Horizon HLTH 2022 Project MISTRAL
"A toolkit for dynaMic health Impact analysiS to predicT disability-Related costs in the Aging population based on three case studies of steeL-industry exposed areas in Europe".

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** The project uses a multi-stage internal review and release process, with defined milestones. Milestone names include abbreviations/terms as follows:*

- *TOC = "Table of Contents" (describes planned contents of different sections);*
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1 Executive Summary

Deliverable 4.7 presents a comprehensive blueprint of MISTRAL's Systematic review and evidence synthesis report. The mission of MISTRAL is to develop a technological toolkit for dynamic, intelligent HIA toolkit to predict the health impact of health-related features, forecasting the trajectories of disability and quality of life reduction. This method will use environmental, socioeconomic, geographical, and clinical characteristics, managed, and elaborated with a federated learning architecture. The generated models will be adjusted for lifestyle and individual conditions data sourced from large population-based digital surveys. The models will be trained and validated on three different exposures to the steel plants' pollution: Taranto in southern Italy, Rybnik in Poland, and Flanders in Belgium.

Performing systematic reviews and exploitation of latest evidence of exposure-response functions and causation resulting from published medical and scientific research accumulated data from the past 10-20 years, including results published based on EU-funded research projects in the MISTRAL project will allow to identify current and ongoing studies and to indicate specific gaps in existing knowledge related with the topic of connection with environmental pollution/exposure and health effects/risk factors.

1.1 Role of deliverable

The role of this deliverable is to detail the strategy and action plan for performing relevant systematic reviews in the project on the topic of exposure-response functions and causation resulting from literature and EU-funded projects. The identified gaps in the environment and health risk factors and health-related tangible and intangible costs will then be used to formulate a list of recommendations on priorities for new data collections.

1.2 Relationship to other MISTRAL deliverables

This deliverable is the result of the WP4 *Innovative analytical methods and models for health impact assessments and related cost-benefit analysis*, Task 4.1. *Systematic Reviews, Identification of Data Gaps and Recommendations on priorities for new data collections*. The identified gaps in the environment and health risk factors and health-related tangible and intangible costs will then be used to formulate a list of recommendations on priorities for new data collections in all tasks in the WP3 *Feature Engineering, Studies' Coordination & Data Collections in three case studies*.

1.3 Structure of the document

This document is structured into four main sections for clarity and ease of reference:

1. **Introduction**: This section provides an overview of the document, outlining its purpose and structure.
2. **Evidence synthesis characteristics**. This section makes an introduction in the evidence synthesis tool to provide necessary knowledge in the topic.
3. **Systematic review structure**. This section briefly describes the construction of the systematic report as the type of evidence synthesis.
4. **Systematic review approach in the MISTRAL project**. This section aligns the plan how the systematic reviews will be performed in the MISTRAL project and how they will contribute to the further work packages of the project.

2 Introduction to evidence synthesis and systematic review

There is mounting interest in using systematic reviews and evidence synthesis over the years. They are growingly used especially in health policymaking, achieving the Sustainable Development Goals (SDGs), improving population health, and recently due to the COVID-19 pandemic in informing critical policy decisions and enhancing accountability and public trust in decision-makers [1]. As the concept of evidence-based decision-making is simple – to help make decisions, the reality is more complex as evidence comes in many forms, empirical studies vary in validity, it is easy to intentionally make selective use of evidence to support a position, they should be based on the synthesis of all available evidence, not all evidence syntheses are robust, and can introduce bias by themselves [2].

Thus, evidence synthesis is based on formal explicit rigorous methods for compiling the findings of already completed studies and to summarize what is known from that pre-existing research and thus clarifies what is known and not known about a research question [3]. In other words, evidence synthesis is a form of research and thus it should meet the expectations of research including usage of formal and transparent methods [3].

