

The Director General

Maisons-Alfort, 22 June 2018

OPINION **of the French Agency for Food, Environmental** **and Occupational Health & Safety**

on the "identification, categorisation and prioritisation of currently non-regulated pollutants for air quality monitoring"¹

ANSES undertakes independent and pluralistic scientific expert assessments. ANSES's public health mission involves ensuring environmental, occupational and food safety as well as assessing the potential health risks they may entail.

It also contributes to the protection of the health and welfare of animals, the protection of plant health and the evaluation of the nutritional characteristics of food.

It provides the competent authorities with the necessary information concerning these risks as well as the requisite expertise and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).

Its opinions are published on its website. This opinion is a translation of the original French version. In the event of any discrepancy or ambiguity the French language text dated 22 June 2018 shall prevail.

On 30 September 2015, ANSES received a formal request from the Directorate General for Health (DGS), the Directorate General for Energy and Climate (DGEC) and the Directorate General for Risk Prevention (DGPR) to conduct the following expert appraisal: identification of non-regulated ambient air pollutants of potential concern for health and the environment.

1. BACKGROUND AND PURPOSE OF THE REQUEST

Technological developments can result in increased emissions or ambient air concentrations of certain pollutants that were previously responsible for few or no emissions. Similarly, advances in knowledge have helped identify a significant or increasing presence of certain pollutants in ambient air, or new toxic effects on health and/or the environment. As a result, certain air pollutants that are not currently covered by the various air quality regulations regarding monitoring of concentrations and control of emissions may be pollutants of concern with regard to their potential impact on health or the environment.

ANSES thus received a formal request to conduct an expert appraisal with the following aims:

- define a method for identifying chemical pollutants of interest in ambient air that have not yet been taken into account by the regulations;

¹ Cancels and replaces the Opinion of 7 May 2018 (see Annex 1)

- Prioritise the identified pollutants and select some of them according to clearly presented methods, in order to draw up a concise list of pollutants of interest from the perspective of their potential health or environmental impacts.

The formal request also asked that the methodology used identify needs in terms of data acquisition (ambient air concentrations, health effects, etc.) for pollutants that are not sufficiently documented to enable their prioritisation for regulatory monitoring.

The ultimate intention was for the expert appraisal to propose a list of currently non-regulated priority pollutants for a future public air quality monitoring policy² for metropolitan France and the overseas territories (DROM). In agreement with the supervisory ministries responsible for the formal request to ANSES, several classes of pollutants were excluded from the scope of this appraisal for the following reasons:

- pesticides³: an expert appraisal recently published by ANSES (ANSES, 2017a) has already led to the identification of pesticides whose monitoring in ambient air seems appropriate;
- pollen and mould: the need to monitor pollen in ambient air was highlighted in an opinion and expert appraisal report published by ANSES in the recent past (ANSES, 2014), and expert appraisal work expected to lead to recommendations for national monitoring of mould in ambient air is under way;
- radioelements: the expert appraisal of these substances falls within the competence of the French Radioprotection and Nuclear Safety Institute (IRSN);
- greenhouse gases (GHGs): given the work timetable to be adhered to, the Agency was asked to focus its work on pollutants with direct impacts on human health.

2. ORGANISATION OF THE EXPERT APPRAISAL

The expert appraisal was carried out in accordance with French Standard NF X 50-110 "Quality in Expert Appraisals – General Requirements of Competence for Expert Appraisals (May 2003)".

The expert appraisal falls within the sphere of competence of the Expert Committee (CES) on "Assessment of the risks related to air environments". ANSES entrusted the expert appraisal to an ad hoc working group (WG) set up after a public call for applications. The WG's work began on 20 April 2016 and was completed on 12 March 2018. The methodological and scientific aspects of the work were presented and discussed with the CES between 30 June 2016 and 1 February 2018. It was adopted by the CES at its meeting of 16 March 2018.

ANSES analyses interests declared by experts before they are appointed and throughout their work in order to prevent risks of conflicts of interest in relation to the points addressed in expert appraisals.

The experts' declarations of interests are made public via the ANSES website (www.anses.fr).

² The pollutants currently regulated for air quality monitoring with the aim of protecting human health are: NO₂, NO_x, SO₂, PM₁₀, PM_{2.5}, CO, benzene, ozone, benzo(a)pyrene, lead, arsenic, cadmium, nickel, mercury gas, benzo(a)anthracene, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3,c,d)pyrene, dibenzo(a,h)anthracene.

³ The term "pesticides" includes products that are used or have been used as plant protection products, biocides or human and veterinary antiparasitics (ANSES, 2017a).

3. ANALYSIS, CONCLUSIONS AND RECOMMENDATIONS OF THE WG AND THE CES

3.1. Methodology for identifying and prioritising pollutants of interest

This is broken down into the four steps described below.

➤ **Step 1: Identification of non-regulated pollutants of potential interest: establishment of a core list**

The aim of this step was to establish a core list of pollutants of interest. In order to compile this list, the actions described below were carried out:

- Identification of "non-regulated" pollutants measured in ambient air in France since 2006:

A consultation was held with the approved air quality monitoring associations (AASQAs) via the ATMO France Federation and with research laboratories: sixteen AASQAs and six national research laboratories responded to this consultation.

