5.1 Serbia

Serbia's monitoring network is managed by SEPA, the Serbia Environmental Protection Agency, in Belgrade.

SEPA's obligations are to:

- Perform air quality monitoring in National monitoring networks.
- Collect AQ data from all AQ networks.
- Maintain AQIS.
- Make AQ assessment report.
- Report at national and EU level.

There are five networks within the country. These are:

- Network of the Autonomous.
- Province of Vojvodina.
- Public health institute of Belgrade.
- Municipal directorate of Pancevo.
- Municipal directorate of Bor.

Air Quality System

SEPA has new Air Quality information system, which is a result of the IPA 2012 Project: "Establishment of an integrated environmental monitoring system for air and water quality", part "Supply of ICT equipment and software for Air Quality Monitoring System". The system is still under construction, and the basic functionality of this system is to enable SEPA to perform collecting, updating and processing the results from air quality monitoring stations to the public in near-real-time.

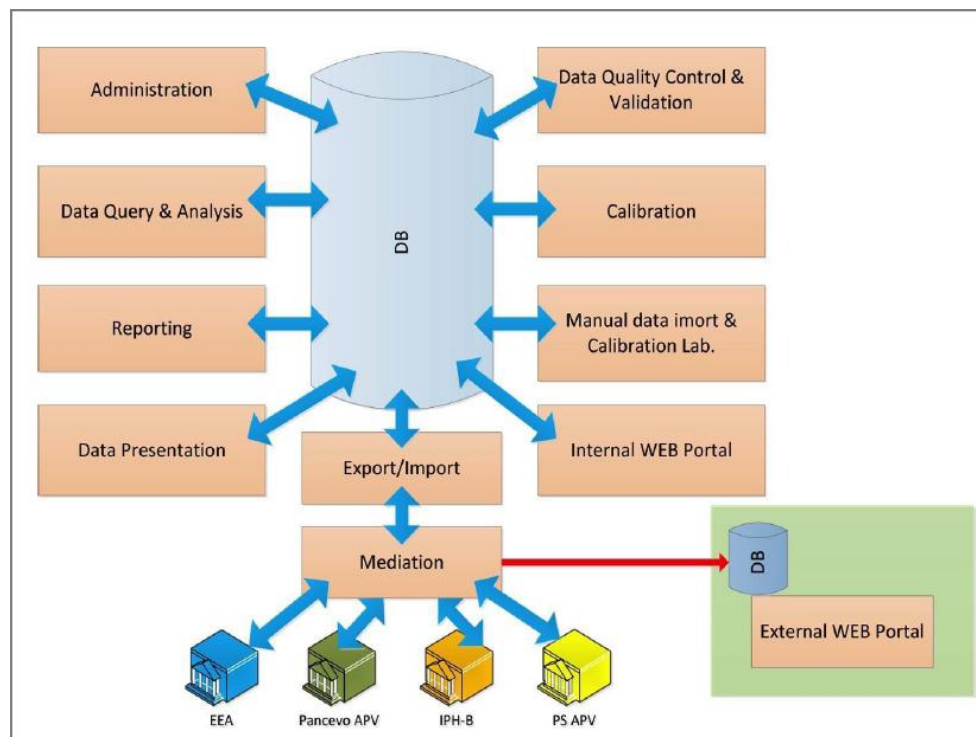


Figure 3: Block diagram of software modules within the central system
(Figure provided by Serbian Environmental Protection Agency)

The system is built on the Open Source platforms: ESXi 6.0, Linux Ubuntu LTS 14.04, Apache WEB server, PHP, PERL, Java Script, JQuery, High Chart, Google Maps and PostgreSQL.

The server infrastructure contains of: Server for application, Database server, Communication server and two WEB servers, one for external public presentations and one for internal for SEPA's experts and collaborators.

View Online

Data can be viewed online here:

<http://www.amskv.sepa.gov.rs/pregledpodatakazbirni.php>

Stations

There are 48 stations in Serbia comprising 22 background, 11 industrial, 12 traffic and 3 urban stations.

Possible implementation issue

A specific possible implementation risk that one can foresee at this stage, except from the possible risk described in chapter 4, could be that Serbia's new air quality system is still under construction and that functionality required for populating the e-Reporting templates is not implemented.