There are many outputs of performing evidence synthesis, for instance rapid reviews, gap maps, scoping reviews, policy briefs, or clinical practice guidelines, etc., however, systematic review is the most common type of evidence synthesis [1]. The difference between these two is that evidence synthesis refers to any method of identifying, selecting, and combining results from multiple studies, while systematic review is a rigorous type of evidence synthesis, that requires more time and multi-person research team than traditional literature reviews [4].

3 Evidence synthesis

Evidence synthesis is the process of identifying and combining data from all relevant information on a research question and to create a clear understanding of a body of research [5]. Evidence synthesis is the interpretation of individual studies within the context of global knowledge for a given topic. To do this in an accountable way there is a need for fit-for-purpose methods of evidence synthesis, that brings together what we know and how we know it, to apply it ethically, rigorously, and transparently, and to report it completely [3].

Important in all types of evidence syntheses is the usage of explicit and transparent methodology in the formation of the research questions and the transparent methodology comprises identification, selection, appraisal, analyses, and the strength of the evidence assessment of the studies to answer the stated question [6]. All studies on a topic are assessed here together in a context and individual studies until they are put in context of what is already known they should not form the basis of decision making [6]. In the process of evidence syntheses, a methodical and comprehensive literature synthesis from a variety of sources focused on a well-formulated research question is performed due to identify and synthesize all the scholarly research on a particular topic, including both published and unpublished studies [7]. Evidence syntheses are performed in an unbiased and reproducible way to provide evidence and guidance for practice and policymaking, as well as to identify gaps in the research [8].

3.1 Types of Evidence Synthesis

Evidence synthesis refers to any method of identifying, selecting, and combining results from multiple studies. However, there are few types of evidence synthesis, and the choice is dependent on the purpose of performing, available people, time to complete, broadness of the topic, including other systematic reviews to review, well-formulated research question, and usage of statistical methods in the process [9]:

Literature (Narrative) review. This term is wide and refers to reviews with a wide scope and non-standardized methodology, where search strategies, comprehensiveness, and time range covered vary and do not follow an established protocol.

Rapid Review. This type of evidence synthesis applies systematic review methodology within a time-constrained setting and is useful for addressing issues needing quick decisions, however, employs methodological “shortcuts” (like limiting search terms) at the risk of introducing bias.

Scoping Review/Systematic Map. This type systematically and transparently collects and categorizes existing evidence on a broad topic or set of research questions, seeks to identify research gaps and opportunities for evidence synthesis, may critically evaluate existing evidence, but does not attempt to synthesize the results in the way a systematic review would and may take longer than a systematic review.

Umbrella Review. This type is on performing reviews of other systematic reviews on a topic. Often defines a broader question than is typical of a traditional systematic review. Is mostly useful when there are competing interventions to consider.

Systematic review. This is a methodical and comprehensive literature synthesis focused on a well-formulated research question. It aims to identify and synthesize all the scholarly research on a particular topic, including both published and unpublished studies, together with grey literature and stakeholder input. It is conducted in an unbiased, reproducible way to provide evidence for practice and policymaking and to identify gaps in

research. It may involve a meta-analysis and takes much more time than traditional literature reviews. The detailed description of systematic review is presented in Chapter 4 of this report.

Meta-analysis. It is a statistical technique for combining the findings from disparate quantitative studies. Statistical methods are used here to objectively evaluate, synthesize, and summarize results. Meta-analysis may be conducted independently or as a part of a systematic review.

3.2 Scientific disciplines and general resources

Evidence syntheses methods have been applied to a diverse and growing number of areas for instance: social, behavioral, educational, crime and justice, international development, health care delivery, health technology assessment, veterinary medicine, pre-clinical drug development and toxicology, food safety, business and economics, environmental protection, environmental health, and environmental toxicology [6].

As the research practices and study designs differs among various fields of science this is also the case for evidence syntheses, where for research fields different and specific guidelines are used. The most popular research topics currently have their own guidelines and supporting tools [10]:

Medicine/health: Cochrane Handbook for Systematic Reviews of Interventions, National Academy of Medicine (NAM), previously Institute of Medicine (IOM) Standards for Systematic Reviews, Systematic Reviews for Animals & Food.

