



# FAIRMODE

## 2020-2022 roadmap

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## Introduction

The Forum for Air Quality Modelling (FAIRMODE) was launched in 2007 as a joint initiative of the European Commission Joint Research Centre (JRC) and the European Environment Agency (EEA). Its aim is to bring together air quality modellers and users in order to promote and support the harmonized use of models by EU Member States, with emphasis on model application under the European Ambient Air Quality Directives (AAQDs). FAIRMODE is currently chaired by the Joint Research Centre of the European Commission. This document summarizes the FAIRMODE work-plan for the years 2020-2022. The terms of reference and users of the network are first recalled, before introducing the structure and work-plan and expected deliverables. The connections between FAIRMODE and other activities are finally discussed to provide a view of the network in a broader context.

## Mandate - Terms of reference

FAIRMODE is a Forum for Air Quality Modelling created for exchanging experiences and results from air quality modelling in the context of the Ambient Air Quality Directives (AAQDs) and for promoting the use of modelling for air quality assessment and management in a harmonized manner between Member States. Its main objectives are:

- To provide a permanent European Forum for air quality modellers and users of models results, to address air quality modelling issues
- To study and set-up a system (protocols and tools) on the quality assurance and the continuous improvement of air quality models and input data operating at different spatial scales from national to regional<sup>1</sup>, urban and local.
- To provide guidance, support the standardization and evaluate the fitness-for-purpose of air quality models and input data, for assessing current and future air quality within the framework of implementing the EU's Ambient Air Quality Directives.
- To support air quality management (at the national, regional and local level) in developing and implementing plans and measures to improve air quality with efficient modelling tools.
- To promote capacity building activities aiming at ensuring an optimum use of the proposed common methodologies and guidance and to promote good modelling practices among the EU Member States.
- To make recommendations on future priorities, research activities and other relevant initiatives to secure Air Quality improvements.

## Participation in the network

The FAIRMODE network intends to support model users at all administrative levels (national, regional urban and local) in their policy-related model applications. The network aims at establishing tools and mechanisms to enhance communication and promote good modelling practice. The network provides a framework for exchanging experience at all levels of application, including electronic interfaces, databases and tools as well as workshops, seminars and common projects and activities.

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<sup>1</sup> Regional is intended here as sub-national

Member states can designate one or more representatives to FAIRMODE. The representatives should be experts in the use and/or development of air quality models. More than one representative can be designed as expert, in which case Member States should indicate the person that would be acting as “national reference point” for FAIRMODE. National reference points have the responsibility to disseminate the results of FAIRMODE in the respective Member State. In addition to its national contact points, FAIRMODE is also open to the participation and contribution of regional and local air quality managers and air quality modelling groups in order to cover a wider range of model applications.

## Organisation of work

### FAIRMODE structure for 2020-2022

The organization of work within FAIRMODE has evolved in time to optimally achieve its goals. The working structure of FAIRMODE intrinsically reflects the main recommendations on the use of models identified by the forum back in 2011<sup>2</sup>. The priority lines of work are set according to the major applications of models within the Ambient Air Quality Directives. In particular, all activities relate to one (or more) of the five following pillars:

- Pillar 1 - Assessment of air quality levels to establish the extent of exceedances and establish the population exposure. It also includes the forecasting of air quality levels for short term mitigation and public information and warnings
- Pillar 2 - Source apportionment to trace the origin of air pollution, with particular reference to the exceedances of air quality standards and to provide a knowledge basis for planning strategies
- Pillar 3 - Compilation of emissions to support all modelling assessment, management and planning activities as their output highly depend on the quality of the emission input data.
- Pillar 4 - Planning to support plans and measures to improve air quality
- Pillar 5 - Air quality management to implement and test practices considered in the previous four pillars.

Figure 1 provides an overview of the organization of the work and proposed FAIRMODE structure for the period 2020-2022. Within the framework provided by the five pillars above, the work is structured according to three years priorities established in dialogue with Member States. The priority activities identified for this three year period respond to the current scientific advances and needs for guidance, expressed by MS in various fora, in particular the Ambient Air Quality Expert Group. These are organized through the following 9 crosscutting tasks:

1. Source apportionment to support air quality management
2. Development of an overall quality assurance and quality check (QA/QC) protocol for air quality assessment
3. Quality control indicators for air quality forecast
4. Microscale air quality modelling
5. Best practices for local / regional air quality management
6. Near real-time assessment with low-cost sensors

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<sup>2</sup> <http://www.eea.europa.eu/publications/fairmode>

7. Compilation of high resolution emission inventories
8. Exposure and exceedance model indicators and network optimization
9. Effectiveness and robustness of air quality projections

