

JRC TECHNICAL REPORTS

Reporting of Air Quality Plans and Programs in Europe

*Guidelines for INSPIRE
compliant data transmission*

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Executive summary

The EEA Member countries¹ have obligations to report on the assessment and management of ambient air quality on a regular basis. The data sharing obligations are thoroughly defined in the Commission Implementing decision (IPR) of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality. The IPR requires member countries to do this in accordance with Directive 2007/2/EC of the European Parliament and the Council of 14 March 2007 establishing an infrastructure for spatial information in the European Community (INSPIRE).

The Commission (notably the Joint Research Centre, and Directorate General Environment, supported by Directorate General Informatics), the European Environment Agency (EEA) and organizations in the European Union Member States (MS), are collaborating on a pilot project for air quality e-reporting. The pilot project addresses a broad spectrum of aspects, ranging from INSPIRE-based reporting sheets, network services, guidelines, as well as software tools, all contributing to a long term solution for interoperable exchange of air quality data.

This report focuses on the solutions for a subset of the reporting obligations, namely the reporting of the air quality plans and programs, as defined in article 23 of Directive 2008/50/EC of the European Parliament and of the Council (Air Quality Directive)². It provides a step-by-step user guide for the deployment and use of the open source software developed for this purpose.

The intended readership is people in the member states that are involved in the preparation and submission of the air quality plans and programs, at both national and sub-national levels. It also helps IT-specialists to deploy and configure the software tool within their organizations.

¹ Member States of the European Union, together with Iceland, Liechtenstein, Norway, Switzerland and Turkey, as well as six West Balkan cooperating countries: Albania, Bosnia and Herzegovina, the Former Yugoslav Republic of Macedonia, Montenegro, Serbia as well as Kosovo under the UN Security Council Resolution 1244/99.

² <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:EN:PDF>

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1. Introduction

1.1 *Intended readership*

The intended readership is people in the member states that are involved in the preparation and submission of the air quality plans and programs, at both national and sub-national levels. It also helps IT-specialists to deploy and configure the software tool within their organizations.

1.2 *Air quality e-reporting in Europe - overview*

The EEA Member countries³ have obligations to report on the assessment and management of ambient air quality on a regular basis. The data sharing obligations are thoroughly defined in the Commission Implementing decision (IPR) of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality.

In accordance with the IPR decision the Commission, assisted by the EEA, *'shall establish a data repository and make it accessible through the ambient air quality portal'* and *'Each Member State shall nominate a person or persons responsible for the delivery on its behalf to the data repository of each reported and exchanged information'*. Moreover, the air quality directive recognizes the necessity to adapt procedures for data provision, assessment and reporting of air quality to enable electronic means and the Internet to be used as the main tools to make information available, and so that such procedures are compatible with Directive 2007/2/EC of the European Parliament and the Council of 14 March 2007 establishing an infrastructure for spatial information in the European Community (INSPIRE).

Information which shall be delivered to the EEA is for simplicity subdivided into data flows, which are all connected in a logical manner through the common electronic reporting (e-reporting) data model (Figure 1). The IPR decision also defines different deadlines for data provision on each of the individual data flows.

- (B) Information on zones and agglomerations (Article 6)
- (C) Information on the assessment regime (Article 7)
- (D) Information on the assessment methods (Articles 8 and 9)
- (E1a) Information on primary validated assessment data - measurements (Article 10)
- (E1b) Information on primary validated assessment data -modelled (Article 10)
- (E2a) Information on primary up-to-date assessment data -measurements (Article 10)
- (F1a) Information on generated aggregated data - primary validated measurements (Article 11) [terminated]
- (F1b) Information on generated aggregated data - primary validated modelled (Article 11) [terminated]
- (F2) Information on generated aggregated data - primary up-to-date measurements (Article 11) [terminated]
- (G) Information on the attainment of environmental objectives (Article 12)
- (H) Information on air quality plans (Article 13)
- (I) Information on source apportionment (Article 13)
- (J) Information on the scenario for the attainment year (Article 13)

³ Member States of the European Union, together with Iceland, Liechtenstein, Norway, Switzerland and Turkey, as well as six West Balkan cooperating countries: Albania, Bosnia and Herzegovina, the Former Yugoslav Republic of Macedonia, Montenegro, Serbia as well as Kosovo under the UN Security Council Resolution 1244/99.

- (K) Information on measures (Articles 13 and 14)
- (B) Preliminary information on zones and agglomerations (Article 6)
- (C) Preliminary information on the assessment regime (Article 7)

Figure 1. Air quality e-reporting data flows defined in 2011/850/EU

A pilot project is established by reporting organizations in the European Union Member States (MS), European Commission (Directorate General Environment and the Joint Research Centre, supported by Directorate General Informatics) and the European Environment Agency (EEA). Partners of the pilot and are collaborating on a broad spectrum of topics related to finding a long term solution for interoperable exchange of air quality data, following a commonly agreed reporting model. A major activity of the pilot project is the establishment of an e-reporting model which satisfies the legally binding obligation of the air quality directive, but also being in compliance with the INSPIRE Directive. Information on the e-reporting data model is provided by Schleidt (2013), while Kotsev et. al. (2014) provide details on the experience and lessons learned from the process of e-reporting. Further technical details (reporting model, guidance documentation, xml examples, user forum, etc.) are provided through the ambient air quality portal, part of EEA's reporting infrastructure (EIONET)⁴.

1.3 Air quality "Plans and Programs"

In accordance with Article 23 of the Air Quality Directive when in given zones or agglomerations, the levels of pollutants in ambient air exceed any limit value or target value, plus any relevant margin of tolerance in each case, Member States shall ensure that air quality plans are established for those zones and agglomerations in order to achieve the related limit value or target value specified. Information on those air quality plans shall be made available to the Commission without delay, and no later than 2 years after the end of the calendar year in which the first exceedance was observed. The EEA should then receive and host those air quality plans in accordance with the IPR decision.

The process of data transmission on air quality plans and programs in Europe is not new. Data have been provided to the EEA by MS for many years through an excel questionnaire. With the adopting the newly created schema, the overall process of reporting is converted to a new e-reporting model, and the only accepted format becomes xml.

Data on plans and programs is subdivided into four interrelated flows:

- (H) Air quality plans (Article 13 of 2011/850/EU);
- (I) Source apportionment (Article 13 of 2011/850/EU);
- (J) Scenario for the attainment year (Article 13 of 2011/850/EU);
- (K) Measures (Articles 13 and 14 of 2011/850/EU).

1.4 Infrastructure for Spatial Information in the European Community - INSPIRE

Through the Directive for the establishment of an Infrastructure for Spatial Information in the European Community (INSPIRE), the European Union has created a common standard to make environmental information

⁴ <http://www.eionet.europa.eu/aqportal/>

quickly and easily accessible for integrated policy decision-making at all levels of government while supporting the flow of information and data between the local, regional, national and European or international levels. By implementing INSPIRE and the Shared Environmental Information System (SEIS), Member States, the Commission, and the European Environment Agency are adopting innovative data management practices that greatly improve the consistency, availability and re-use of spatial information for environmental policy making.

The INSPIRE Directive and the Implementing Rules Legal Acts have become law in all EU Member States and in several EFTA countries. INSPIRE rules are binding for all public environmental data management activities, including those related to the Air Quality Directive.

On October 21st 2013 the European Commission amended Regulation (EU) No 1089/2010 implementing Directive 2007/2/EC as regards interoperability of spatial data sets and services, thus completing what is probably the world's single largest data harmonization effort for environmental information. It is the result of an effort of hundreds of experts from across Europe that have been working together for several years to agree common definitions in important policy areas such as energy, climate change, biodiversity, the marine environment, and human health (c.f. Figure 2).

This legal act complements other INSPIRE legal acts and standards, that together form the basis of the Infrastructure for Spatial Information in the European Community (INSPIRE) that Directive 2007/2/EC envisions. Now that most documents needed for the establishment of the infrastructure are agreed, the implementation of INSPIRE continues with Member State implementation and maintenance. Considering the deadlines, INSPIRE will be fully implemented by 2020.

INSPIRE uses international standards as building blocks of the European spatial data infrastructure. By implementing the legislation, authorities add value to existing systems by making them interoperable.

All legal acts, technical guidance documents, and the INSPIRE geoportal are accessible through <http://inspire.ec.europa.eu>.

| | | |
|--|---|---|
| <p>Annex I</p> <ol style="list-style-type: none"> 1. Coordinate reference systems 2. Geographical grid systems 3. Geographical names 4. Administrative units 5. Addresses 6. Cadastral parcels 7. Transport networks 8. Hydrography 9. Protected sites | <p>Annex III</p> <ol style="list-style-type: none"> 1. Statistical units 2. Buildings 3. Soil 4. Land use 5. Human health and safety 6. Utility and governmental services 7. Environmental monitoring facilities 8. Production and industrial facilities 9. Agricultural and aquaculture facilities 10. Population distribution – demography | <ol style="list-style-type: none"> 11. Area management/ restriction/regulation zones & reporting units 12. Natural risk zones 13. Atmospheric conditions 14. Meteorological geographical features 15. Oceanographic geographical features 16. Sea regions 17. Bio-geographical regions 18. Habitats and biotopes 19. Species distribution 20. Energy Resources 21. Mineral resources |
| <p>Annex II</p> <ol style="list-style-type: none"> 1. Elevation 2. Land cover 3. Ortho-imagery 4. Geology | | |

Figure 2. INSPIRE data themes

The air quality plans and programs model, and the solution which is developed based on it are both done with interoperability in mind, as the e-reporting model⁵ itself is created, considering from the very beginning the

⁵ <http://www.eionet.europa.eu/aqportal/datamodel>

requirements of two European Directives - INSPIRE (2007/2/EC) and air quality (2008/50/EC). The INSPIRE data models⁶ and correspondent Data specifications⁷ are used as a backbone which is further extended with the air quality specific content, and that is why the air quality "Plans and Programs" system, which strictly follows the requirements of the model are compliant with the INSPIRE data models.