Public health: EPPI-Centre, Guidelines for Systematic Reviews of Health Promotion and Public Health Interventions, NHS Centre for Reviews and Dissemination, Schema for Evaluating Evidence on Public Health Interventions.

Social sciences: Systematic Reviews in the Social Sciences by Petticrew, Matt, Campbell Collaboration.

Environmental sciences: The Collaboration for Environmental Evidence.

3.3 Organizations in evidence synthesis

In the discipline related with public health policy there are several organizations aiming to provide support and collate systematic reviews. They are as follows [7]:

The Cochrane Collaboration. This is a global organization consisting of various review groups, that each of them is focus on a different health topic. Cochrane reviews are usually focused on the effectiveness of clinical interventions. The Public Health group provides the global supports to those, who conducts systematic reviews in accordance with the Cochrane model and standard.

The Campbell Collaboration. This organization provides similar support in evidence synthesis as the Cochrane Library, however, focuses on disciplines related with education, social welfare, and development.

The JBI Collaboration (JBIC), formerly the Joanna Briggs Institute, is a global collaborative evidence network that drives global effort to promote and support the use of the best available evidence to inform decisions made at the point of care. The functions of the JBIC focus on the knowledge needs of local clinicians and consumers [11].

The Evidence for Policy & Practice Centre (EPPI-Centre). This Centre is the part of the Institute of Education at the University College London (UCL). This unit performs systematic reviews for different government departments, with a wide variety of topics and methods. The Centre has also developed novel synthesis

techniques, software, and review methods including participatory methods, as well as provide training and seminars.

International Initiative for Impact Evaluation (3IE). This NGO funds, produces, quality assures, and synthesizes rigorous evidence on development effectiveness. 3IE is the global leader in funding and producing high-quality evidence of what works, how, why, and at what cost in international development and in effective policies for the poor [12].

Centre for Reviews and Dissemination (CRD), York. This Centre performs health-relevant systematic reviews and have developed expertise in high quality systematic reviews and associated economic evaluations.

The Health Evidence Network (HEN). HEN is an information service for public health decision-makers in the WHO European Region, initiated and coordinated by the WHO Regional Office for Europe. It constitutes a single point of access to the best available public health evidence and information. The network provides responses to support the decision-making process: up-to-date summaries highlight what is known, indicate gaps in evidence and information, and underscore key areas of debate, including trends and policy options as well as easy access to evidence and information from several websites, databases, documents and networks of experts, which resources are carefully selected, and their focus and content described [13].

3.4 Software tools

As the performance of the systematic review is very complex task the help of software tools in essential these days. Among the most frequently used software tools are [14]:

Covidence is a software for screening and data extraction tool that allows for streamlining the production of standard intervention reviews.

EPPI-Reviewer is web application allowing for the management of the whole lifecycle of a review in a single location, where the users can upload studies for screening, complete keywording and data extractions as well as for analyzing the results over the internet.

Rayyan is a web-tool designed to help researchers working on knowledge synthesis projects, by speeding the process of screening and selecting studies. Rayyan relies on cloud services like Heroku and Amazon Web Services to securely store its database, logs, and uploaded files, to host and monitor the machines running Rayyan, and to send system emails [15].

RevMan is Cochrane's bespoke software that assists in the protocols and full reviews preparations, including text, characteristics of studies, comparison tables, and study data. It can perform meta-analysis of the data entered, as well as to present the results graphically.

4 Systematic review

Due to the exponential increase of the number of research literature making it impossible for individual decision makers to make the most appropriate healthcare decisions based on all these sources of information, systematic review was developed to ensure informing decisions on human health and life based on an up-to-date and complete understanding of the relevant research evidence [16].

The other important reason of the systematic review popularity is that new research should be performed if it does not duplicate existing research. Therefore, undertaking a systematic review before establishing new primary research will allow to identify current and ongoing studies, indicate specific gaps in existing knowledge or lack in evidence is lacking, and reveal limitations in the previous studies that might be addressed in the new research [16].