- Identification of available data on air pollutant emissions in France:

A hearing took place with the Interprofessional Technical Centre for Studies on Air Pollution (CITEPA), the State operator that conducts an annual national inventory of air pollutants.

- Identification of lists of pollutants of interest in terms of exposure (or occurrence in ambient air) and/or health effects drawn up by international bodies:

The lists established by the World Health Organisation (WHO) in 2016, the Agency for Toxic Substances and Disease Registry (ATSDR) in 2015, and the United States Environmental Protection Agency (US EPA) in 2005 were used.

- Identification of "non-regulated" pollutants subject to monitoring in other countries:

An international consultation was held with the European Environment Agency (EEA), as well as with Canada and the United States.

- Identification in the scientific literature of ambient air pollutants considered to be "emerging":

A literature review on the concept of emergence was conducted. Searches for publications were performed in the Scopus and PubMed databases.

- Compilation of stakeholders' opinions on pollutants that should be considered in future air quality monitoring regulations:

The following non-governmental organisations (NGOs) involved in air pollution issues were interviewed: the Association for the Prevention of Atmospheric Pollution (APPA), *France Nature Environnement* (FNE), the *Respire* association and the *Strasbourg Respire* group.

These hearings were supplemented by a consultation via questionnaire of 10 French scientific experts specialising in air pollution (from universities and institutions).

➤ **Step 2: Categorisation of pollutants from the core list established in Step 1**

The aim of this step was to classify pollutants into "homogeneous" categories, based on the available data and according to two themes: firstly their occurrence and concentration levels in air, and secondly various toxicity criteria.

This approach is similar to that adopted by the Norman network⁴ whose objective was to categorise and prioritise emerging pollutants in water.

A decision tree was constructed to categorise the pollutants based on:

- Criteria of occurrence in the atmosphere (frequency at which they are screened for in ambient air in France and abroad). The criterion adopted corresponded to a minimum number of measurement campaigns (datasets) conducted in urban or suburban environments by the AASQAs and/or the French research laboratories during the period 2012-2016 or, failing this, on a number of publications providing data on measurements in urban environments in France or abroad, identified in the scientific literature.

This led to an initial level of categorisation of the pollutants on the core list into two groups: Category A comprising "pollutants frequently screened for in France and/or abroad", and Category B containing "pollutants rarely or not screened for in France and/or abroad".

- Health criteria, considering both:
 - ↳ classifications on carcinogenicity, mutagenicity and reprotoxicity (CMR) and endocrine-disrupting (ED) effects, existence of toxicity reference values (TRVs), establishment of indicative toxicity values (iTVs)⁵, and selection of other health reference values as appropriate;
 - ↳ comparison of the TRV or iTV or another health reference value with an air concentration value;
 - the selected concentration value was the maximum of the averages of the measured air concentrations for each available dataset, all types of measurement sites combined,
 - the TRV selected was the most protective,
 - if an iTV was chosen, its establishment took protective choices into account.

The TRVs and iTVs considered correspond to situations of chronic inhalation exposure, since these are the situations that mainly guide the identification of pollutants of interest for the implementation of nationwide monitoring, which was the objective here.

This approach enabled the pollutants to be categorised into the following four groups:

- **Category 1: "priority pollutants for prioritisation with a view to monitoring"**. These are pollutants that are sufficiently documented in terms of data on ambient air concentrations and health effects to be prioritised. The data available suggest a potential health risk to the general population.
- **Category 2: "pollutants requiring the acquisition of data"**. These are pollutants requiring the acquisition of more data on ambient air concentrations and/or health effects, or requiring an in-depth analysis of additional data not taken into account in this expert appraisal:
 - **Category 2a: "pollutants requiring the acquisition of health data"**. There is sufficient information on their concentration in ambient air (screening frequency) but the health criteria selected for categorisation are not available. However, classifying pollutants in this category does not mean that there are no health effects;

⁴ European network of reference laboratories, research centres and related organisations for monitoring of emerging environmental substances

⁵ An iTV is a toxicological benchmark that can be used for risk assessment. It is an indicative value that is less robust than a TRV with a low confidence level. An iTV is proposed when the necessary conditions for establishing a TRV are not met and a quantitative health risk assessment is required in a given exposure context, particularly when there are time or resource constraints. The iTV is developed as fully as possible within the time available to meet the decision-makers' policy imperatives and then, if necessary, further work is carried out to propose a TRV (ANSES, 2018).

- **Category 2b: "pollutants requiring the acquisition of data on their occurrence in ambient air and potentially of health data"**. There is insufficient information on their concentration in ambient air (screening frequency);
- **Category 3: "non-priority pollutants for monitoring"**. These are pollutants that are sufficiently documented in terms of data on ambient air concentrations and health effects. The data available do not indicate any health risk for the general population.

Following this categorisation, a critical analysis of the results *a posteriori* was carried out which may lead to a possible re-categorisation of certain pollutants.

➤ **Step 3: prioritisation of pollutants**

This step focused on the "priority pollutants for prioritisation with a view to monitoring" (Category 1). The prioritisation exercise was based on the calculation of a risk score corresponding to the ratio of a concentration (reflecting the level of ambient air contamination) to the TRV selected for each pollutant.

The concentration in ambient air was the average of the measured concentrations for all the available datasets. All types of measurement sites were considered.

The TRV selected was the most protective for human health.