1.5 Structure of the report

Chapter 2 goes into further detail and describes the open source e-reporting system which is being created by the Digital Earth and Reference Data unit of the Joint Research Centre (JRC) in support of MS e-reporting. This chapter is dedicated to those who would be using the system to create data which would then be transmitted to the EEA infrastructure. The next two chapters (3 & 4) provide a thorough guidance on how the system should be used and administered, thus streamlining e-reporting. The final chapter is an installation guide, dedicated to those European reporting authorities which would want to deploy the system as part of their own data infrastructure, potentially extending the core functionality in order to meet other obligations, but ensuring that those are based on exactly the same data which has been reported to the EEA.

⁶ <http://inspire.ec.europa.eu/index.cfm/pageid/2/list/datamodels>

⁷ <http://inspire.ec.europa.eu/index.cfm/pageid/2>

2 E-reporting system, an overview

2.1 Architecture

A “Plans and Programs” reporting system is put in place to support MS in preparing and delivering the required data. Its underlying architecture is created, considering the wide diversity of existing infrastructures in Europe. Figure 3 represents a birds-eye view of the architecture with several levels of report creation (national, regional and local), by using the same web-based solution. The solution allows a flexible approach for e-reporting which can be fit to the specificity of any of the infrastructures in the reporting countries.

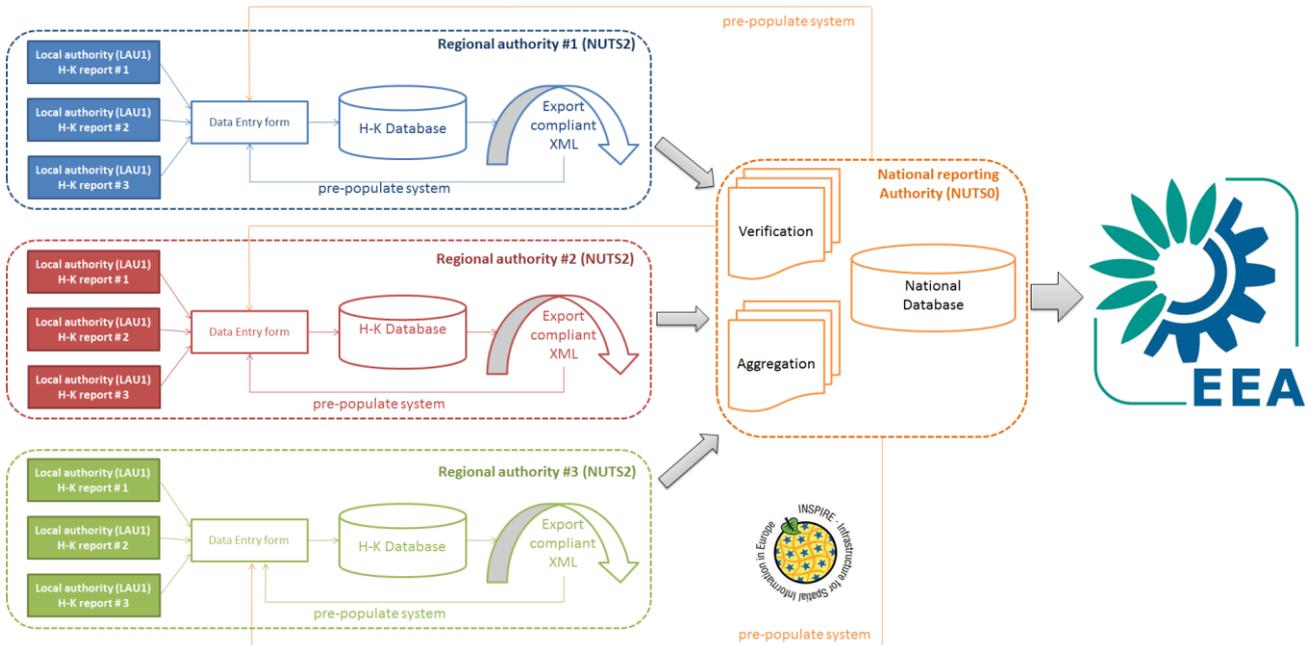


Figure 3. Architecture for e-reporting of air quality plans and programs (indicative)

The system is designed with several implementation options in mind. This is done in order to satisfy the different demand of MS following consultations during the meetings of the air quality pilot project. Those solutions include:

- A centralized solution, which is deployed and made available for reporting authorities in Europe for instant online access. The solution is available on <http://inspireaq.jrc.ec.europa.eu/aqrsystem>, but will be migrated to the EEA infrastructure in 2015 for operational use and maintenance.
- A decentralized solution, with the following options ensuring flexibility and adaptability to user needs:
 - Source code, provided through git repository, and available at <https://webgate.ec.europa.eu:443/CITnet/stash/projects/AQRTOOL/repos/aqr-public/browse/SourceCode>
 - Binary, distributed as a Web application Archive (*.war) for deployment in Apache Tomcat, and available at <https://webgate.ec.europa.eu:443/CITnet/stash/projects/AQRTOOL/repos/aqr-public/browse/Application>

- Virtual Machine, providing a fully functional out-of-the box solution for e-reporting. The virtual machine can be used with various virtualization software such as Oracle VirtualBox and VMware player. <http://inspireaq.jrc.ec.europa.eu/vm/AQRSystem.vmdk>.

Credentials for accessing the system through this option are:

- Username: aqplans
- Password: Only4plans

2.2 Licensing

The software is made available under the “European Union Public License” (EURL) version 1.1. The EURL is the first European Free/Open Source Software (F/OSS) licence, created within the framework of the ISA (Interoperability Solutions for European Public Administrations) program on the initiative of the European Commission. EURL ensures the following rights to the licensee⁸:

- Obtain the source code of the software from a free access repository
- Use the software in any circumstance and for all usage
- Reproduce (copy, duplicate) the software
- Modify the original software, and/or make derivative works out of it
- Communicate the software to the public (i.e. using it through a public network or distributing services based on the software via Internet)
- Distribute the software or copies thereof to other users (inside or outside the licensee's organisation)

Through the use of EURL reporting authorities on air quality “Plans and Programs” can have access to the source code of the solution and extend it to satisfy requirements beyond the formal e-reporting of data to the EEA. Such extensions might be done for instance in order to meet national obligations, ensuring the same information base with what is already reported to EEA, generate output from the system in specific formats, provide human-readable output, feed information to the EC “Catalogue of air quality measures”⁹, etc.

2.3 Design overview

The following general requirements are built in within the “Plans and Programs” e-reporting solution:

- Hierarchical access: Structurally the system provides three levels of access which have different control over the functionality of the system, depending on their level of access. Those are: “EEA Administrator”, “National Administrator” and “User”.
- Localizable user interface: The system allows localization (translation) into any language to allow users to translate the interface in any of the 24 official languages of the European Union.
- Extensibility: The system uses generic software components, and the source code is well documented, thus allowing easy extensibility for providing functionality which is currently not being implemented.
- Data upload: Information represented through xml for any of the H-K dataflows (Plans, Source Apportionment, Measures, Evaluation Scenarios), as well as dataflow “G” (Attainments) can be imported into the system if they pass a validation step during the import process against the air quality schema.