Belonging to the evidence synthesis, systematic review must follow the structured, rigorous, and transparent approach that is described by the set of consecutive steps described in brief in the following subchapters [17].

4.1 Protocol development

A systematic review protocol aims to state the rationale, hypothesis, and planned methodology. Members of the review team should use the protocol as a guide to conduct the research. It is also recommended to register the protocol before systematic review conducting, to improve transparency and reproducibility, reduce bias, and to avoid research duplication by the other research teams. Detailed protocols should be developed first, made publicly available, and registered in a registry. To develop a protocol the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach is commonly used. The PRISMA is an evidence-based a minimum set of items to be reported in systematic reviews, using checklist and flow diagram [18].

4.2 Developing research question

Developing the research question is one of the crucial steps in the process. At this stage of the process identification of the knowledge gap takes place and specific research questions are set.

Based on the research questions possible search concepts are defined to build the search strategy. To help formulate the research question many research question frameworks (almost 40) were developed, however the most common frameworks in clinical research questions are: **PICO** (P – population/problem, I – intervention, C – Comparison, O – Outcome) or **PECO** frameworks (P – population/problem, I – exposure, C – Comparison, O – Outcome). Outside the health sciences other popular frameworks are: **PICo** (P – population/problem, I – phenomenon of interest, Co – context), **SPICE** (S – settling, P – perspective for whom, I – intervention/exposure, C – comparison, E – evaluation), **SPIDER** (S – sample, PI – phenomenon of interest, D – design, E – evaluation, R – study type).

Inclusion and exclusion criteria are developed after a finalizing a research question and before a search. They determine the limits for the evidence synthesis and are typically reported in the methods section of the publication.

4.3 Selecting databases

The choose of the databases for search depends on the research question as well as the disciplines in which relevant research may be conducted. To the most common databases of published, peer-reviewed literature belongs according to the discipline:

General: Web of Science, Scopus; health/medicine: MEDLINE via PubMed, TRIP Database, CINAHL, CABI, WHO Covid-29 Global literature on coronavirus disease;

Health evidence: Epistemonikos, PAIS International, 3IE database, Health Systems Evidence, EVIPNet, PDQ-Evidence;

Agriculture/food: CAB Abstracts, AGRICOLA, BIOSIS, Food Science and Technology Abstracts (FSTA), Environment Index;

Social Sciences: PsycINFO, GenderWatch, AgeLine, ERIC, Sociology Source Ultimate, Sociological Astracts; business/economics: EconLit, ABI/Inform, Business Source Complete, Human Resources Abstracts, PAIS Index;

Regional databases: Health Sciences Spanish Bibliographic Index (IBECS), Latin American and Caribbean Center on Health Sciences Information (LILACS), Scientific Electronic Library Online (SciELO), Virtual Health Library, Native Health Library, African Index Medicus (AIM), Western Pacific Region Index Medicus (WPRO), China Academic Journals (CNKI), Scholarly Academic Information Navigator (CiNii), Index Medicus for the South-East Asian Region (IMSEAR), Index Medicus for the Eastern Mediterranean Region (IMEMR).

4.4 Selecting grey literature sources

As the intent of systematic review is to synthesize all available evidence that is applicable to investigated research question, also co called grey (or gray) literature should be searched. Grey literature is literature produced outside of commercial and/or academic publishers. It can be government reports, conference proceedings, graduate theses and dissertations, conference proceedings, preprints repositories, unpublished clinical trials, etc.

The reason to incorporate grey literature in the systematic review is that there is a strong bias in in the scientific publishing to publish studies that reveal some sort of significant effect. Studies that show no effect often end as unpublished, while they represent a valuable body of information when synthesizing and evaluating all available evidence.

4.5 Writing a search strategy

In writing the successful search strategy it is recommended to design comprehensive search across variety of the databases together with an intimate knowledge of bibliographic databases and Boolean logic as the important components.