5.2 Albania

Albania's monitoring of urban air quality is managed by the National Environment Agency and the Institute of Public Health.

NEA's obligations are to:

- Perform air quality monitoring in National monitoring network.
- Maintain AQ.
- Make AQ assessment report.
- Report at national and EU level.

Air Quality System

The air quality system is developed, hosted and maintained by an Austrian company. Data is accessible through a web browser.

Stations

They measure air quality at 6 stations (1 traffic-, 3 urban-, and 2 urban/background stations).

These are:

- Tirana Mobile Station – traffic.
- Korca Station – urban.
- Vlora Station - urban background.
- Durres Station – urban.
- Elbasan Station – urban.
- Shkodra Station - urban background.

Possible implementation issue

A specific possible implementation risk that one can foresee at this stage, except from the possible risk described in chapter 4, is that the air quality system hosted by an Austrian company, does not includes an automatic export routine of UTD data.

5.3 Bosnia and Herzegovina

Bosnia and Herzegovina is divided into two political entities, the Federation of B&H and the Republic of Srpska + District of Brčko. The monitoring network is also separated, creating logistical problems in terms of reporting national air quality data.

The Federal Hydrometeorological Institute (FHMI) communicates with the EEA about air quality. However, the Republic of Srpska has no obligation to send AQ data to the Federal Hydrometeorological Institute.

View Online

Data can be viewed online here:

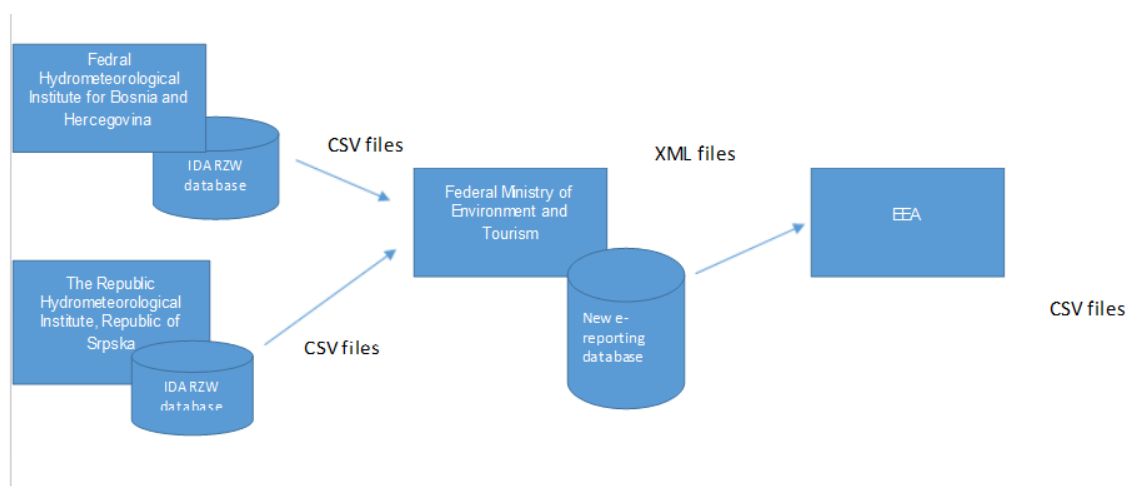
<http://fhmzbih.gov.ba/latinica/AKTUELNI/A-zrak.php>

Stations

There are 20 fixed measurement stations in Bosnia and Herzegovina. 16 are in the Federation, while four are in the Republic of Srpska.

For Bosnia and Herzegovina, one probably need to install the IT-solution package at the Federal Ministry of Environment and Tourism, which will act as the responsible reporter to EU.

The Federal Hydrometeorological Institute for Bosnia and Hercegovina and the Republic Hydrometeorological Institute, Republic of Srpska, are responsible for all measurement data collection and will be responsible for submission of data to the Federal Ministry of Environment and Tourism. See figure below.



Possible implementation issue

A specific possible implementation risk that one can foresee at this stage, except from the possible risk described in chapter 4, is that Bosnia and Herzegovina is divided into two political entities, and it may be an political issue regarding sharing of data.