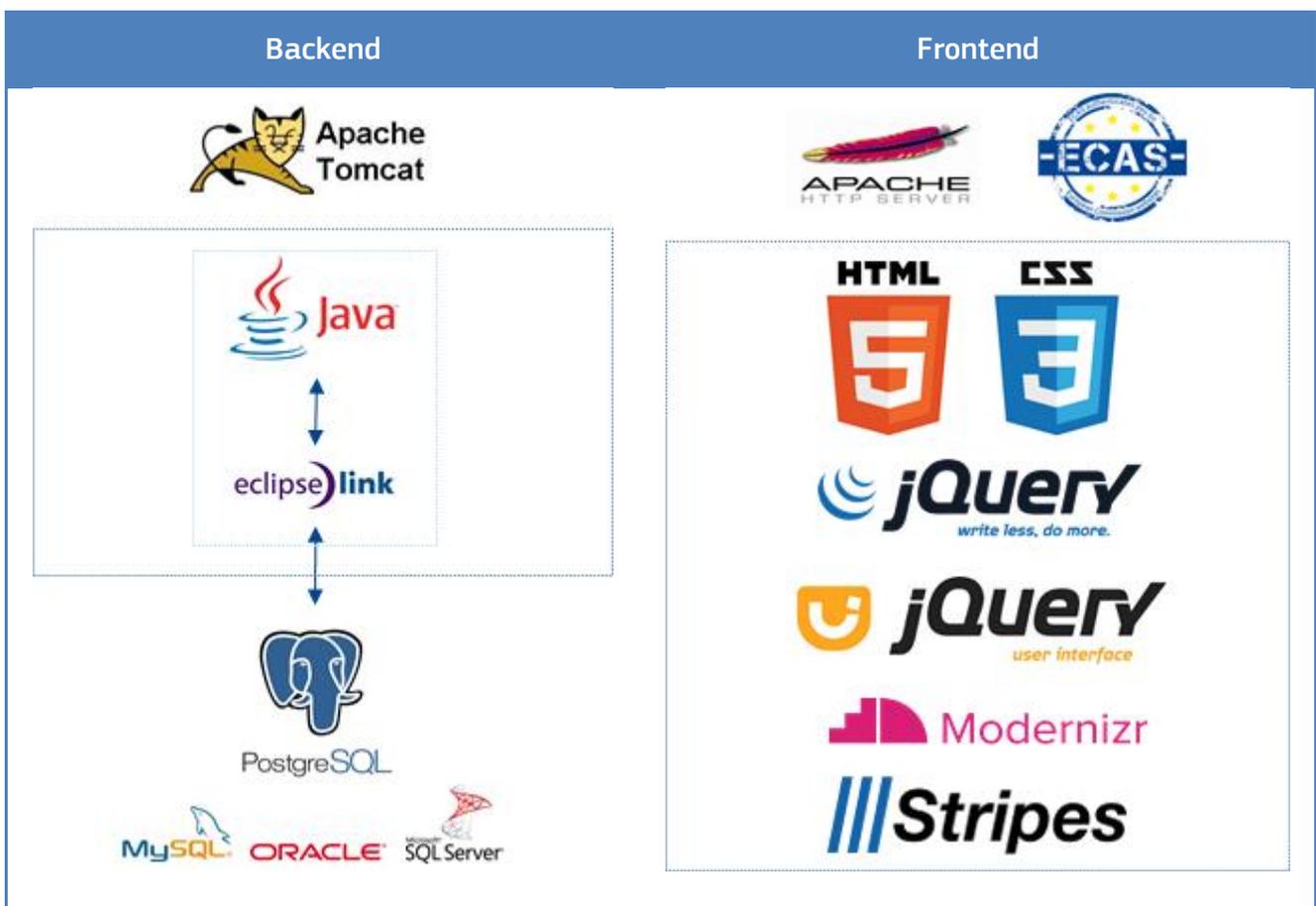
⁸ Source: <https://joinup.ec.europa.eu/software/page/eupl/how-use-eupl>

⁹ <https://luft.umweltbundesamt.at/measures/>

- Data reuse: Data which is already loaded can be reused through ‘clone’ functionality which creates identical records of already existing reports, which can then be modified and resubmitted to the EEA.
- Data export: The solution is implemented strictly following the reporting model, and there is built in functionality which controls the quality of the input against the model (mandatory fields, cardinalities¹⁰, etc.). A dialogue provides overview of what are the mandatory fields which needs to be populated and validates all data XML format for P&P reporting. Reported data is flagged as either DRAFT (when one or more of the mandatory fields is missing, and/or when a relation on another dataflow is not being provided).
- Licencing: The software product is entirely open source, licensed under the EUPL, allowing reuse of the code and unconstrained further development.

2.4 Technology

The “Plans and Programs” reporting system is implemented using Java 1.6 technology. The libraries used in the system are thoroughly described within a Project Object Model (POM) file. This project is built using the Apache Maven project management and comprehension tool¹¹. The major components of the system are depicted and described below.



¹⁰ Relationships between elements in the model.

¹¹ <http://maven.apache.org/>

Web Server

The system is implemented through two different web servers: one used to serve a Representational State Transfer (RESTful) web service, and the other one for Servlet container for the “Plans and Programs” Java-based web application. The two server applications used for that purpose are:

- Apache HTTPD Version 2
- Apache Tomcat Version 7

RESTful web services are built to work best on the Web. Representational State Transfer (REST) is an architectural style that specifies constraints, such as the uniform interface, that if applied to a web service induce desirable properties, such as performance, scalability, and modifiability, that enable services to work best on the Web. In the REST architectural style, data and functionality are considered resources and are accessed using Uniform Resource Identifiers (URIs), typically links on the Web. The resources are acted upon by using a set of simple, well-defined operations. The REST architectural style constrains an architecture to a client/server architecture and is designed to use a stateless communication protocol, typically HTTP. In the REST architecture style, clients and servers exchange representations of resources by using a standardized interface and protocol.¹²

A Servlet is a Java programming language class used to extend the capabilities of servers that host applications accessed by means of a request-response programming model. Although servlets can respond to any type of request, they are commonly used to extend the applications hosted by web servers. For such applications, Java Servlet technology defines HTTP-specific servlet classes.¹³

Database

The database layer of the system is handled by the EclipseLink library. That is why all databases supported by EclipseLink (incl. MySQL, Oracle, MS SQL Server, etc.) can possibly be used for the system, thus ensuring adaptability to the hosting infrastructure. The actual implementation is however been implemented within a PostgreSQL server 9.3.

Stripes

Stripes is a Java web applications framework which is used in order to reduce the complexity of the system and ensure its high quality. Stripes has been successfully applied for improving the efficiency of the development team, reduces the amount of code and improves maintainability.

jQuery

jQuery is used within the interface of the system. It is a fast and lightweight, yet feature-rich JavaScript library. It makes things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers.

ECAS

The system uses the European Commission's Authentication Service (ECAS) for authentication. User management and authentication are intentionally kept separate to ensure that another authentication service is used if necessary. ECAS is a single sign-on system, which means that one username and password can be used to access a range of European Commission systems. Once a user logs into a website or service with ECAS she will not be required to re-authenticate for other EC systems.

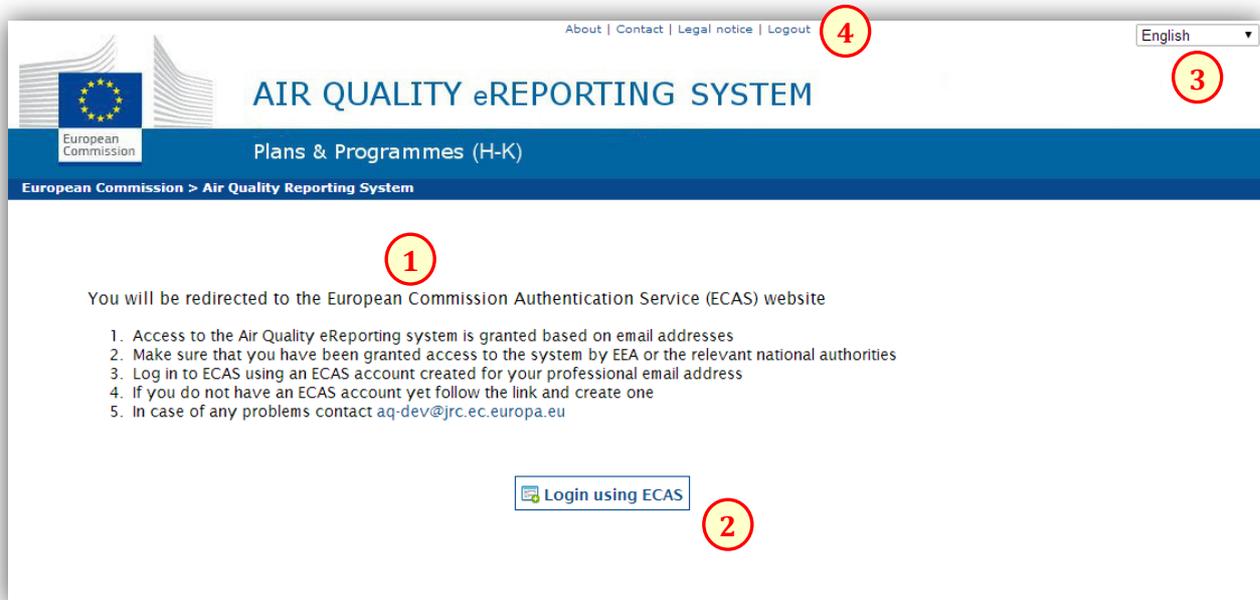
¹² Source: <http://docs.oracle.com/cd/E19798-01/821-1841/qijqy/index.html>

¹³ Source: <http://docs.oracle.com/cd/E19798-01/821-1841/bnafnd/index.html>

3. Guidelines for use of the e-reporting system

3.1. *Accessing the system*

The homepage of the system provides introductory information and login button. An instance of the latest version of the system is available at <http://inspireaq.jrc.ec.europa.eu/aqrsystem>. In order to be able to access the system one should have been approved for accessing the system.