4.6 Registering a protocol

The PROSPERO register is commonly used to register the systematic review in topics like health and social care, welfare, public health, education, crime, justice, and international development, related to a health outcome [19].

Considering other registries Open Science Framework (OSF) is an open, multidisciplinary web application that can be used by researchers to pre-register a systematic review protocol and to share documents such as a Zotero library, search strategies, and data extraction forms. Examples of other registers to pre-register scoping review protocols are: Cochrane (discipline healthcare), Campbell Collaboration (business and management, crime and justice, disability, education, international development, knowledge translation and implementation, methods, nutrition, and social welfare), Collaboration for Environmental Evidence (environmental issues).

4.7 Translating search strategies

Since in systematic review authors are required to search multiple databases and as each database requires use of specialized search "syntax", after the search strategies must be 'translated' between databases to document the performed search strategy, syntax translations tools, results, and examples.

4.8 Citation management

Using a citation management program allows a researcher to save a lot of time during performing the systematic review. Commonly used programs in this step are: Endnote, Zotero, or Mendeley, that allow for storing and organizing the citations collected during the screening, de-duplicating the results and formatting automatically into in-text citations and bibliographies in the manuscript.

4.9 Article screening

The aim of article screening is to remove studies that are clearly not related to the investigated topic. At first the inclusion/exclusion criteria are used to screen the title and abstracts of the studies and to determine whether they are relevant to the research question. After titles and abstracts were screened, the full text must be retrieved and screened to decide whether the study fits the eligibility criteria of the systematic review. The crucial issue is that at least two independent reviewers screen all studies, resolving areas of disagreement by consensus or by a third party, who is an expert in the field. Commonly used article screening tools are Covidence, Rayyan, and the most basic Excel.

4.10 Assessment of the risk of bias (ROB)

The purpose of performing risk of bias (ROB) assessment (also known as *quality assessment* or *critical appraisal*) is to establish transparency of evidence synthesis results and findings. A risk of bias assessment is recommended to be performed for each included study in the systematic review as individual studies selected to the systematic reviews may include biases in their results or conclusions. Risk of bias assessments is commonly presented in a table in a systematic review to show each included study and how strong it is across defined quality criteria for that particular study.

4.11 Data extraction

In this step relevant data for further process of summarizing and analyzing must be gathered, preferably in the form of table. Depending on the amount and types of data collected and the number of collaborators extracting these data, various extraction tools might be used. Among available data extractions tools are: Excel, Google Spreadsheets, Covidence, RevMan, Systematic Review Data Repository (SRDR), DistillerSR, JBI Sumari, and ST Toolbox.

4.12 Data synthesis and results description

As a systematic review summarizes existing research there are various ways of these data synthetizing. In general, if data in the systematic review are sufficiently similar (homogenous), synthetizing these multiple studies using statistical approach, called “meta-analysis”, is suggested. If the studies included are not similar (different research designs due to diversity in the evidence base) the meta-analysis is not possible and data synthesizing is performed in a process called *narrative or descriptive synthesis*. Additionally, synthetizing data from systematic reviews of qualitative research is *meta-synthesis* approach. It is important to underline that regardless of whether as systematic review presents qualitative or quantitative information, reporting the results using the PRISMA flow diagram is recommended.

5 METEOR – Workshop on Systematic Reviews in Environmental Health

5.1 Objectives and organization

In the METEOR cluster of five financed by five Horizon Europe projects (MARCHES, UBDPOLICY, MISTRAL, VALESOR, BEST-COST) investigating the health impacts of environmental stressors and related socioeconomic costs to protect health and the Earth through policy recommendations, systematic reviews (SR) on environmental health subjects will be performed. In order to accomplish consistent systematic reviews within the cluster Workshop on METEOR – Systematic Reviews in Environmental Health was organized by the University of Aarhus and took place in the Climate Chambers of the University of Aarhus in Denmark between 26 and 28 June, 2023. The goal of the workshop was to learn, unify, and develop consistent SR protocols by going through all the steps of a systematic review. Some preparations were required from participants prior the workshop and hands-on group work was used during the training. The program of the METEOR Workshop on Systematic Reviews in Environmental Health is attached in the **Appendix 1**. The workshop was conducted by the **Prof. Xavier Bosch-Capblanch**, PD, MD, MSc, PhD, from the Swiss Tropical and Public Health Institute and was facilitated by **Prof. John Eyers** from the International Initiative for Impact Evaluation (3IE). The workshop allowed to learn and to order the existing knowledge on SR with the expert in the field. The workshop was also very practical with a lot on exercises. The participant had the opportunity to ask the questions that were relevant to SR performed already in their projects or planned to be performed.