To accompany this score and enable it to be placed into perspective through critical analysis, the number of datasets whose average concentration exceeds the TRV was identified, and the associated measurement site typologies were documented. All this information was compiled in a summary sheet, pollutant by pollutant (see the expert appraisal report).

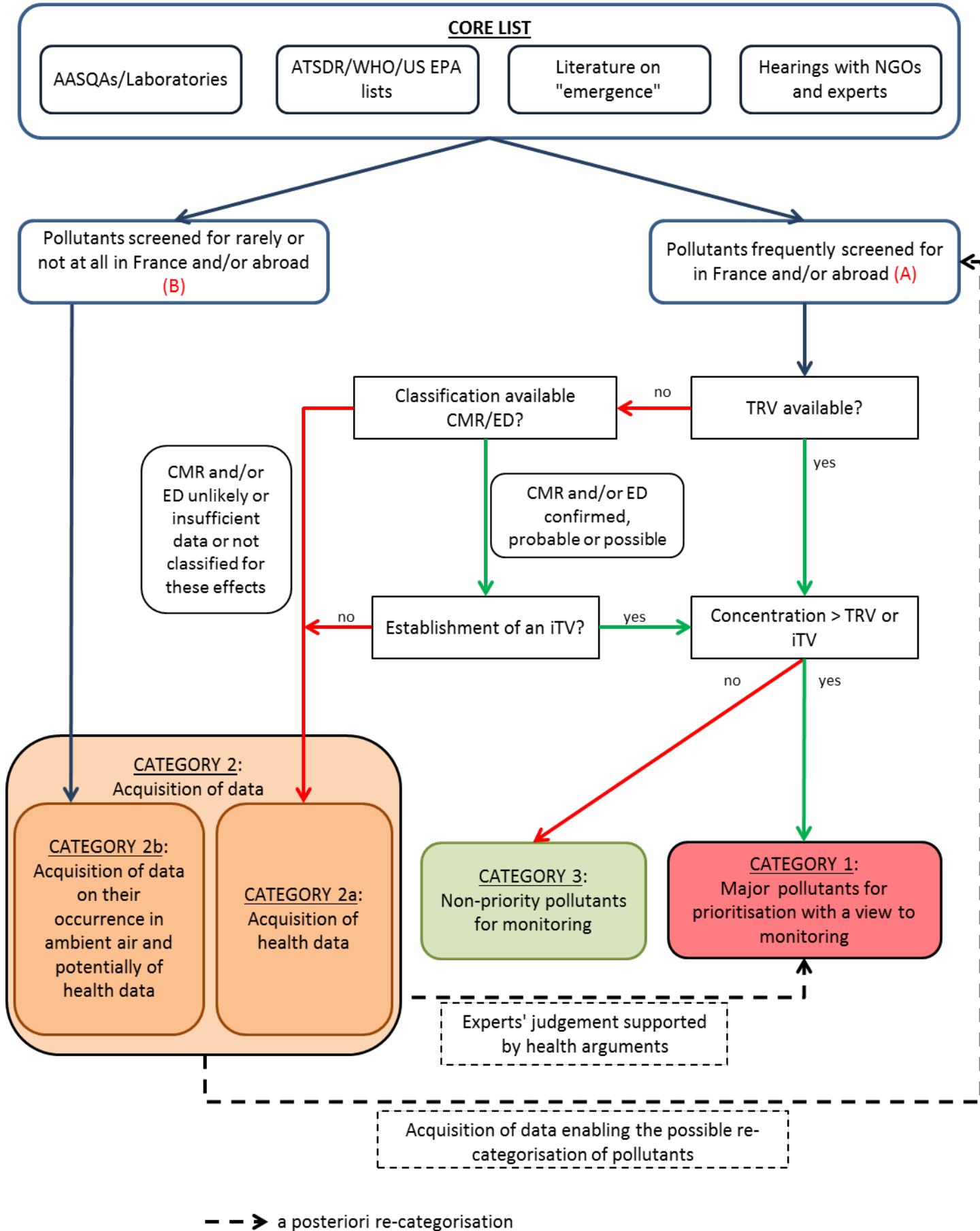
➤ **Step 4: Identification and description of sources of uncertainty throughout the process**

The aim of this step was to identify and provide a structured description of the different sources of uncertainty and their potential impact on the results of the expert appraisal. This concerns:

- uncertainties related to the context and scope of the expert appraisal,
- uncertainties related to the identification of the pollutants in the core list,
- uncertainties related to the pollutant categorisation exercise,
- uncertainties related to the pollutant prioritisation exercise.

3.2. Results

At the end of Step 1, after removal of duplicates and pollutants outside the scope of the expert appraisal (pesticides, biological pollutants, GHGs, radioelements), a core list of 557 pollutants was created. By applying the decision tree established in Step 2, these 557 pollutants were then categorised. The decision tree for categorising the pollutants in the core list is shown in Figure 1.



Experts' judgement supported by health arguments

Acquisition of data enabling the possible re-categorisation of pollutants

Figure 1: Categorisation flow chart for the pollutants in the core list

The first two groups were identified according to the frequency at which the pollutant is screened for in ambient air in France and/or abroad:

- **Category A – Pollutants frequently screened for in France and/or abroad:** The pollutant is covered by at least two French datasets (or measurement campaigns) in the urban environment over the period 2012-2016 or two post-2012 publications providing measurement data in France or abroad. One hundred and sixty-three (163) pollutants fell into this category.
- **Category B – Pollutants screened for rarely or not at all in France and/or abroad:** Three hundred and ninety-four (394) pollutants fell into this category.