The landing page of the system consists of the following components:

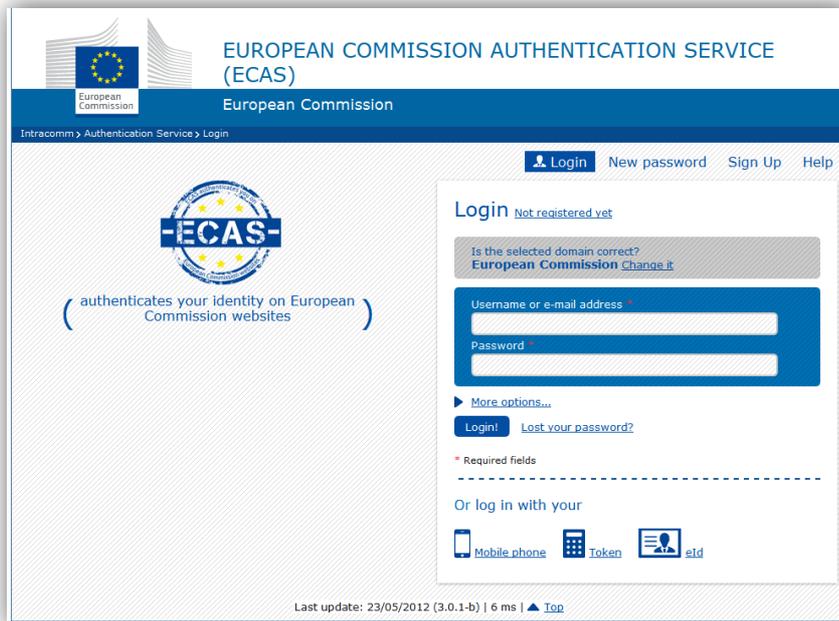
1. Introductory information about the access to the system.
2. The login button. To access the system the login button needs to be clicked. It redirects the user to ECAS, which is the European Commission Authentication System (see User Authentication).
3. Language selection field. The system has been localised into the European languages. To change the currently used language one can choose the preferred language from the language selection field.
4. Top menu. The top menu provides additional information and links, e.g. the contact details.

3.2 *User Authentication*

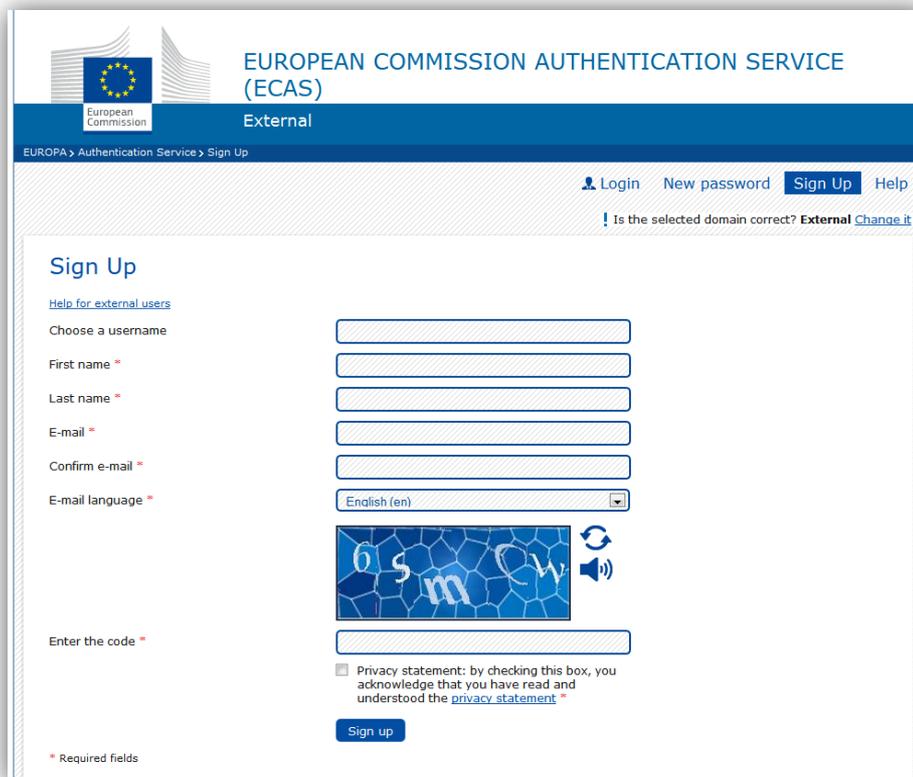
The system uses the European Commission's Authentication Service (ECAS) for granting access to individual users and/or organizations. ECAS is a single sign-on system, which means that one username and password can be used to access a range of European Commission systems. After the use of ECAS to log in to a website or service, one will not be required to re-authenticate for other EC systems.

To be able to use the Air Quality "Plans and Programs" e-reporting System users need to create an ECAS account, as well as they need to be given access rights by the administrator of the Air Quality "Plans and Programs" e-reporting System (EEA, JRC or National reporting authority).

To register to the ECAS services, users have to visit the ECAS website: <https://webgate.ec.europa.eu/cas> and click on the „Sign Up” link.

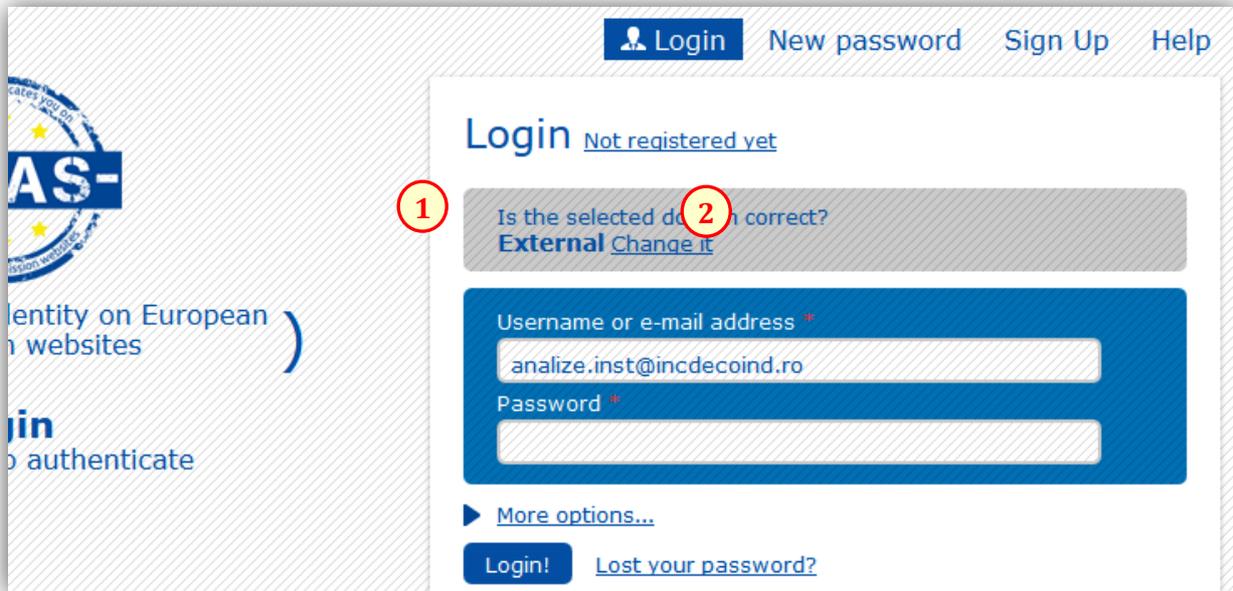


The registration page will be displayed.

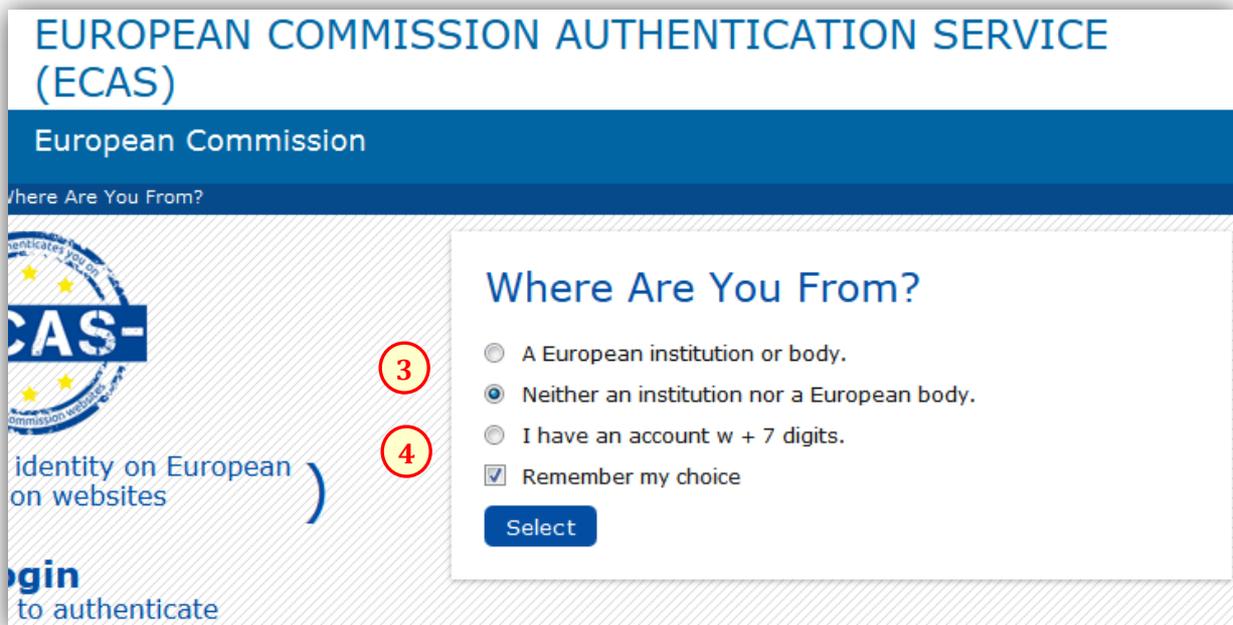


Users should provide the required data, click the “Sign up” button, and confirm the contact email address by clicking the link in the email that one should receive immediately after registration. The email address should be the same as the one which is provided to the authority granting access to the Plans and Programs reporting system (EEA or National reporting authority).