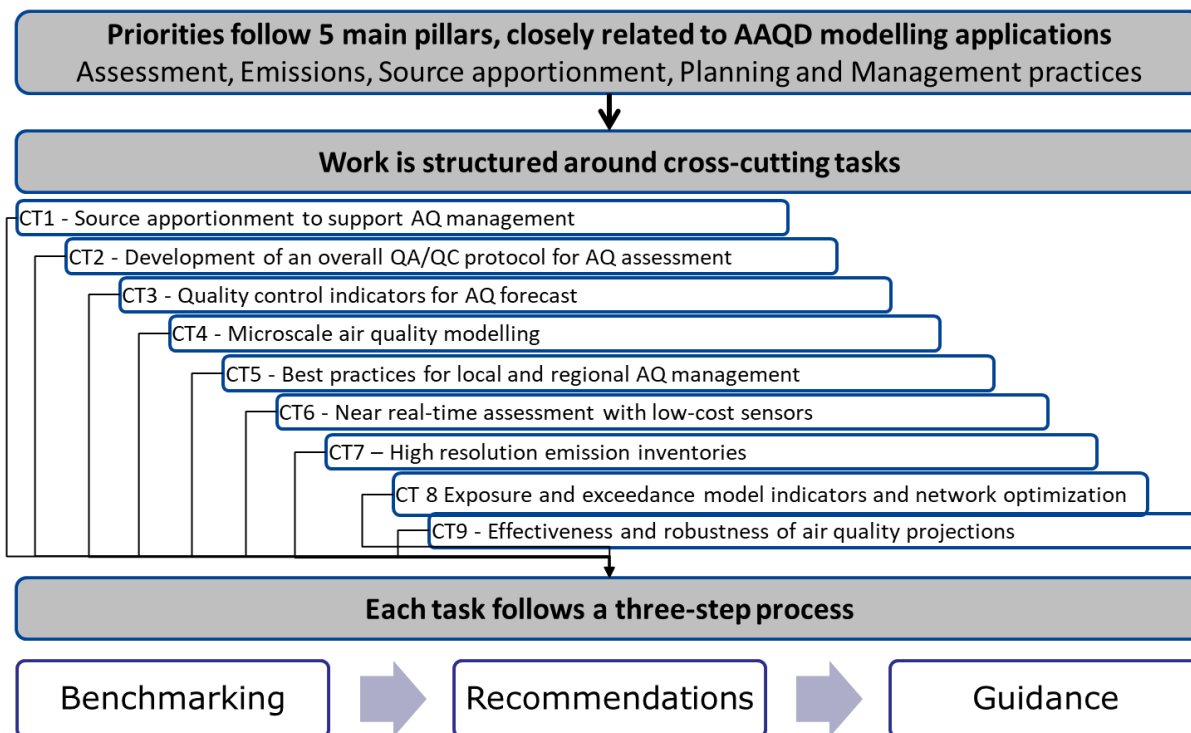


Figure 1: Overview of FAIRMODE's working structure. Crosscutting tasks are defined within the framework of five main priority pillars. Work in the crosscutting tasks is organized in a three-step approach (see next section).

## FAIRMODE's implementation approach

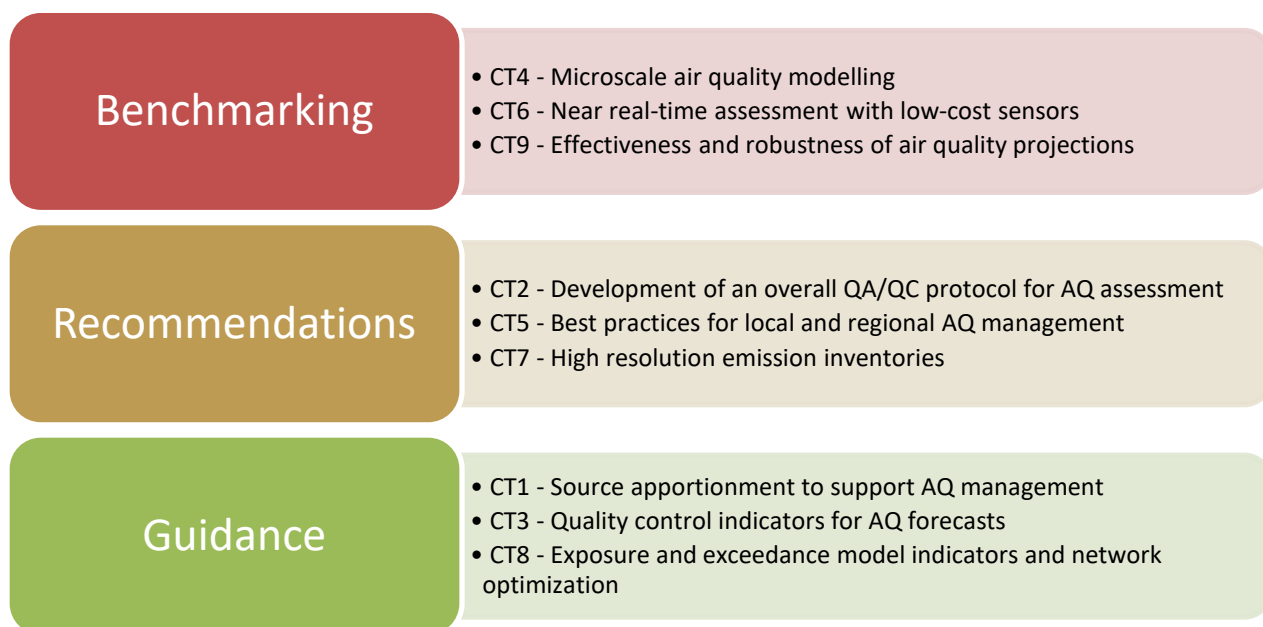
FAIRMODE's implementation approach is common to each crosscutting task (CT) and is highlighted in the bottom part of Figure 1. It secures a chronological three-step working process.