On this basis the pollutants were classified according to the level of data available at the time of the expert appraisal:

- **Category 1 –Major pollutants for prioritisation with a view to monitoring:** Thirteen (13) pollutants fell into this category (2% of the core list).
- **Category 2 – Pollutants requiring the acquisition of data:**
 - **Category 2a – Pollutants requiring the acquisition of health data:** Sixty-nine (66) pollutants were classified in this category (12% of the core list).
 - **Category 2b – Pollutants requiring the acquisition of data on their occurrence in ambient air and potentially of health data.** Because of the categorisation approach developed as part of this work, no search for health data was conducted for these pollutants. Three hundred and ninety-four (394) pollutants fell into this category (71% of the core list).
- **Category 3 – Non-priority pollutants for monitoring:** This category covered 84 pollutants (14% of the core list).

The 13 pollutants classified in Category 1, i.e. those that appear to warrant priority consideration for possible future ambient air monitoring, are the following, listed in alphabetical order: acrylonitrile, antimony, 1,3-butadiene, black carbon, cobalt, copper, manganese, naphthalene, ultrafine particles (UFPs), hydrogen sulphide, 1,1,2-trichloroethane, trichloroethylene and vanadium.

The prioritisation exercise based on the calculation of risk scores in Step 3 resulted in the classification of 11 pollutants presented below (it should be noted that ultrafine particles (UFPs) and black carbon could not be ranked because they do not have TRVs).

Table 1: Result of prioritisation of major pollutants with a view to monitoring (Category 1)

Ranking	Risk score	Pollutant	CAS number
1	5.1	1,3-butadiene	106-99-0
2	1.4	Manganese	7439-96-5
3	0.9	Hydrogen sulphide	7783-06-4
4	0.88	Acrylonitrile	107-13-1
5	0.86	1,1,2-trichloroethane	79-00-5
6	0.7	Copper	7440-50-8
7	0.4	Trichloroethylene	79-01-6
8	0.3	Vanadium	7440-62-2
9	0.2	Cobalt	7440-48-4
10	0.088	Antimony	7440-36-0
11	0.087	Naphthalene	91-20-3

Category 1 pollutants that cannot be prioritised according to the selected method
Ultrafine particles (UFPs)
Black carbon

The tables annexed to this opinion present firstly the information that led to these pollutants being classified into Category 1 (Table A), and secondly the information relating to the datasets accompanying the classification obtained after calculation of the risk scores (Table B).

Lastly, throughout the process, the uncertainties were described and analysed (Step 4). For each source of uncertainty identified, a proposal was made to deal with the uncertainty where appropriate, and the impact on the results of the expert appraisal was estimated. It was mainly within the context of this taking uncertainties into account that the possibility of re-categorising pollutants was identified, sensitivity analyses were carried out or additional work to prioritise pollutants classified in Categories 2a and 2b was identified for carrying out in the future (see the expert appraisal report). In the end, this exercise reinforced the results of the expert appraisal concerning Category 1 pollutants, and underlined the need to conduct additional work for Category 2a and 2b pollutants, which may possibly lead to a re-categorisation of certain pollutants.

3.3 Conclusions of the CES

The aim of this expert appraisal was to provide the public authorities with a priority list of ambient air pollutants that are not covered by current air quality monitoring regulations and are of interest with regard to their potential impact on human health. The work was based on a methodology that also identified a need for additional knowledge on pollutants that are currently insufficiently documented to allow them to be prioritised.

The main difficulties encountered in conducting this exercise were related to the large number of pollutants potentially concerned and the heterogeneity of the data associated with them, in both qualitative and quantitative terms. Indeed, the available data on population exposure and on the pollutant hazards varied considerably from one pollutant to another: some of these pollutants are well known and well documented, covered by numerous measurement campaigns, while others, according to the data available, are measured very little or not at all in France.

To take this heterogeneity into account, the approach followed consisted in categorising the pollutants according to criteria of occurrence in ambient air and health criteria, prior to their prioritisation. This approach was based on the one developed by the Norman network for prioritising emerging pollutants in aquatic environments. In particular, the Norman network's approach made it possible to take the lack of data into account, which often leads to pollutants being excluded because they are not sufficiently documented. In addition, this is an evolving method that can be applied to a large number of pollutants.

The method and results of the expert appraisal are summarised in the table below.