Logging in to the system next time, one should make sure to log in to the External domain.



If users are not in the External domain, they have to change it by clicking to “Change it” (2) and then selecting “Neither an institution nor a European body” (3) and also select “Remember my choice” (4).



More information about the ECAS authentication is provided in the HELP menu of the above mentioned website.

3.3 User Roles

The Air Quality Plans and Programs e-Reporting System has three types of users built-in:

- *EEA Administrators* – who can grant access to each of the countries
- *National Administrators* – who can administer the country related settings of the system as well as may develop reports themselves
- *Regular Users* – who can use the system to develop reports for a certain country

The list of the features that users of each type can use is given below.

| Feature | EEA Administrator | National Administrator | Regular User |
|-------------------------------------|-------------------|------------------------|--------------|
| View data of all the countries | ✓ | | |
| View data of a country | | ✓ | ✓ |
| Edit/Delete reports of the country | | ✓ | |
| Edit/Delete own reports | | ✓ | ✓ |
| Clone items | | ✓ | ✓ |
| Export items to XML | | ✓ | ✓ |
| Import XML files | | ✓ | ✓ |
| Upload data from Flow G | | ✓ | ✓ |
| Manage users of all countries | ✓ | | |
| Manage users of the country | | ✓ | |
| Manage country namespace | | ✓ | |
| Manage the default provider details | | ✓ | ✓ |

3.4 National Spaces

Users of the Air Quality “Plans and Programs” e-reporting system work within their national spaces, which means that:

- National Administrators and Users can only view the data of their own country.
- The National Administrator can change the namespace of the country, which will have impact on all the users from this country.
- The National Administrators and Users can upload data for attainments (data flow “G”), which will be available to all the users from their country.
- The National Administrators and Users see the statistics of data from their country.
- The National Administrators and Users can only link in their reports to items from their country.

3.5 E-Reporting

3.5.1 Main Tab

When one logs in to the system s/he will see six tabs at the top of the screen, just under the European Commission banner. These tabs represent six main areas of the system that the user should get familiar with.



The purpose of the tabs is as follows:

1. Home. This tab contains statistics about the data in the system of the country of the user.
2. Plan. The tab for reporting flow “H” data (Plans).
3. Source Apportionment. The tab for reporting flow “I” data (Source apportionment).
4. Evaluation Scenario. The tab for reporting flow “J” data (Evaluation Scenario).
5. Measures. The tab for reporting flow “K” data (Measures).
6. Settings. Additional settings, user management, Flow “G” (Attainments) data upload.

3.5.2 Home Tab

The Home tab contains statistical summary of the data in the system. Users and national administrators see information about their country. EEA administrators see information about the whole system.



3.5.3 Creating Reports

Users and National Users can create new items for each of the flows. To this end they need to click the “Create” button (1). As a result a new item will be added to the table. The system will automatically populate the “Provider” section with the data in the “Default Provider” section of the Settings tab. The namespace will as well be automatically populated taking the value from the configuration settings of the country, which are maintained by the national administrator.

The newly created item will be visible to all the users and national administrators of the country, as well as to the EEA administrators. The person who created the item will be the only one, though, with the right to edit the item.

To view and edit an item a name in the table (2) should be clicked, and this will redirect the user to the edit view.

The screenshot shows the 'AIR QUALITY eREPORTING SYSTEM' interface. At the top, there is a navigation bar with the European Commission logo and the system title. Below this, there are navigation tabs: Home, H: Plan, I: Source Apportionment, J: Evaluation Scenario, K: Measures, and Settings. The main content area is titled 'Plan' and contains two buttons: 'Create plan' and 'Import plan'. Below the buttons is a table with the following data:

| Name | Created | Last modified | Status | Command |
|----------------------------|--------------------|--------------------|--------|---------|
| Draft_2014-07-02.08.47.611 | 14/07/02 08:47 GMT | 14/07/02 08:47 GMT | DRAFT | [Icons] |
| UK0001_H_NO2_2011 | 14/03/21 14:17 GMT | 14/03/21 14:20 GMT | COM | [Icons] |

The table also includes a 'Filter' input field and pagination controls at the bottom: 'Showing 1 to 2 of 2 entries', 'First', 'Previous', 'Next', and 'Last'. Red circles with numbers 1, 2, and 3 are overlaid on the image to highlight specific elements: 1 points to the 'Plan' header, 2 points to the table, and 3 points to the 'Status' column.

Each of the items in the table has a status, which is either “DRAFT” or “COMPLETE”. This indicates whether or not all the required data has been provided.

3.5.4 Editing Reports

The edit forms for all the flows are designed in a uniform way, and subdivided by pollutant. They are composed of a relatively lengthy main form, which refers to smaller forms that are opened in dialog boxes.

The main form is composed of standard data input fields (1, 2).

Mandatory fields are marked (3) with a red asterisk. Incomplete items, with missing mandatory fields may be saved though. However, as long as some of the mandatory fields are missing the status of the item will be “DRAFT”.

Edit plan

H.1.1 INSPIRE Id

A.8.1 Local Id * **1**

A.8.2 Namespace

A.8.3 Version Id

H.1.2 Provider

A.1.1 Organisation name * **3**

A.1.2 Website *

A.1.3 Individual name *

A.1.4 Address *

A.1.5 Telephone *

A.1.6 Email *

H.1.3 Change documentation **2**

A.7.1 Change

A.7.2 Description of change *

Apart from simple data input fields tables are also widely used in the system. Existing items can be edited by clicking the name of the item (4). New items can be added using the “Add” button (5).

H.2.7 Pollutants covered *

5

Items per page Filter

| 4 | Pollutant code | Command |
|----------|--------------------------|---|
| | Organic carbon (aerosol) |   |

Showing 1 to 1 of 1 entries

In both cases, i.e. when (4) or (5) is clicked a dialog box is displayed. In the dialog box is a subform with all the details of the table item, which can be edited and saved (6).

Edit pollutant

H.2.7.1 Pollutant code *
 Values from
<http://dd.eionet.europa.eu/vocabulary/aq/pollutant>

H.2.7.2 Protection target *
 Not applicable
 Values from
<http://dd.eionet.europa.eu/vocabulary/aq/protectiontarget>

6

Furthermore, most of the fields are supported by explanation of the meaning of the field. To see the tooltip users should hover over a field for a second or two.

H.1.2 Provider

7

A.1.1 Organisation name *

A.1.2 Website *

A.1.3 Individual name *

A.1.4 Address *

A.1.5 Telephone *

A.1.6 Email *

When users save the form the status of the item is automatically updated (1). There are two possibilities:

- “DRAFT” means that not all of the mandatory fields have been filled in,
- “COMPLETE” means that all the mandatory fields have been provided.

Home **H: Plan** I: Source Apportionment J: Evaluation Scenario K: Measures Settings

The "Clone_2014-07-11.08.37.86" plan has been updated.

The status of the plan is "DRAFT" because the following fields have not been filled in: *H.2.5 Time position, H.2.11 URL* **2**

Plan

Create plan Import plan

Items per page 10 **1** Filter

| Name | Created | Last modified | Status | Command |
|----------------------------|--------------------|--------------------|----------|---------|
| Clone_2014-07-11.08.37.86 | 14/07/11 08:37 GMT | 14/07/11 08:37 GMT | DRAFT | |
| Draft_2014-07-02.08.47.611 | 14/07/02 08:47 GMT | 14/07/02 08:47 GMT | DRAFT | |
| UK0001_H_NO2_2011 | 14/03/21 14:17 GMT | 14/03/21 14:20 GMT | COMPLETE | |

Showing 1 to 3 of 3 entries First Previous 1 Next Last

If the item is saved as a "DRAFT" the system will display a message explaining which of the mandatory fields are still missing (2).

3.5.5 Selecting Multiple Items in a List

In many of the forms of the system it is required to select more than one value from a list of provided values, as in the example below (1).

2

Classification

K.2.5 Classification * **1**

- Low emission stationary combustion sources
- Low emission fuels for stationary and mobile sources
- New vehicles, including low emission vehicles
- Other (Public procurement)

Values from
<http://dd.eionet.europa.eu/vocabulary/aq/measureclassification>

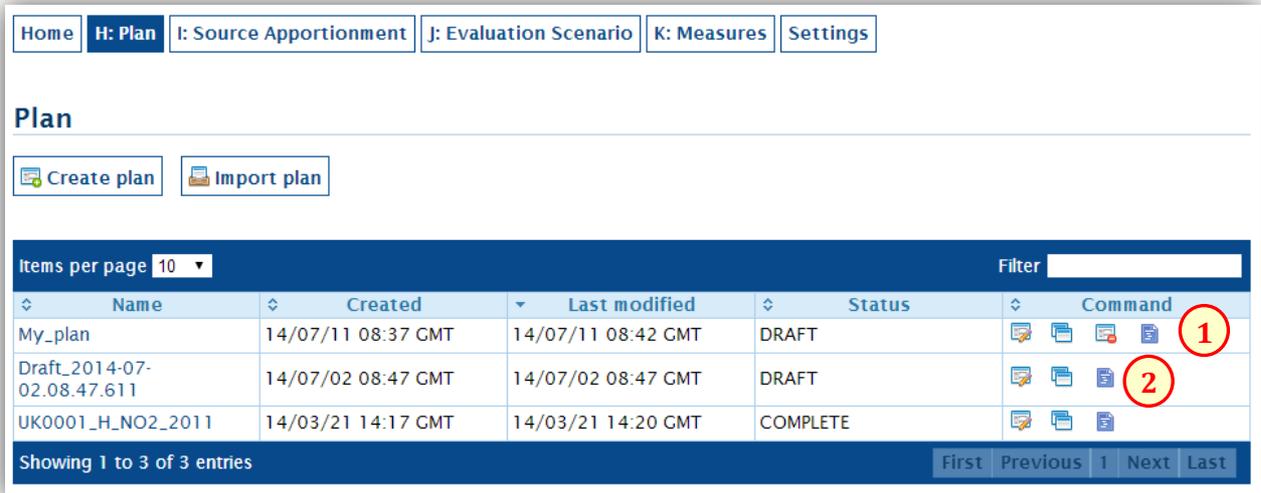
Selection of the items in these controls follows the conventions known from other web systems.