- **Benchmarking** is intended here as a first step that aims at exploring and comparing results from different approaches. The goal is to understand the strengths and weaknesses of the different approaches. This stage also requires developing and testing a standardized evaluation or inter-comparison methodology (possibly supported by common tools and common datasets) for collecting and reporting model inputs and outputs in a way that enables relevant comparisons.
- **Recommendations:** Based on practices identified via benchmarking, we further identify best practices and elaborate recommendations on which approaches are better suited for different applications. These recommendations constitute a necessary step before reaching the level of the guidance documents. They include the list of actions and tests necessary before compiling the final guidance.

- Guidance is the last and more effort and resource demanding step of this process. Guidance is compiled in an evolving document that includes a detailed description of all steps required to choose and apply a fit-for-purpose approach for a given modelling application.

The stage of each crosscutting task is set by the FAIRMODE community according to its level of maturity. While an exploration and testing phase (benchmarking), will be necessary for a newly introduced CT (e.g. near real-time assessment with sensors), the guidance stage will be appropriate for more mature CTs (e.g., source apportionment). Each stage lasts for three years at most.

The 2020-2022 stage for each of the cross-cutting tasks is indicated in Figure 2.



*Figure 2: Overview of the crosscutting tasks and their expected outcome*

One advantage of this structure is that it leads to guidance being produced within the FAIRMODE network. It also emphasizes as a key task the communication of good practices as identified by expert groups to the broader FAIRMODE community, including national and local authorities applying models for regulatory purposes.

### **FAIRMODE Meetings**

The network meetings include a yearly *plenary meeting* devoted to national contact points and local policy makers, where the main focus is to review the progress made and discuss strategic options. In addition, there is a yearly *technical meeting* dedicated to model experts with the purpose to develop and agree on common methodologies, carry out benchmarking and establish good practice and guidance. Independently of these two general meetings, dedicated capacity-building workshops are organized on

specific issues, tools and guidance (e.g. DELTA<sup>3</sup>, DELTA SA<sup>4</sup>, SHERPA<sup>5</sup>...) as well as progress meetings to cover specific issues (e.g., past hackatons on forecast indicators). The scope of the two main types of meetings is further explained below.

**Plenary meeting:** This meeting focuses on policy aspects with the following objectives:

- Report on outcomes and review the progress made in each CT
- Get feedback from national contact points
- Communicate experiences, e.g. challenges and good practices, for each of the existing applications
- Discuss strategic options (including preparation of roadmaps)
- Approve plans for further developments related to all cross-cutting activities
- Gather information from related projects
- Discuss the most efficient way to support DG ENV (e.g. implementing provision on reporting of the AAQD, INSPIRE, etc.)
- Explore potential collaborations and funding mechanisms

**Technical meeting:** This meeting focuses on technical discussions on benchmarking as well as on the drafting of recommendations and guidance documents. The main purposes of this expert meeting is to:

- Identify expert approaches to the activities related to each CT
- Report on progress of benchmarking activities, incl. development of methodologies and indicators
- Identify and discuss good practices
- Plan and discuss progress on the preparation of recommendations and guidance
- Report the feedback of the Plenary meeting to the experts

## Expected Outcomes

For the roadmap for 2020-2022, activities are organized across cross-cutting (CT) tasks with specific outcomes. The identified CTs above are in different stages of maturity. Some CTs may therefore devote more time to the development of benchmarking methodologies while others will mostly focus on the drafting of recommendations or guidance. This is reflected in the detailed work-plan for each CT proposed below.