Table 2: Summary of steps and results

Steps	Method	Results
<p>1. Identification of pollutants <i>Establishment of the core list of non-regulated pollutants of potential interest</i></p>	<p>Consultation of the AASQAs and French research laboratories (data measured in France) Hearing with CITEPA Consideration of priority pollutant lists drawn up by the WHO, ATSDR and US EPA International consultation Literature on the concept of emergence Stakeholder consultation (NGOs, specialised experts)</p>	<p>N = 557 (excluding pesticides, GHGs, radioelements, biological pollutants)</p>
<p>2. Categorisation of pollutants <i>Classification of pollutants into categories, based on health criteria and air concentrations</i></p>	<p>Categorisation of pollutants based on: - the frequency at which they are screened for in France and abroad - the existence of health data (CMR/ED classifications, TRVs) - comparison of the TRV (when available) with a concentration data point Critical analysis of results and possible re-categorisation</p>	<p>Category 1 "Major pollutants for prioritisation with a view to monitoring" N = 13</p>
		<p>Category 2a "Pollutants requiring the acquisition of health data" N = 66</p>
		<p>Category 2b "Pollutants requiring the acquisition of data on their occurrence in ambient air and perhaps also health data" N = 394</p>
		<p>Category 3 "Non-priority pollutants for monitoring" N = 84</p>
<p>3. Prioritisation of pollutants <i>Classification of pollutants in Category 1</i></p>	<p>Calculation of a risk score from data on ambient air concentration and TRVs</p>	<p>Unranked pollutants: UFPs and black carbon</p> <hr/> <p><u>Ranking results</u> 1) 1,3-butadiene 2) Manganese 3) Hydrogen sulphide 4) Acrylonitrile 5) 1,1,2-trichloroethane 6) Copper 7) Trichloroethylene 8) Vanadium 9) Cobalt 10) Antimony 11) Naphthalene</p>

NB: The pollutants in Categories 2a and 2b require additional prioritisation/ranking work to be carried out by ANSES at a later date. This work could lead to additional pollutants being included in Category 1.

Eleven pollutants were classified in Category 1 "Priority pollutants for ranking with a view to monitoring", indicating exposure situations where their TRVs were exceeded. In addition to these pollutants, there are UFPs and black carbon, for which no TRV or hazard classification is available, but for which epidemiological studies have shown the existence of health effects. The CES stresses that among these pollutants, 1,3-butadiene, trichloroethylene, acrylonitrile, hydrogen sulphide, manganese and vanadium are on the WHO's list of priority pollutants for updating its ambient air quality guidelines (WHO, 2016a).

Lastly, analysis of the data that led to the categorisation of these pollutants showed that:

- 1,3 butadiene is covered by numerous measurement campaigns in France by several AASQAs and/or research laboratories. The results of these campaigns frequently lead to TRV exceedance, regardless of the typology of the measurement site;
- the acquisition of data on UFPs and black carbon needs to be supplemented and sustained, given their potential health impacts;
- for the other Category 1 pollutants, levels above the TRVs can be observed, related to particular contexts (e.g. influence of nearby industries, proximity to traffic). Some of these pollutants may be monitored within a regulatory framework such as the one for classified facilities for environmental protection (ICPE) (manganese, copper, cobalt, vanadium, antimony). Data for other pollutants are more fragmented (trichloroethylene, naphthalene, 1,1,2-trichloroethane, hydrogen sulphide and acrylonitrile).

3.4 Recommendations of the CES

In view of the results of the prioritisation, the CES is issuing the following recommendations. Note that the following sections of recommendations are presented in order of priority for action and that the recommendations in each section are themselves numbered in order of priority where appropriate.

I. Concerning the "Major pollutants for prioritisation with a view to monitoring" (Category 1), the CES recommends:

1. Implementing national monitoring of 1,3-butadiene, together with a proposed environmental objective related to the protection of human health;

The CES points out that monitoring of 1,3-butadiene in air is regulated in other EU countries, in particular Hungary and the United Kingdom, where there is an air concentration benchmark value.

2. Increasing the number of measurement sites across France (covering various types of location) for UFPs and black carbon and ensuring continuous long-term monitoring;

The CES stresses the fact that various studies conducted within the "UFP" Working Group of the Central Laboratory for Air Quality Monitoring (LCSQA) recommend monitoring UFP concentrations by counting, according to different particle size classes.

3. Regarding the other Category 1 pollutants, the CES points out that the expert assessment showed that TRVs were exceeded in specific industrial or other contexts. The CES therefore recommends searching for and analysing other existing metrological data and, where appropriate, conducting additional measurement campaigns for these pollutants in order to study the exposure of populations in the vicinity of the emission sources.

II. Concerning the "Pollutants requiring the acquisition of health data" (Category 2a) and "Pollutants requiring the acquisition of data on their occurrence in ambient air and potentially of health data" (Category 2b), the CES recommends:

- Prioritising Category 2a pollutants on the basis, for example, of the hazard statements of the different classifications used, the number of measurement campaigns carried out, the concentrations measured and associated typologies, the calculation of iTVs, etc.;
- Prioritising Category 2b pollutants at least on the basis of the health criteria taken into account for the categorisation of Category A pollutants: existence of TRVs, existence of CMR and/or ED classifications.

The prioritisation work should mainly aim to identify priority needs regarding data acquisition: implementation of ambient air measurement campaigns, toxicology studies, establishment of TRVs, etc.

- Examining the relevance of taking other exposure and health criteria into account to refine the categorisation of Category 2a and 2b pollutants.

III. Concerning additional work to be carried out in terms of expert appraisal and scientific monitoring:

Regarding access to data and in order to improve the method of identifying, categorising and prioritising pollutants, the CES recommends:

1. Centralising in a database the data and metadata on non-regulated pollutants generated during measurement campaigns carried out by the AASQAs and research laboratories, or in any other monitoring context, to facilitate their availability and use for research or scientific expert appraisal purposes, as is the case with regulated pollutants;
2. Developing a TRV or other health reference value for UFPs and black carbon;
3. Revising the TRV for copper given the low confidence level placed on this value (subacute TRV without any information on the key study and critical effect selected);
4. Assessing the relevance and feasibility of refining or establishing TRVs for the respiratory tract and chronic exposure for Category A pollutants "Pollutants frequently screened for in France and/or abroad" classified as CMR/ED but without TRVs. Within the framework of this expert appraisal, this concerns benzo(e)pyrene, HBCDD, isoprene and short-chain chlorinated paraffins.