To select several items users should just press and hold the Ctrl button on the keyboard and click the selected items in the list.

To unselect items one should just press and hold the Ctrl button on the keyboard and click the the items which should be unselect.

3.6 XML Export

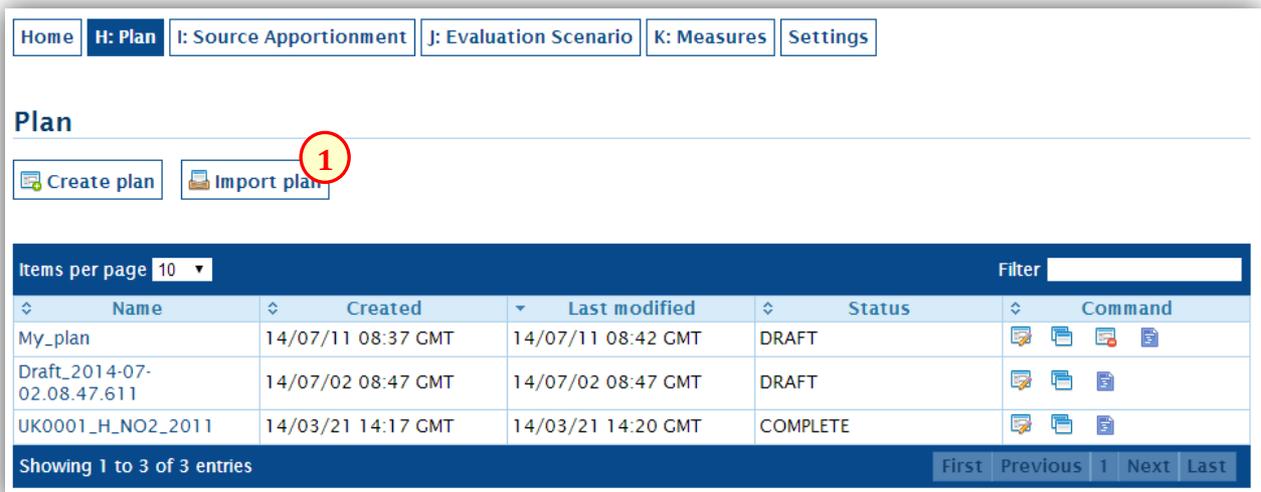
The system is capable of exporting xml which is compliant with the common application schema. Each user can export the items from his country for further submission to the EEA, or reuse in another solution. All the items can be exported, i.e. the ones which the user created, as well as those created by other users from the same country.



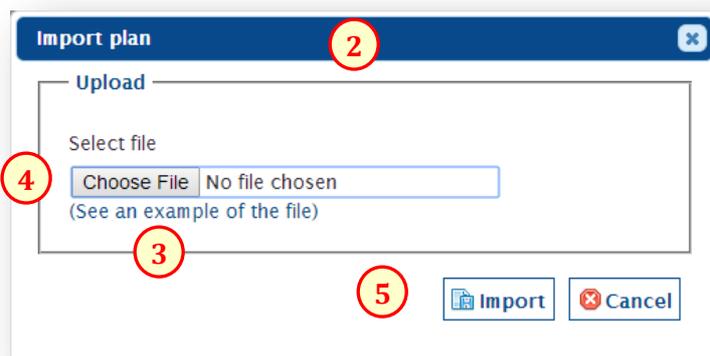
In both cases, i.e. when the user is the author of the item or when he can access it in the read only mode, it is possible to export the item by clicking the “Export to XML” icon (1 and 2).

3.7 XML Import

Each user and national administrator is allowed to import items to the space of his country. To this end the user must click the “Import” button (1).



Clicking the “Import” button opens the import dialog (2).



The import dialog provides an example of an XML file, which can be downloaded and used to understand the structure of the file to be imported (3), when needed.

To import a file it must be selected (4), and the “Import” button (5) must be clicked.

It is possible that the import procedure will terminate with an error message (6).

Total file size [15310195 bytes] exceeds the limit [10485760 bytes] (6)

Plan

[Create plan](#) [Import plan](#)

| Name | Created | Last modified | Status | Command |
|----------------------------|--------------------|--------------------|----------|---------|
| My_plan | 14/07/11 08:37 GMT | 14/07/11 08:42 GMT | DRAFT | |
| Draft_2014-07-02.08.47.611 | 14/07/02 08:47 GMT | 14/07/02 08:47 GMT | DRAFT | |
| UK0001_H_NO2_2011 | 14/03/21 14:17 GMT | 14/03/21 14:20 GMT | COMPLETE | |

Showing 1 to 3 of 3 entries

First Previous 1 Next Last

The most common reasons of unsuccessful import of an XML file are:

- an attempt to import a file which exceeds the size limit (set at the moment to 10 MB), or
- an attempt to import a file with incorrect structure (all imported files must validate against <http://dd.eionet.europa.eu/schemas/id2011850eu-1.0/AirQualityReporting.xsd>).

4 System Administration

4.1 Default Provider

Each of the main items created in the tabs for flows H-K includes a set of fields defining the data provider. As this information is repetitive and usually constant for a single user it is possible to define this information once, and then reuse it for any of the new items created.

To define the default data provider users need to go to the “Settings” tab (1) and select “Default provider” (2). These settings are available for users and national administrators only.

In the “Default provider” tab it is possible to provide the content for all the fields that describe the provider. The new settings can be saved using the “Save” button (3).

The screenshot shows a web application interface for system administration. At the top, there is a navigation bar with tabs: Home, H: Plan, I: Source Apportionment, J: Evaluation Scenario, K: Measures, and Settings (1). Below this, there is a sub-navigation bar with tabs: G: Attainments, User management, Default namespace, and Default provider (2). The main content area is titled "Default provider of data for flows H-K" and contains several input fields: A.1.1 Organisation name, A.1.2 Website, A.1.3 Individual name (with "UK Admin" entered), A.1.4 Address, A.1.5 Telephone, and A.1.6 Email (with "aqrsystem.demo.uk.national.admin@onet.pl" entered). A "Save" button (3) is located at the bottom right of the form.

4.2 Upload of data for attainments

Some of the items from flows H-K need to refer to items from flow G. To this end, the data must be uploaded to the system prior to any reference to it is made.

To upload flow G data with a list of Attainments users need to select the “Settings” tab (1) and then the “G: Attainments” section (2). This section provides the “Import” button (3), with which a file can be selected and uploaded. A list of all the uploaded Attainments (4) for the country of the user is available as well.

Home | H: Plan | I: Source Apportionment | J: Evaluation Scenario | K: Measures | **Settings** 1

G: Attainments | User management | Default namespace | Default provider 2

Uploaded attainments

Items per page 10 4 Filter

| Local Id | Namespace | Version ID | User Name | Command |
|--------------------|---|-------------------------------|-----------|---------|
| GB_Attainment_1734 | http://environment.data.gov.uk/air-quality/so | Wed Jun 04 11:28:11 CEST 2014 | UK User_1 | |
| GB_Attainment_1728 | http://environment.data.gov.uk/air-quality/so | Wed Jun 04 11:28:11 CEST 2014 | UK User_1 | |
| GB_Attainment_1721 | http://environment.data.gov.uk/air-quality/so | Wed Jun 04 11:28:11 CEST 2014 | UK User_1 | |
| GB_Attainment_1733 | http://environment.data.gov.uk/air-quality/so | Wed Jun 04 11:28:11 CEST 2014 | UK User_1 | |
| GB_Attainment_1729 | http://environment.data.gov.uk/air-quality/so | Wed Jun 04 11:28:11 CEST 2014 | UK User_1 | |

Showing 1 to 5 of 5 entries First Previous 1 Next Last 3

Import

Note: The uploaded data is uploaded to the country space, which means that all the users of the country will have access to it. Users with “National Administrator” privileges can also delete attainments which are uploaded to the system.

Note: Duplicates are removed prior to the import procedure.

4.3 Changing a National Namespace

Each country has a namespace which is attached to the identifier of each of the items created in the system (1). This field is automatically populated whenever a new item is created and it comes from the configuration data of the country space, which are controlled by the national administrator.