### **CT1 – Source apportionment to support AQ management (stage: guidance)**

The experience gained so far with the inter-comparisons and the writing of various guides and publications constitute the starting point for the future activities of CT1. The main aim of CT1 is to deliver guidance on the fitness for purpose of different source apportionment approaches in the overall context of air quality management practices. Future CT1 activities will focus on:

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<sup>3</sup> [DELTA](#): tool to support the evaluation of modelling results

<sup>4</sup> [DELTA SA](#): tool to support the evaluation of source apportionment results

<sup>5</sup> [SHERPA](#): tool to support the design of local and regional air quality plans

- Consolidating the fitness for purpose source apportionment guide, in particular with the remaining open issues (e.g., use of combined approaches, theoretical vs. practical range of applications, extension to other species than particulate matter, etc.)
- Supporting the e-Reporting process in relation to the source apportionment data-flow.
- Supporting pilot regions and cities in their source-apportionment estimates (first stage of an air quality plan).
- Interacting with CEN to take advantage of synergies and contribute to standardization.

## **CT2 – Development of an overall QA/QC protocol for AQ assessment (stage: recommendations)**

FAIRMODE has been working for a long time on a methodology to benchmark model performance. This resulted in the proposing of a Modelling Quality Objective (MQO), which has been extensively tested over the recent years and eventually reached a good level of maturity and consensus within the community. On the other hand, the FAIRMODE community identified a need to develop a QA/QC protocol to ensure that the quality of a modelling application is not determined only by the pass/fail result of the MQO test. Future CT2 activities will focus on:

- Following up and contributing to the consolidation of the MQO, together with the CEN TC264/WG43 working group that has the mandate to develop a European standard for this modelling quality objective.
- Elaborating recommendations to set up an overall QA/QC protocol for air quality modelling purposes. This protocol will be based on a two-step approach (Documentation and Assessment).
- Following up and further developing of the EU Composite Mapping Platform in which national, regional and local air quality maps are collected and assembled. This platform will be further elaborated in particular to support the goals of this CT.

## **CT3 – Quality control indicators for modelling of AQ forecasts (stage: guidance)**

This activity aims at providing a specific benchmarking framework for modelled air quality forecasts. Performance indicators have been developed to provide additional information about the capability of the forecasting system to detect and anticipate regulatory threshold exceedances and to check its ability to provide accurate forecasts (benchmarked against the ‘persistence model’). Future CT3 activities will focus on:

- Testing the proposed indicators (currently normalized by the persistence model) with additional datasets (in particular CAMS).
- Elaborating a guidance document on the use of forecast indicators for the assessment of the quality of forecast applications.

## **CT4 – Microscale AQ modelling (stage: benchmarking)**

Microscale air quality modelling refers to air quality modelling at high spatial resolution (typically down to a scale in the order of one meter), usually focused on urban environments.



Based on discussions within the FAIRMODE community, it is noted that this type of modelling applications is more and more used in an AQD policy context. This evolution is driven by the fact that more and more exceedances occur at local hotspots which require high spatial resolution for understanding their causes and setting up specific and localized measures to mitigate the problem. The focus points of this CT4 are thus:

- Identifying current uses of microscale AQ modelling, including challenges in their implementation and collecting best practices in relation to the assessment and management under the AAQD
- Determining how to derive an annual averaged concentrations (and other AQD statistics such as percentiles) with a microscale model as a first step to discuss how to use microscale models for air quality assessment or planning in the framework of AQ directives.

### **CT5 – Best practices for local and regional AQ management (stage: recommendations)**

The objective of FAIRMODE's pilot exercise was to ensure that the FAIRMODE methodologies and guidance are applied in practice at all levels, from national to regional and urban level. Eleven regions/cities/countries participated to the pilot. Based on the experience gained through this exercise and further work with the FAIRMODE network, the CT5 activities will focus in particular on elaborating recommendations (handbook) to support local, regional and national authorities in quantifying emission changes from an available set of measures and in quantifying their impacts in terms of concentration; this will be done partly taking advantage of the results already produced by other CTs, and partly through the work that CT5 will develop, in coordination with other existing activities.

### **CT6 – Near real time assessment with low-cost sensors (stage: benchmarking)**

One main outcome of previous FAIRMODE meetings is that (low-cost) sensors are very relevant for FAIRMODE, especially concerning methodologies to combine sensor networks with modelled data and official measurements.