5.4 FYROM

FYROM's monitoring of urban air quality is managed by Ministry of Environment and Physical Planning Republic of Macedonia (MEPP).

Air Quality System

MEPP utilizes air quality data management system AIRVIRO (<http://www.smhi.se/airviro>) for collection, storing and quality control of air quality monitoring data. This system is a commercial software, which cannot be extended to fulfil the requirements of the e-Reporting.

View Online

Data can be viewed online here:

<http://airquality.moepp.gov.mk/>

Related project

A related project is the EU-funded Twinning Project "Further strengthening the capacities for effective implementation of the acquis in the field of air quality". MEPP has reported the air quality data (B, D and E1a datasets) to EEA using temporary AQUI tool. In May 2015 the e-Reporting system development was started with the support of the experts of Finnish Meteorological Institute as part of the Twinning project. The system will be based on the Finnish solution for e-Reporting modified to suit the existing systems in MEPP. With the new system datasets D, E1a and E2a will be reported.

The new tool is using MySQL as database platform. The database has been filled with metadata, which MEPP has reported in dataset D with AQUI. The e-Reporting system creates the D-report automatically when requested from the metadata in the MySQL database.

Currently the database for the dataset D is mostly finalized and testing will start soon. The solution for the E2a dataset is close to finalization. E1a dataset is already reported with the new system.

This means that technically FYROM does not need the package developed in the frame of our project. In practice further discussion is needed to identify how the project can support FYROM in effectively implementing e-Reporting.

Remark:

One of the issue mentioned by the NRC is the lack of user interface for the database developed by the twinning project. The NRC and the NFP have requested the support from the EEA to develop this interface. However this falls outside the role of the EEA as well as outside the scope of the present project.

5.5 Kosovo

The Ministry of Environment and Spatial Planning (MESP) and Hydro-meteorological Institute of Kosovo (HMIK) are obliged to monitor air quality in the entire territory of Kosovo. MESP respectively KEPA/KHMI manages the current air monitoring network in Kosovo.