Edit plan

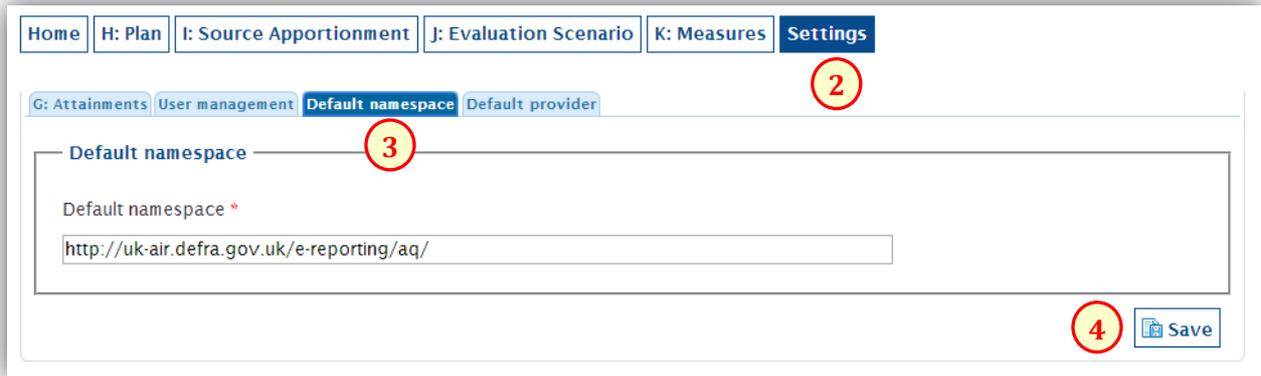
H.1.1 INSPIRE Id

A.8.1 Local Id * 1

A.8.2 Namespace

A.8.3 Version Id

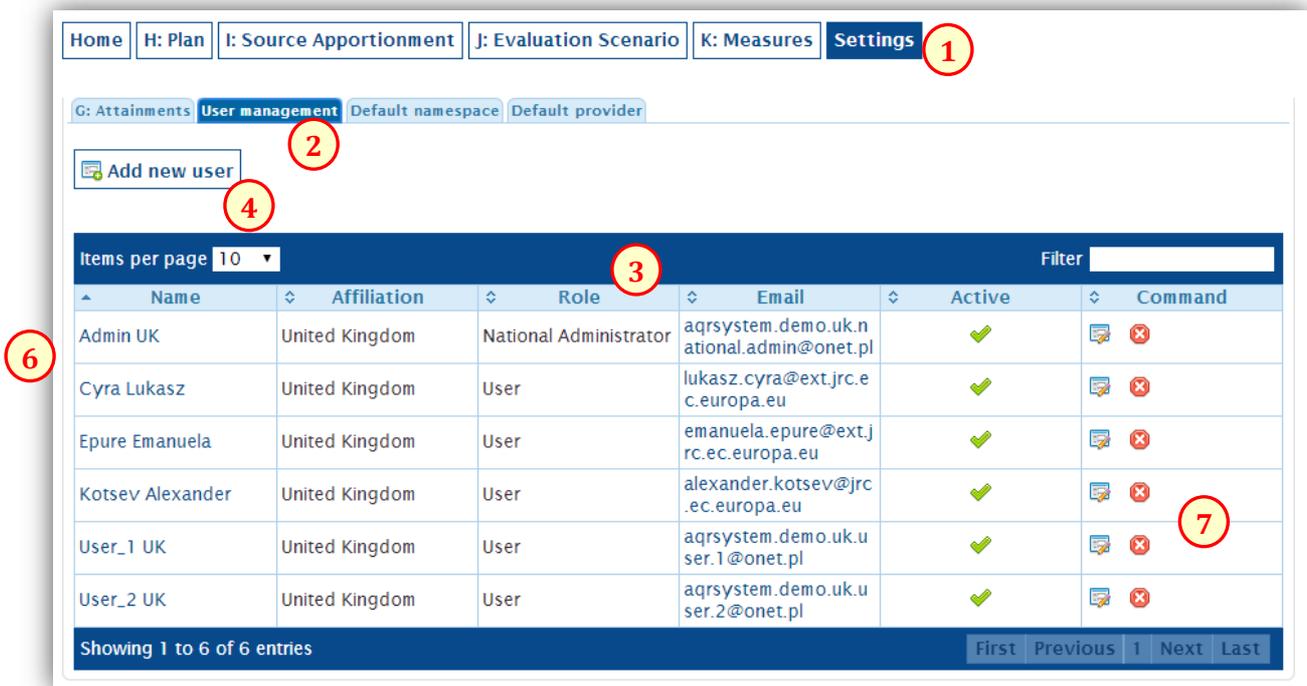
To change the national namespace the administrator should go to the “Settings” tab (2) and select the “Default namespace” section (3). There is a form where a new namespace can be defined and saved with the “Save” button (4).



4.4 User Management

The main role of National Administrators and EEA Administrators is to define users of the system, to whom reporting responsibility can be delegated. The system provides a user management module which allows creation and management of users with different user rights.

To open the user management module select the “Settings” tab (1) and the “User management” section (2). A list of existing users will be displayed (3).



New users can be added using the „Add new user” button (4). When the button is clicked it opens the add new user dialog (5).

5

Edit user ✕

Active *

Forename *

Surname *

E-mail *

Role *

5. System installation

This section of the technical report is dedicated to those who would like to build and/or deploy the reporting system within their institution's reporting infrastructure as an alternative to the centralized web-based solution, available online. There are two possible approaches for setting-up and running the system, and they both share common installation steps, further described in section 5.1:

- Build from source code. The source code needs to be imported in an Integrated Development Environment (IDE), such as NetBeans, and then compiled. The use of the source code provided the possibility to execute the code and, if needed, to debug and extend it beyond the already existing functionality.
- Deploy precompiled binary (*.war) file. The precompiled .war is faster to install and run; this installation can be used if the system is not meant to be extended. A running instance of Apache Tomcat (version 6 or above) is required for deploying the war file.

The project package is made available through the git repository contains both the source code and a precompiled copy of the software product together with example data. They are available at <https://webgate.ec.europa.eu:443/CITnet/stash/projects/AQRTOOL/repos/aqr-public/>

5.1 *Common installation steps*

5.1.1 Installation of prerequisites

The following software products should be installed prior to deployment of the air quality "Plans and Programs" e-reporting system:

- Apache webserver
- Java 1.6 (or above)
- Apache Tomcat 6 (or above)
- PostgreSQL 9.0 (or above)

5.1.2 Database creation and initialization

A database and user with appropriate rights should be created on the server in order for the solution to be able to store data. The database and user should be created by executing the following console commands, normally while logged in on the server as the default `postgres` user.

```
$ psql -d templatel -U postgres
# CREATE USER aqrssystem WITH PASSWORD 'new_password' SUPERUSER VALID UNTIL
'infinity';
#CREATE DATABASE aqrssystem;
#GRANT ALL PRIVILEGES ON DATABASE aqrssystem TO aqrssystem;
#ALTER USER aqrssystem WITH SUPERUSER;
```

Preload the database with the required tables and content through executing the following sql scripts, located in the /Database git folder:

- `create_aqd.sql`
- `insert_aqd.sql`

- UK_examples.sql (optional demos for UK)

5.1.3 Server Configuration for ECAS

Apache Tomcat should be configured to work with ECAS prior to the actual deployment of the air quality e-reporting system. ECAS is the Commission's Authentication Service. It is the system for logging on to a whole range of web sites and online services run by the Commission. Once ECAS is used to log on to a website or service, users won't have to identify them again as long as they leave their browser open.

Configuration of a user to grant him with privileges to use the air quality "Plans and Programs" e-reporting solution consists of two steps:

1. The user must create an ECAS account.
2. The air quality "Plans and Programs" e-reporting system should be configured to add the user privileges (in particular the role) to use the system.

The server must be properly configured in order to enable the application to use ECAS. Then, when a user accesses the system s/he is redirected to ECAS. ECAS asks for login and password, and if authentication is successful, ECAS passes to the air quality "Plans and Programs" e-reporting system the email of the logged in person. Based on the email address AQRSystem decides about the role and privileges of the user.

There are 5 consequent steps (5.1.3.1 to 5.1.3.5) which should be followed in order to configure Apache Tomcat to work with ECAS. All necessary files can be found in the "ServerConfiguration" folder in git.

5.1.3.1 Trusting the CommisSign PKI

The ability to open SSL connections from the application to the ECAS server should be ensured, in order to validate ECAS tickets. For that purpose, the CommisSign PKI certificates need to be imported into the server's Java trustStore, as the SSL certificate of the ECAS server is issued by the CommisSign PKI. To do so the two CommisSign PKI certificates should be obtained ("EuropeanCommission.cer" and "CommisSign.cer") from the git folder ServerConfiguration/ecas/certs). Then the certificates are imported into the Java trustStore of the JVM¹⁴. The certificates can be imported with the `keytool` command-line utility from the JDK or through a GUI tool such as portecle, keytoolGUI or KeyMan.

```
#keytool -import -v -keystore cacerts -storepass changeit -alias
EuropeanCommission -file EuropeanCommission.cer

Owner : CN=European Commission Root CA
Issuer : CN=European Commission Root CA
Serial Number : 1
Valid from : Tue Jan 21 19:01:38 CET 2003 to : Mon Dec 31 19:01:38 CET 2012
Certificate Fingerprint :
    MD5 : 18:C1:AC:06:B0:C1:55:79:2F:A8:79:72:D3:6A:8F:3B
```

¹⁴ This default trustStore is usually located at `${JRE_HOME}/lib/security/cacerts` and its default password is "changeit".

```
SHA1: 8B:E9:C1:E9:68:93:A3:3C:19:3F:52:2C:8F:F1:E1:00:E7:7F:70:83
```

```
Trust this certificate? [no] : yes
```

```
Certificate added to Keystore
```

```
[Storing cacerts]
```

```
#keytool -import -v -keystore cacerts -storepass changeit -alias CommisSign -  
file CommisSign.cer
```

```
Certificate added to Keystore
```

```
[Storing cacerts]
```