There is a need to elaborate on the role of the FAIRMODE community in the development and use of sensors and help define what type of activities should be carried out to facilitate the use of sensor data for air quality mapping. As CT6 is at the benchmarking stage, the activities should be closely related to this, at least in this phase of the roadmap. I.e. discuss and understand the strengths and weaknesses of the different ways low-cost sensors can be used. This does not prevent FAIRMODE from providing indications on long-term need for guidance and explaining what the scope of such guidance would be. Present experiences suggest important roles for data fusion/assimilation approaches, and possibly other techniques with similar scopes. The focus points for CT6 are:

- Exchanging potential concepts and best practices about the integration of sensor network data in air quality mapping methods
- Exploring how air quality modelling can contribute to the exploitation and validation of an air quality sensor network.

## **CT7 – Compilation of high resolution emission inventories (stage: recommendations)**

The focus of this CT is on the compilation of high resolution emissions. This is because the compilation of high resolution emissions follows uneven practices across Europe, some times following approaches that are systematically different from those of emission compilation at national level. One of the main aims is to provide recommendations on the necessary steps to document and compile these emission inventories to support air quality assessments and the elaboration of national plans and program under EU legislation. The CT7 activities will focus on:

- Elaborating recommendations for a common system to document the use of ancillary data and define the relevant meta-data that support each emission inventory at urban area. The metadata recommendations will provide a common documentation framework to better understand the differences between inventories. The composite mapping platform will be used to support this task and test its feasibility
- Identifying best practices and drafting final recommendations for the compilation of traffic and residential heating high resolution emission inventories.
- Initiate benchmarking activities for the compilation of high resolution emissions from new sectors (construction, off-road, agriculture). This will be achieved through applying the benchmarking methodology (quality assurance) to a large number of datasets to capture local specificities across Europe. The composite mapping platform will also support this benchmarking activity.
- Providing relevant feedback to improve European inventories used for regulatory purposes (EMEP) and Copernicus monitoring services (CAMS-REG).

## **CT8 – Exposure and exceedance model indicators and network optimization (stage: guidance)**

The AAQDs offer the opportunity for MS to report on the air quality status via the use of modelling results. The Implementing Provision on Reporting (IPR) and related e-Reporting process have accelerated and strengthened this possibility. As a result, an increasing number of MS are reporting modelling data. However, there is still a clear lack of guidance on the use of model results in the formal reporting cycle (e.g. estimation of exceedances, exposure in given areas or spatial representativeness of the monitoring station). Based on the work carried out in the past years, the ambition is to prepare guidance to support best practices in this respect. The CT8 activities will focus on:

- Providing guidance on the assessment of spatial representativeness of monitoring stations depending of the context of the application domain. This can involve/require network optimization, selection of stations for model validation and assimilation or exceedances estimated.
- Defining specific methods to assess the estimation of areas and population exposed to exceedances.
- Providing guidance on fit-for-purpose modelling approaches to assess exposure and exceedances indicators.
- Supporting the e-reporting process in relation to the “Exceedance situation” data type

## **CT9 – Effectiveness of measures and robustness of AQ projections (stage: Benchmarking)**

This topic deals with the approaches that Member States use to plan future strategies for air quality, taking into account EU and national legislation (e.g. the National Emission Ceilings Directive) and at the same time fulfilling local compliance. The aims of this CT are to deliver (1) recommendations on methods to prioritize measures and policies, (2) recommendations on methods to assess the robustness attached to the potential impact of a modelled measure<sup>6</sup>, 3) recommendations on how to integrate the requirements of the National Emission Ceilings and Ambient Air Quality directives. In the frame of this roadmap, the CT9 activities will mostly focus on point (2). They will include:

- Assessing the sensitivity of the model responses to emission reductions when input data (emissions, meteorology...) or the model itself is changed
- Contributing to the harmonization of the specifications used to classify abatement measures that can be selected at the regional and local scales. The identified abatement measures will be classified according to their impacts on emission and concentration reductions.
- Providing overall support to model users (SHERPA, air quality models...) in their planning activities (measures, emission and model scenarios).

## **FAIRMODE co-operation with other networks**

This section details the interactions between FAIRMODE and other networks and projects where relevant work on ambient air quality is also taking place. A good communication is secured by the participation of key scientists in the different networks to help disseminating the advances in each network to the others.