Regarding scientific monitoring, the CES recommends:

- Setting up a literature watch on the "health" component as well as on the "exposure" component of the pollutants in Categories 1 and 3. An assessment and expert appraisal of new data collected could lead to some of these pollutants being re-categorised. This watch could be carried out every three years;
- Taking into account the results of the work under way at ANSES on the physico-chemical characterisation of particles, and the weight of evidence attributable to the different fractions of particulate matter.

Lastly, the CES reiterates ANSES's recommendations concerning:

- The relevance and importance of monitoring pesticides in ambient air (ANSES, 2017a).
- Strengthening the pollen monitoring system and ensuring its long-term future (ANSES, 2014).

4. AGENCY CONCLUSIONS AND RECOMMENDATIONS

The French Agency for Food, Environmental and Occupational Health & Safety endorses the conclusions and recommendations of the CES on "Assessment of risk related to air environments" presented above.

The objective of this expert assessment was to draw up a concise list of ambient air pollutants that are not regulated in terms of monitoring, and that seem to be of interest given their potential health impacts. The expert appraisal led to the development of an original methodology, based on the method developed by the Norman network whose objective was to categorise and prioritise emerging pollutants in water. The uncertainties were described throughout the process and a means of dealing with several of them could therefore be proposed. In the end, this exercise underlined the need to conduct additional work on Category 2a and 2b pollutants. ANSES points out that such work, focusing on prioritising the pollutants classified in Categories 2a and 2b, is already under way at the Agency.

In view of the available data on air concentrations and the existing health data, ANSES stresses the importance of national-level monitoring of 1,3-butadiene in ambient air.

Concerning ultrafine particles and black carbon, ANSES believes that the acquisition of data relating to them should be supplemented and sustained, given their potential health impacts.

For the other pollutants classified in Category 1 (priority pollutants), the cases where the TRVs were exceeded mainly seemed to be related to specific contexts:

- For manganese, copper, cobalt, vanadium and antimony, ANSES draws attention to the fact that the cases where the TRVs were exceeded in the campaigns were associated with activities that are most likely subject to ICPE regulations (municipal waste incineration plants (MWIPs), smelting, etc.). ANSES therefore recommends ensuring adequate regulatory supervision of this type of facility concerning the emission of these pollutants (release limits, surveillance measures, etc.).
- For the other pollutants (trichloroethylene, naphthalene, 1,1,2-trichloroethane, hydrogen sulphide and acrylonitrile), the data remain more fragmented. It may be necessary to search for and analyse other existing metrological data and, where appropriate, conduct additional campaigns in order to study the exposure of populations in the vicinity of the emission sources.

ANSES draws attention to the fact that the exercise to categorise and rank pollutants was based on their intrinsic toxicity and did not include their indirect effects, which may also be precursors of secondary pollutants such as secondary particles or ozone. ANSES therefore reiterates the importance of reducing emissions of such precursors, so as to also act on reducing secondary particles and ozone.

Furthermore, ANSES stresses the complexity of the exercise to identify and collect existing measurement data on non-regulated ambient air pollutants, and insists on the need to develop a national-level data bank for collecting them and making them available for research or scientific expert appraisal work, as is the case with regulated pollutants.

Regarding other non-regulated pollutants, the Agency reiterates the conclusions of previous opinions and expert appraisal reports that led it to advocate the fact that:

- it is relevant and necessary to monitor pesticides in ambient air. Based on a list of 90 priority pollutants, this national monitoring should make it possible to assess the chronic exposure of the general population and the associated health risks. The Agency has also recommended setting up specific measurement campaigns to assess the exposure of populations living in the vicinity of pesticide emission sources, particularly residents in agricultural areas (ANSES, 2017a). A national exploratory campaign will be conducted in 2018 by the AASQAs, in conjunction with the LCSQA.

The need to consider pesticides as priority pollutants for ambient air monitoring was also reiterated on numerous occasions during this expert appraisal.

- it is important to sustain the current monitoring system for pollen, whose purpose is to inform the population and health professionals about atmospheric concentrations of pollen, allowing them to anticipate when to take medication or postpone an activity (ANSES, 2014).

Lastly, the Agency points out that it has received a formal request from the Directorate General for Health to undertake an expert appraisal leading to the proposal of recommendations for the national monitoring of mould in ambient air, in light of the public health challenges it poses. This work is currently in progress.

Dr Roger Genet

KEYWORDS

Outdoor air pollution, air quality monitoring, health effects, chemicals, general population, emerging pollutants, non-regulated pollutants, categorisation, prioritisation

ANNEX 1: TRACKING OF OPINION UPDATES

Date	Version	Page	Description of the change
May 2018	01		First signed version of the ANSES opinion
June 2018	02	13	Clarification provided in Section 4 of the Opinion: "ANSES draws attention to the fact that the exercise to categorise and rank pollutants was based on their intrinsic toxicity and did not include their indirect effects, which may also be precursors of secondary pollutants, such as secondary particles or ozone. ANSES therefore reiterates the importance of reducing emissions of such precursors, so as to also act on reducing secondary particles and ozone."