5.1.3.2 Copying the client JARs

Default folder locations on Linux

```
$TOMCAT.HOME=/usr/share/tomcat6
```

```
$CATALINA_BASE=$CATALINA_HOME=/var/lib/tomcat6
```

Default folder locations on Windows

```
$TOMCAT.HOME=$CATALINA_BASE=$CATALINA_HOME="top level folder of the Tomcat installation"
```

The latest version of the ECAS client for Apache Tomcat should be obtained from `/ServerConfiguration/ecas/tomcat` of git, and copied into the installation of Tomcat at `$TOMCAT.HOME/lib`. The ECAS client uses Log4J for its logging statements, so the `log4j` jar (`log4j-1.2.14.jar`) should also be copied to `$TOMCAT.HOME/lib`

5.1.3.3 Adding the ECAS Authenticator for Tomcat

The content of the folder `/ServerConfiguration/ecas/tomcat/org` should be copied into `$TOMCAT.HOME/lib`, so that the following two files are added in `/lib`:

- `mbeans-descriptors.xml` in `org/apache/catalina/authenticator`, which is the JMX xml description of the ECAS Authenticator for Tomcat
- `Authenticators.properties` in `org/apache/catalina/startup/` which registers the ECAS authorization method besides the standard authentication methods which can be specified within the `web.xml` descriptors

5.1.3.4 Allowing authenticated users who have no roles

The file `$TOMCAT.HOME/conf/server.xml` should be edited for extension of the `Realm` element. This `Realm` element should look like that before the edits:

```
<Realm className="org.apache.catalina.realm.UserDatabaseRealm"
        resourceName="UserDatabase"/>
```

The `allRolesMode="authOnly"` attribute should be added as follows:

```
<Realm className="org.apache.catalina.realm.UserDatabaseRealm"
        resourceName="UserDatabase" allRolesMode="authOnly"/>
```

5.1.3.5 Configuring logging

The Java-based logging utility `log4j`¹⁵ should be configured centrally on the server through the following steps:

1. The file `log4j.properties` from the git folder `ServerConfiguration/log4j` should be put into `$(CATALINA_BASE)/lib`. The file content may need to be adjusted in order to adapt to the server specific configuration
2. `tomcat-juli-adapters.jar` from the git folder `ServerConfiguration/log4j` should be put into `$(CATALINA_HOME)/lib`
3. The file `$(CATALINA_HOME)/bin/tomcat-juli.jar` should be replaced with `tomcat-juli.jar` (`ServerConfiguration/log4j`)
4. `$(CATALINA_BASE)/conf/logging.properties` should be deleted

5.2 Deployment of a precompiled WAR file

Deployment of the air quality “Plans and Programs” e-reporting solution should be done in Tomcat. This can be achieved directly through the console, or through the Tomcat manager web application. A precompiled binary (`aqrssystem.war`) is made available within a git at <https://webgate.ec.europa.eu:443/CITnet/stash/projects/AQRTOOL/repos/aqr-public/browse/Application>.

5.2.1 Copy the .war file to the server machine

Before moving the `aqrssystem.war` file, make sure that the Tomcat server is not running. Take the `.war` file from the “Application” folder in the project package and move it in the Tomcat’s “webapp” folder. Alternatively, if the Tomcat Manager web application is available the binary can be deployed directly through web access (1).

¹⁵ <http://logging.apache.org/>

| | | | | |
|-----------------------------------|----------------------------|------|---|--|
| /host-manager | Tomcat Manager Application | true | 0 | Expire sessions with idle ≥ 30 minutes |
| /jms | | true | 0 | Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes |
| /js | | true | 0 | Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes |
| /manager | Tomcat Manager Application | true | 2 | Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes |
| /incWMS | | true | 0 | Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes |
| /petascope_earthlook | PetaScope | true | 0 | Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes |
| /print-manifest-sample-sequential | | true | 0 | Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes |
| /xml-examples | | true | 0 | Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes |

Deploy

Deploy directory or WAR file located on server

Context Path (required):

XML Configuration file URL:

WAR or Directory URL:

WAR file to deploy

Select WAR file to upload No file selected.

Diagnostics

Check to see if a web application has caused a memory leak on stop, reload or undeploy

This diagnostic check will trigger a full garbage collection. Use it with extreme caution on production systems.

| Server Information | | | | | |
|----------------------|--------------|--------------------|---------|------------------|-----------------|
| Tomcat Version | JVM Version | JVM Vendor | OS Name | OS Version | OS Architecture |
| Apache Tomcat/6.0.35 | 1.7.0_55-b14 | Oracle Corporation | Linux | 3.2.0-65-generic | i386 |

Once all the previous steps are completed the air quality “Plans and Programs” web application can be started, and the system should be available at <http://localhost:8080/aqrsystem>.¹⁶

5.3 Source code configuration and compilation

Access to the `git` repository at JRC¹⁷ should be ensured, and all its content should be downloaded to the host system prior to compilation and deployment.

This section provides details on how to build and run the air quality “Plans and Programs” e-reporting system for the first time using the provided source code within the NetBeans IDE. NetBeans is chosen, since it is the official open source IDE provided by Java. In order to deploy and test the application, the two projects (`aqrmodel` and `aqrsystem`), contained in the “SourceCode” folder of the package should be loaded using the IDE.

The values highlighted in orange below should be modified with the system’s specific parameters within the POM.xml file of the air quality “Plans and Programs” e-reporting system.

```
<properties>
  <persistence.unitname>custom_persistence_unitname</persistence.unitname>
  ...
</properties>
```

¹⁶ The url may differ, depending on system specific configuration.

¹⁷ <https://webgate.ec.europa.eu:443/CITnet/stash/projects/AQRTOOL/repos/aqr-public/browse/SourceCode>

```

<profiles>
  <profile>
    <id>profile_name</id>
    <activation>
      <property>
        <name>env</name>
        <value>custom_value_name</value>
      </property>
      <activeByDefault>true</activeByDefault>
    </activation>
    <properties>
      <!-- Database configurations -->
      <persistence.jdbc.url>jdbc:postgresql://IP:PORT/DB_name</persistence.
      jdbc.url>
      <persistence.jdbc.username>username</persistence.jdbc.username>
      <persistence.jdbc.password>password</persistence.jdbc.password>

      <!-- Loggers configurations -->
      <log.file.name>login_file_path</log.file.name>
    </properties>
  </profile>
</profiles>

<!-- Loggers configurations -->
<log.file.name>login_file_path</log.file.name>

```

After reflecting the changes above the `agrmodel` and `agrsystem` projects should be consequently build (together with their dependencies). The system can be run following a successful compilation.

References

- Schleidt, K. (2013). INSPIREd Air Quality Reporting. In Environmental Software Systems. Fostering Information Sharing (pp. 439-450). Springer Berlin Heidelberg. doi: 10.1007/978-3-642-41151-9_41.
- Kotsev, A., Peeters, O., Smits, P., & Grothe, M. (2014). Building bridges: experiences and lessons learned from the implementation of INSPIRE and e-reporting of air quality data in Europe. Earth Science Informatics, 1-13. doi: 10.1007/s12145-014-0160-8.

List of Acronyms

| Acronym | Description |
|---------|---|
| AQD | Air Quality Directive (2008/50/EC) |
| DG ENV | Environment Directorate-General of the European Commission |
| ECAS | European Commission's Authentication Service |
| EEA | European Environment Agency |
| EUPL | European Union Public Licence |
| F/OSS | Free and Open Source Software |
| IDE | Integrated Development Environment |
| INSPIRE | Infrastructure for Spatial Information in the European Community |
| IPR | Commission Implementing Decision of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality |
| JAR | Java ARchive |
| JRC | Directorate General "Joint Research Centre" of the European Commission |
| MS | Member States of the European Union |
| P&P | Air quality plans and programs |
| PKI | Public Key Infrastructure |
| SEIS | Shared Environmental Information System |
| SSL | Secure Sockets Layer |
| SQL | Structured Query Language |
| XML | Extensible Markup Language |

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Abstract

The EEA Member countries have obligations to report on the assessment and management of ambient air quality on a regular basis. The data sharing obligations are thoroughly defined in the Commission Implementing decision (IPR) of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality. The IPR requires member countries to do this in accordance with Directive 2007/2/EC of the European Parliament and the Council of 14 March 2007 establishing an infrastructure for spatial information in the European Community (INSPIRE).

The Commission (notably the Joint Research Centre, and Directorate General Environment, supported by Directorate General Informatics), the European Environment Agency (EEA) and organizations in the European Union Member States (MS), are collaborating on a pilot project for air quality e-reporting. The pilot project addresses a broad spectrum of aspects, ranging from INSPIRE-based reporting sheets, network services, guidelines, as well as software tools, all contributing to a long term solution for interoperable exchange of air quality data.

This report focuses on the solutions for a subset of the reporting obligations, namely the reporting of the air quality plans and programs, as defined in article 23 of Directive 2008/50/EC of the European Parliament and of the Council (Air Quality Directive). It provides a step-by-step user guide for the deployment and use of the open source software developed for this purpose.

The intended readership is people in the EEA Member countries that are involved in the preparation and submission of the air quality plans and programs, at both national and sub-national levels. It also helps IT-specialists to deploy and configure the software tool within their organizations.

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