### **FAIRMODE and CAMS**

Since the FAIRMODE launch, searching for possible synergies with the Copernicus Atmosphere Service, CAMS, has been a key issue. While CAMS contributes with a series of products and information that may be relevant for all activities under FAIRMODE, it is not always clear how these products can be directly used for the assessment of air quality levels to establish the extent of exceedances, the forecasting of urban air quality levels for short term mitigation and public information and warning, determining the origin of exceedances or providing a knowledge basis for national planning strategies. FAIRMODE, through its guidance and benchmarking activities can play an essential facilitator role providing feedback for suitable applications of the CAMS products. Experiences of use of CAMS products compiled under the technical FAIRMODE working group activities are to be communicated to the CAMS steering group and effectively contribute to improve the CAMS policy products. In this way, both projects can benefit from each other.

### **FAIRMODE and EMEP Task Forces (TF)**

EMEP can support FAIRMODE by helping identifying key problematic areas for which developments in terms of benchmarking are needed. In return the available FAIRMODE methodologies can be used in

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<sup>6</sup> This second point could also be defined, in future, as QA/QC of air quality models used for planning purposes.

support to the QA/QC process of EMEP work, in particular related to assessment (TFMM), emissions (TFEIP) and planning (TFIAM). As a result of its benchmarking activities, FAIRMODE can contribute to EMEP by identifying the main reasons driving inconsistencies and differences between national scale assessment versus regional and local assessment.

### **FAIRMODE and AQUILA**

Some topics are recognized of being of common interest to both the FAIRMODE and AQUILA community (e.g. spatial representativeness, detection of outlying measurements, measurement uncertainty, assimilation of monitoring data with modelling studies, use of low-cost sensors...). Ad-hoc workshops or common sessions on one of these specific themes took place in past meetings and will continue in future.

### **FAIRMODE and EIONET**

The European Environment Information and Observation Network (EIONET) brings together some of the main potential users of modelling results (AQ managers and EEA) with some of the model developers and modelling groups (for instance national groups and some of the partners in the European Topic Centre on Air Pollution, Transport, Noise and Industrial pollution (ETC/ATNI)).

AQ managers can be supported in both their assessment and their management practices, since their reporting obligations on air quality (may) require all the modelling applications identified in the TCs. At the same time their feedback and their specific needs are drivers for future FAIRMODE work.

### **FAIRMODE and CEN**

The harmonization in the methodologies to assess model performance developed in FAIRMODE are being used in the standardization process started in 2015 with the creation of WG 43 on Model Quality Objectives and WG 44 on Source apportionment. The close collaboration between these two working groups and FAIRMODE is essential to increase the efficiency of the work and to ensure full coherence between guidance and CEN standards for a better support to the environmental policy.

## **FAIRMODE governance**

- 1) **The Ambient Air Quality Expert Group (AQEG)** endorses the FAIRMODE work plan and supports the participation of national reference points and relevant national, regional and local representatives to achieve the FAIRMODE work plan goals.
- 2) **The national reference points (NRP)** are the primary link between FAIRMODE and the air quality modelling communities in their Member State. They assure the coordination of the national cooperation and the transmission of information between FAIRMODE and the national actors. NRP are expected to:
  1. Distribute the FAIRMODE information (e.g guidance, notes) to the relevant modelling communities in their Member State.
  2. Collect expert feedback and transmit it to the FAIRMODE community

3. Invite experts to follow the CTs and to attend the FAIRMODE plenary and technical meetings
  4. Promote the FAIRMODE products in their Member State
  5. Cooperate with the AAQEG representatives and with the Member State network to get an overview of the country positions in relation to the FAIRMODE issues.
  6. Interact with the FAIRMODE community and with other NRP, participating in the plenary and technical meetings and in the consultation and endorsement processes of documents.
- 3) **The FAIRMODE plenary meeting** is the decision-making organ in the network. It includes all national reference points, national environmental authorities and national experts. It is in the plenary meeting where the workplan for FAIRMODE is approved. It is also at the plenary meeting where recommendations and guidance documents from FAIRMODE are endorsed for general distribution.
- 4) **The FAIRMODE Steering Group (SG)** has the mandate to define and implement the FAIRMODE strategy, communicate to the broader community and contribute to the organization of the FAIRMODE meetings. The SG also secures that activities in the different crosscutting tasks are coordinated. The FAIRMODE network is chaired by the JRC with the support of DG ENV and EEA. Representatives of these three Institutions (with a permanent seat at the SG) form the FAIRMODE Steering Group (SG) together with five experts to cover the five thematic pillars. The appointment of the experts is not time-limited. If a SG member steps down, substitute candidates are proposed for nomination to the SG by any of their members and should be approved unanimously by the remaining SG members. Within the SG, the JRC covers the overall coordination of the activities, DG ENV ensures that the topics identified in need for further research are included in the priorities of its non-regulatory support actions (e.g. LIFE+ program) and further set-up the frame for relations with the Ambient Air Quality Expert group. EEA supports networking and ensures that experiences and results gained from work within the EIONET network are conveyed to the FAIRMODE community, and vice versa. Both EEA and DG ENV supports FAIRMODE by actively contributing to the review of guidance documents with the focus of strengthening and emphasizing policy relevant aspects of FAIRMODE products. Participation of thematic experts in the SG is voluntary and self-funded. Thematic experts share their experience and discuss the most effective way of fostering the activities within the crosscutting tasks.
- 5) **The Crosscutting task (CT) leaders** are responsible for the progress of work withing FAIRMODE. FAIRMODE CT leaders are voluntary and self-funded. The CT leaders have the mandate to coordinate the work of the CT by promoting the participation of the experts and distributing relevant information to the task members, organizing, coordinating the sessions in technical meetings and providing CT session summaries to the plenary meetings. They should continuously monitor the status of the CT activities to ensure high quality outcomes, linking to activities and projects that can be relevant to FAIRMODE. The CT leaders are experts that belong (or not) to the SG but at least one member of the SG should act as co-chair in each CT. Candidates for the leaders of each CT are proposed for nomination to the SG by their members for a period of 3 years. The SG can do so at any time either because a current member steps down or because the composition of the team needs to be adapted to the objectives. After their term ends, they may decide to continue as leaders or they may step