ANNEX 2: INFORMATION AVAILABLE ON CATEGORY 1 POLLUTANTS (TABLE A) AND RESULTS OF THE RANKING OF CATEGORY 1 POLLUTANTS (TABLE B)

Table A: Information available on Category 1 pollutants

Pollutant (CAS No.)	Sources of exposure (main uses)	Documentation on ambient air contamination levels		Health data		
		AASQAs and/or research laboratories	Literature (number of relevant publications)	CMR/ED classifications	TRV selected (the most protective)	Other health data
1,1,2-trichloroethane (79-00-5)	Exclusively anthropogenic sources (reaction intermediate and industrial solvent)	N _{organisations} = 2 N _{campaigns} = 17	NA	<u>Carcinogenicity:</u> IARC: Group 3 US EPA: Possible human carcinogen ECHA (CLP): Cat. 2 <u>Not classified mutagenic, reprotoxic/ED</u>	ERU = $1.6 \cdot 10^{-5}$ ($\mu\text{g} \cdot \text{m}^{-3}$) ⁻¹ (US EPA, 1987)	NA
1,3-butadiene (106-99-0)	Exclusively anthropogenic sources (manufacture of rubber, resins, latex-styrene-butadiene and neoprene emulsions, vehicle engine exhausts, cigarette smoke, combustion of plastics and rubber)	N _{organisations} = 7 N _{campaigns} = 44	NA	<u>Carcinogenicity:</u> IARC: Group 1 ECHA (CLP): Cat. 1B US EPA: Carcinogenic to humans <u>Mutagenicity:</u> ECHA (CLP): Cat. 1B <u>Not classified reprotoxic/ED</u>	ERU = $1.7 \cdot 10^{-4}$ ($\mu\text{g} \cdot \text{m}^{-3}$) ⁻¹ (OEHHA, 2009)	NA

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Pollutant (CAS No.)	Sources of exposure (main uses)	Documentation on ambient air contamination levels		Health data		
		AASQAs and/or research laboratories	Literature (number of relevant publications)	CMR/ED classifications	TRV selected (the most protective)	Other health data
Acrylonitrile (107-13-1)	Exclusively anthropogenic sources (textile industry, plastics manufacturing, feedstock)	No	Yes (4)	<u>Carcinogenicity:</u> IARC: Group 2B US EPA: Probable human carcinogen ECHA (CLP): Cat. 2 <u>Not classified mutagenic, reprotoxic/ED</u>	$ERU = 6.8 \cdot 10^{-5} (\mu\text{g} \cdot \text{m}^{-3})^{-1}$ (US EPA, 1991)	NA
Antimony (7440-36-0)	Anthropogenic sources (metal alloy manufacture, combustion of coal and waste) and natural sources (leaching from soil particles, marine aerosols, forest fires, volcanic emissions)	$N_{\text{organisations}} = 5$ $N_{\text{campaigns}} = 75$	NA	<u>Not classified CMR/ED</u>	$TRV = 0.3 \mu\text{g} \cdot \text{m}^{-3}$ (ATSDR, 2017)	NA
Black Carbon	Anthropogenic sources (incomplete combustion of fossil fuels and biomass) and natural sources (forest and vegetation fires)	$N_{\text{organisations}} = 8$ $N_{\text{campaigns}} = 209$	NA	<u>Not classified CMR/ED</u>	No	Yes (WHO, 2012; 2013a; 2016a)

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Pollutant (CAS No.)	Sources of exposure (main uses)	Documentation on ambient air contamination levels		Health data		
		AASQAs and/or research laboratories	Literature (number of relevant publications)	CMR/ED classifications	TRV selected (the most protective)	Other health data
Cobalt (7440-48-4)	Anthropogenic sources (smoke from thermal power plants and incinerators, exhaust from combustion-powered vehicles, industrial activities related to ore extraction and processes to produce cobalt and its compounds) and natural sources (leaching from soil particles, volcanic eruptions, forest fires)	N _{organisations} = 6 N _{campaigns} = 75	NA	<u>Carcinogenicity:</u> IARC: Group 2B <u>Not classified mutagenic, reprotoxic/ED</u>	TRV = 0.1 µg·m ⁻³ (ATSDR, 2004)	NA
Copper (7440-50-8)	Anthropogenic sources (manufacture of metal alloys and electrical materials, plumbing, industrial equipment, motor vehicles, metalwork) and natural sources (leaching from soil particles, volcanic eruptions, forest fires, marine aerosols)	N _{organisations} = 8 N _{campaigns} = 95	NA	<u>Carcinogenicity:</u> IARC: Group 3 US EPA: Not classifiable <u>Not classified mutagenic, reprotoxic/ED</u>	TRV = 1 µg·m ⁻³ (RIVM, 2000)	NA
Manganese (7439-96-5)	Anthropogenic sources, mainly industrial (ferroalloy production, smelting, fossil-fuel combustion) and natural sources (leaching from soil particles)	N _{organisations} = 9 N _{campaigns} = 108	NA	<u>Not classified CMR/ED</u>	TRV = 0.3 µg·m ⁻³ (ATSDR, 2012)	NA