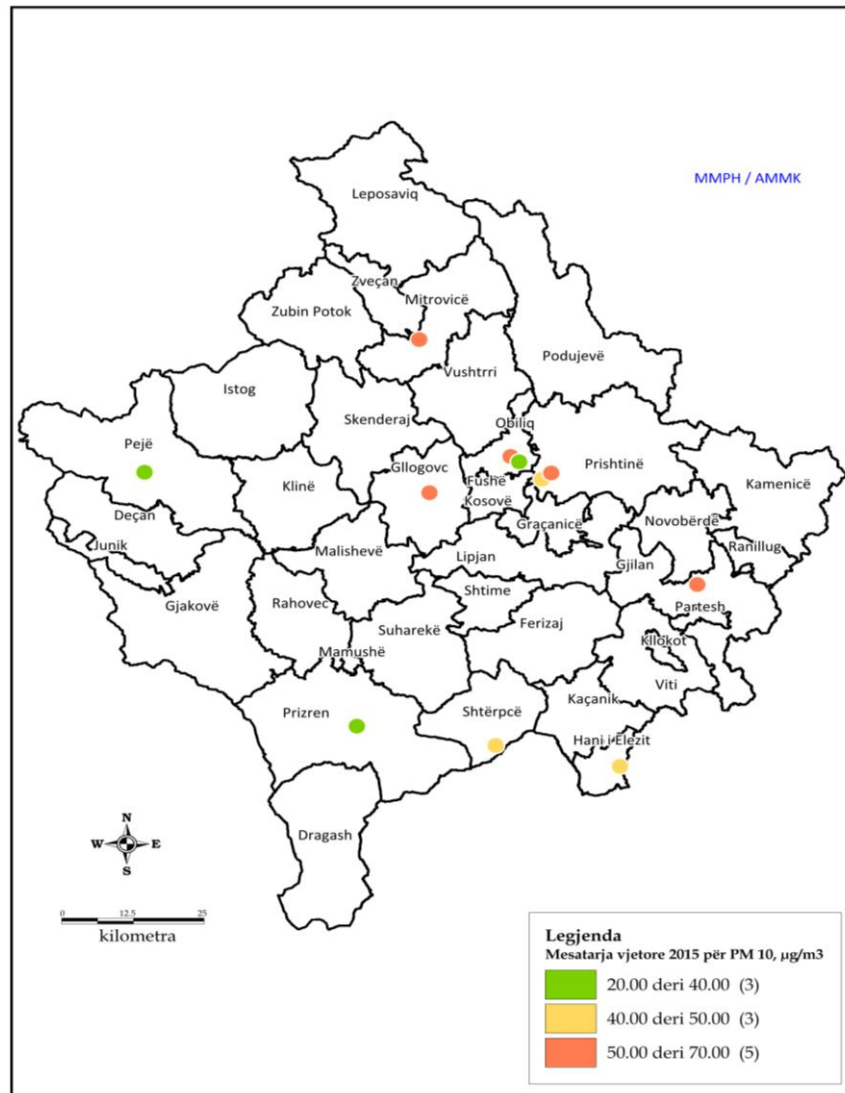


Figure 4: An overview map of air quality stations in Kosovo
(Figure provided by Kosovo Environmental Protection Agency)

View Online

Data can be viewed online here:

<http://www.ammk-rks.net/?page=2,21>

Stations

There are 12 fixed stations and 1 Mobile station, comprising:

- 1 background/suburban station.
- 4 background/urban stations.
- 1 background/urban/industrial stations.
- 2 traffic/urban stations.
- 1 background/urban/industrial stations.
- 3 background/industrial stations.

Table 2: Table provided by Kosovo Environmental Protection Agency

Local code of stations	Name of station	Manager	Type statione/type area	Measurement Parameters
KS0101*	Prishtine-HMIK	KEPA/HMIK	Background/Suburban	SO2, NO2, CO,O3, PM10/PM2.5
KS0102*	Prishtine-Rilindja	KEPA/HMIK	Trafik /urban	NO2, , PM10/PM2.5
KS0103*	Drenas-yard of Municipality	KEPA/HMIK	Background/urban	SO2, PM10/PM2.5
KS0204*	Mitrovicë-Stacioni i meteorologjisë	KEPA/HMIK	Background/urban	CO,O3, PM10/PM2.5
KS0305	Pejë- Primary school "Lidhja e Prizrenit"	KEPA/HMIK	Background/urban	SO2, NO2, CO,O3, PM10/PM2.5
KS0406	Prizren-Yard of Municipality	KEPA/HMIK	Background/urban	SO2, NO2, CO,O3, PM10/PM2.5
KS0507*	Brezovica-Skying area	KEPA/HMIK	Background/rural	SO2, NO2, CO,O3, PM10/PM2.5
KS0508	Hani i Elezit- Primary School " Ilaz Thaqi"	KEPA/HMIK	Background/urban & industrial	SO2, NO2, CO,O3, PM10/PM2.5
KS0609	Gjilan-Yard of Municipality	KEPA/HMIK	Trafik /urban	SO2, NO2, CO,O3, PM10/PM2.5
KS0110	Obiliq- Qendra e mjeksis familjare	KEPA/HMIK	Background/industrial	SO2, NO2, CO,O3, PM10/PM2.5
KS0111	Dardhishte-Shkolla fillore	KEPA/HMIK	Background/industrial	SO2, NO2, CO,O3, PM10/PM2.5
KS0112	Palaj-Kosova Mont	KEPA/HMIK	Background/industrial	SO2, NO2, CO,O3, PM10/PM2.5
*stations that are out of function				

Possible implementation issue

At this stage in the project one cannot foresee any specific implementation issues, except from the possible risk described in chapter 4.

5.6 Montenegro

Air Quality System

Montenegro has an Environmental Information System (EIS), based on PostgreSQL/PostGIS DBMS, and open source GIS server solutions. The infrastructure for the EIS is presented in the figure below.