down. They are welcome to continue for additional 3-year terms as long as their participation contributes to fulfill FAIRMODE's goals. Figure 3 provides an overview of the governance and mandate of the SG and CTs while Figure 4 details their composition with the respective leaders.

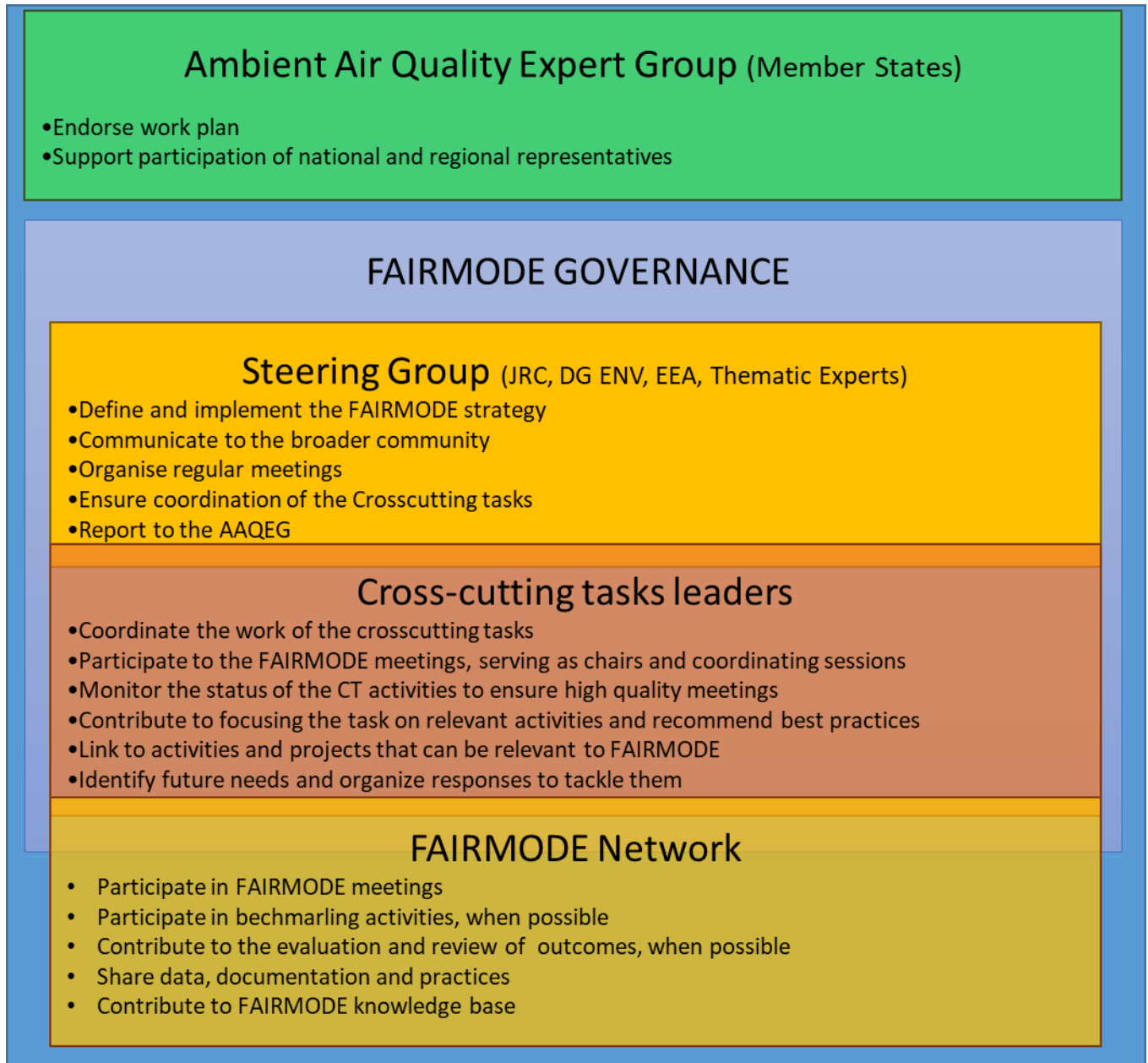


Figure 3: Overview of the governance and mandate of the FAIRMODE Steering Group and cross cutting tasks leaders

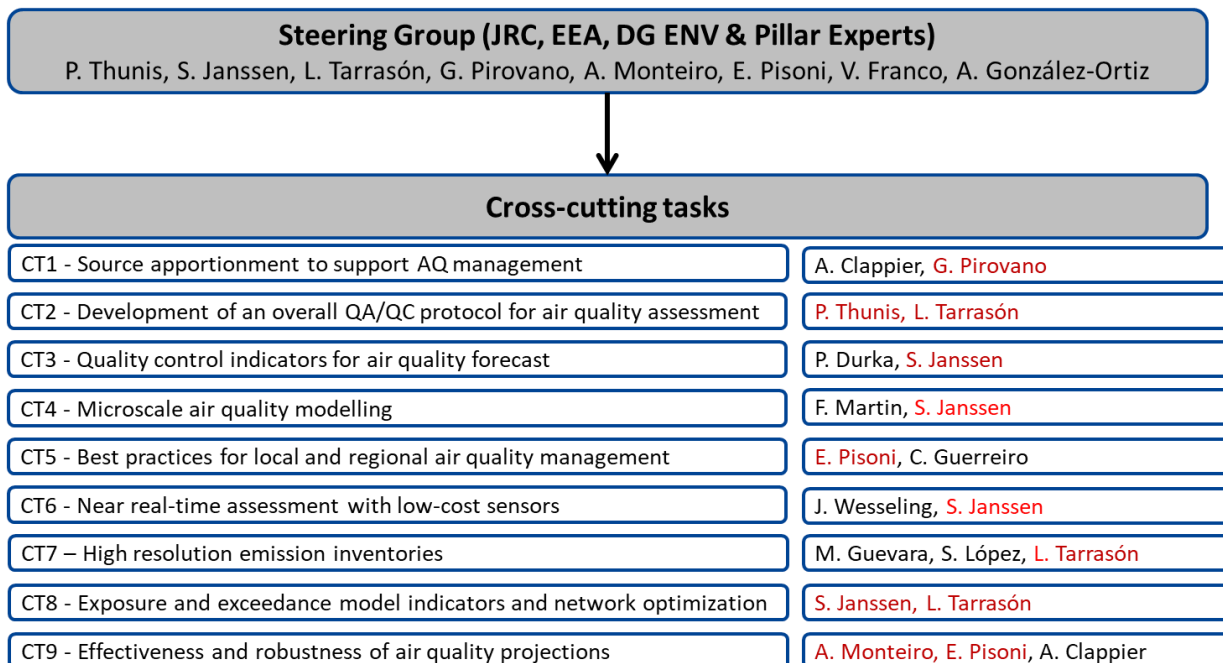


Figure 4: Overview of the composition of the current steering group and crosscutting leaders. At least one Steering group member (in red) is part of the crosscutting leaders

- 6) **The FAIRMODE technical meeting** is the competence building organ of FAIRMODE where experts ensure progress on the different CT activities. Participants at FAIRMODE technical meetings are expected to contribute to building the FAIRMODE knowledge base. Participation in the technical meeting is voluntary and self-funded. Participants are expected, when possible, to contribute in benchmarking activities, in the evaluation and review of CT outcomes, and to do so by sharing data, documentation and best practices.

## Contact points

### Steering Group

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CT1 – Source apportionment to support AQ management

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CT2 – Towards an overall QA/QC protocol for AQ assessment

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CT3 – Quality control indicators for modelling of AQ forecasts

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CT4 – Micro-scale AQ modelling

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CT5 – Best practices for local and regional AQ management

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CT6 – Near real time assessment with sensors

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CT7 – Compilation of high resolution emission inventories

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CT8 – Exposure and Exceedance model indicators and network optimization

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CT9 – Effectiveness and robustness of AQ projections

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