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Pollutant (CAS No.)	Sources of exposure (main uses)	Documentation on ambient air contamination levels		Health data		
		AASQAs and/or research laboratories	Literature (number of relevant publications)	CMR/ED classifications	TRV selected (the most protective)	Other health data
Naphthalene (91-20-3)	Exclusively anthropogenic sources (industrial discharges, road traffic, incomplete combustion when burning wood for heating)	N _{organisations} = 7 N _{campaigns} = 23	NA	<u>Carcinogenicity:</u> IARC: Group 2B US EPA: Possible human carcinogen ECHA (CLP): Cat. 2 <u>Not classified mutagenic, reprotoxic/ED</u>	ERU = $5.6 \cdot 10^{-3}$ (mg.m ⁻³) ⁻¹ (ANSES, 2013)	NA
UFPs	Emissions via primary and secondary anthropogenic sources (combustion processes and motor-vehicle emissions, etc.) and natural/biogenic sources (forest fires, volcanic eruptions, etc.)	N _{organisations} = 2 N _{campaigns} = 83	NA	<u>Not classified CMR/ED</u>	No	Yes (WHO 2013a; 2016a)
Hydrogen sulphide (7783-06-4)	Anthropogenic sources (waste-water treatment, blast furnaces, paper mills, tanneries, oil refineries, food processing) and natural sources (natural presence in oil, natural gas, volcanic gases and some hot springs/geysers, decomposition of organic matter, human and plant waste, etc.)	N _{organisations} = 1 N _{campaigns} = 10	Yes (2)	<u>Not classified CMR/ED</u>	TRV = 2 µg.m ⁻³ (US EPA, 2003)	NA

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Pollutant (CAS No.)	Sources of exposure (main uses)	Documentation on ambient air contamination levels		Health data		
		AASQAs and/or research laboratories	Literature (number of relevant publications)	CMR/ED classifications	TRV selected (the most protective)	Other health data
Trichloroethylene (79-01-6)	Exclusively anthropogenic sources (solvents used in the manufacture of adhesives, lubricants, paints, varnishes, pesticides. Feedstock)	N _{organisations} = 2 N _{campaigns} = 18	NA	<u>Carcinogenicity:</u> IARC: Group 1 US EPA: Carcinogenic to humans ECHA (CLP): Cat. 1A <u>Mutagenicity:</u> ECHA (CLP): Cat. 2 <u>Not classified reprotoxic/ED</u>	ERU = $4.1 \cdot 10^{-5}$ ($\mu\text{g} \cdot \text{m}^{-3}$) ⁻¹ (US EPA, 1987)	NA
Vanadium (7440-62-2)	Anthropogenic sources (industrial discharges, fuel combustion) and natural sources (leaching from soil particles, marine aerosols and volcanic emissions)	N _{organisations} = 6 N _{campaigns} = 89	NA	<u>Not classified CMR/ED</u>	TRV = $0.1 \mu\text{g} \cdot \text{m}^{-3}$ (ATSDR, 2012)	NA

NA: Not Applicable

Table B: Results of the prioritisation of Category 1 pollutants

Pollutant	Risk score*	Number of measurement campaigns	Number of campaigns with average concentrations above the TRV	Typology** associated with campaigns with average concentrations above the TRV
1,3-butadiene (106-99-0)	5.1	45	41 (91%)	Across all environments (urban, suburban and rural)
Manganese (7439-96-5)	1.4	108	4 (3.7%)	Relating either to the impact assessment of a foundry or to the monitoring of an MWIP
Hydrogen sulphide (7783-06-4)	0.9	Nine campaigns, including two from the literature and seven carried out by an AASQA	2 (22.2%)	The countries where the measurements were taken are Italy and Iceland, countries with volcanic activity, a major source of hydrogen sulphide
Acrylonitrile (107-13-1)	0.88	11 campaigns from the literature	3 (27.3%)	The studies were conducted in the United States and Japan, and all in an urban environment
1,1,2-trichloroethane (79-00-5)	0.86	18	7 (38.9%)	All in urban or suburban environments (when information was available)
Copper (7440-50-8)	0.70	95	5 (5.3%)	Relating either to the impact assessment of an industry or to the monitoring of an MWIP

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Pollutant	Risk score*	Number of measurement campaigns	Number of campaigns with average concentrations above the TRV	Typology** associated with campaigns with average concentrations above the TRV
Trichloroethylene (79-01-6)	0.36	18	1 (5.6%)	Relating to a campaign carried out in the Arve valley in France, an area subject to chronic air pollution due to its urbanisation and industrialisation
Vanadium (7440-62-2)	0.28	89	3 (3.4%)	Relating either to the impact assessment of a foundry or to the monitoring of an MWIP
Cobalt (7440-48-4)	0.21	75	1 (1.3%)	Relating to the monitoring of an MWIP
Antimony (7440-36-0)	0.088	75	3 (4%)	Relating to the monitoring of an MWIP
Naphthalene (91-20-3)	0.087	23	1 (4.3%)	No information on the campaign, conducted outside metropolitan France

* The risk score corresponds to the ratio of the selected ambient air concentration data point to the TRV (calculation of an equivalent concentration for an excess risk of 10^{-5} for pollutants with a no-threshold TRV).

** The typology corresponds to the characteristics of the measuring stations according to the site's environment (urban, suburban, rural) and the main influence to which they are subjected (background, industrial activity, traffic).