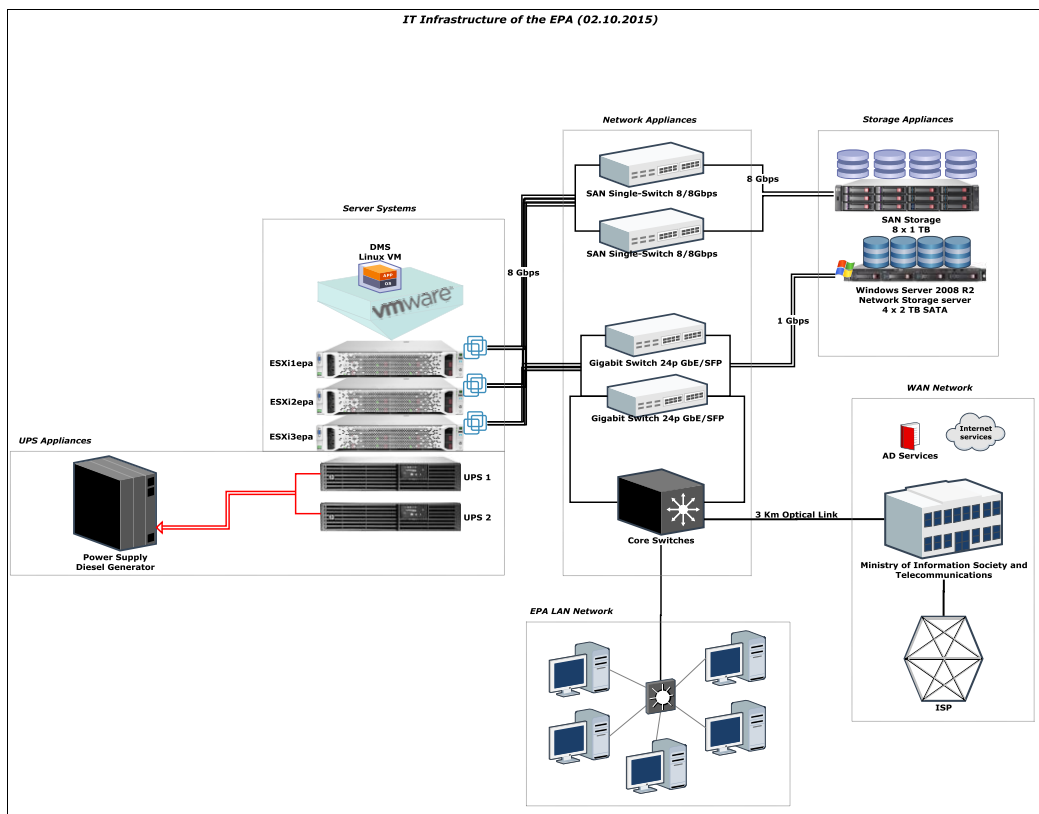


Figure 5: Existing IT infrastructure

(Figure provided by Montenegro Environmental Protection Agency)

Related projects

A related project is the on-going EU founded project, called "Establishment and development of the environmental information system". The objective of this on-going project is to develop an Environmental Information System (EIS) that aim to support the Environmental Protection Agency (EPA) of Montenegro in its mission to provide accurate, reliable and timely environmental information to policy-makers and the public. The EIS will cover the topics put forward by European Environment Information and Observation Network (EIONET): Air pollution, Chemicals/ Waste, Biodiversity change and nature, Climate change, Soil, Water, Air Quality. The EIS will act as data provider to the IT software package.

Possible implementation issues

A specific possible implementation risk that one can foresee at this stage, except from the possible risk described in chapter 4, could be that Montenegro's new EIS is still under construction and that functionality required for populating the e-Reporting templates is not implemented.

Another implementation issue is that the Centre for Ecotoxicological Research (CETI) hosts the air quality UTD data, while the Environmental Protection Agency (EPA) host the validated air quality data. It is therefore essential that both CETI and EPA will be involved in the implementation phase of the project.

NILU – Norwegian Institute for Air Research

NILU – Norwegian Institute for Air Research is an independent, nonprofit institution established in 1969. Through its research NILU increases the understanding of climate change, of the composition of the atmosphere, of air quality and of hazardous substances. Based on its research, NILU markets integrated services and products within analyzing, monitoring and consulting. NILU is concerned with increasing public awareness about climate change and environmental pollution.

NILU's values: Integrity - Competence - Benefit to society

NILU's vision: Research for a clean atmosphere

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