5.2 Training on Systematic Review Report

The program of the METEOR Workshop on Systematic Reviews in Environmental Health in presented **Appendix 1**. The training was divided into 9 sections and three sections took place each day.

The first session entitled “Systematic reviews and knowledge translation” introduced participants into the METEOR “ecosystem” meaning based on the projects names and their main objectives revealed the direction in which systematic reviews will be headed. This part also discussed so called knowledge translation from research sector to policy, managerial, and societal domains. The knowledge for the systematic reviews is needed to be addressed to various stakeholders defined and to what extend replies to their needs. Ideally, knowledge supports the deliberative process in which stakeholders develop guidance products that, in turn, result in policies for services and programs arrangements, and the latter are evaluated to ascertain the extent to which the needs of the population have been met [20]. In the second session entitled “Rationale and protocol development” overview of SR structure and protocol rationale were discussed, followed by protocol description and challenges in the protocol development. The third session was dedicated to issues related to searches of the literature, databases, library support, and software. In this part of the training the practical training with the librarian from the Aarhus University was provided focused on technical aspect of working with databases. The fourth session entitled “Studies selection: relevance and inclusion/exclusion criteria” discussed the process of data selection according to relevance and inclusion/ exclusion criteria according to the protocol in the specific Systematic Review. The fifth session entitled “Data extraction” focused on the practical issues related to extraction scope, performing the extraction data process, formulating outcomes, comparison, and cleaning of data. The sixth session entitled “Risk of bias” discussed the rationale and domains of the risk of bias (ROB). Next, practical examples of ROB were presented followed by the practical ROB assessment in the working groups. The seventh session entitled “Analyses” discussed the practicalities

of the specific steps of the data analysis process. During this session the differences between the systematic review and meta-analysis were discussed and guidelines of performing meta-analysis were presented to the participants. The eighth session entitled “GRADEning the evidence” described the GRADE method and the practical aspects of gradening the quality of evidence and strength of the recommendations in investigated scientific discipline. The nineth session was dedicated to issues related with implications, wrap-up, and next steps of Scientific Reports in the METEOR Cluster.

6 Systematic reviews in the MISTRAL project

6.1 The objective of the systematic review in MISTRAL

In the MISTRAL project we will investigate three sites, where in two of them intensive steel production was performed (Rybnik, Poland), is still performed (Taranto, Italy), and the third site is a reference area (Hasselt-Gent, Belgium). Steel production is responsible for the heavy environmental pollution of all its compartments: air, water, soil/ground, waste generation, landscape devastation, etc.

Environment is one of the most important factors influencing health. The Global Burden of Disease report projects an increasing impact on disability and a decline in global quality of life, especially for the elderly population [21]. Dementia, chronic pulmonary disease, cerebrovascular and chronic ischemic heart diseases are among the key non-communicable diseases that are predicted to be on the rise because of the interaction between socio-environmental risk factors and sub-clinical circumstances [22, 23]. Most of the causal processes underlying these interactions' multidimensional nature remain unclear. Scientists have concentrated on the mounting evidence of a connection between the environment and the emergence of cancers, but policy makers do not share the same perspective on the connections between the environment and chronic illnesses, even in cases where causal pathways have been clearly and systematically identified. Particularly, although appearing to be far from pathophysiological mechanisms based on air exposure pathways, very debilitating diseases with a large economic and social cost, such dementia and stroke, are becoming more and more acknowledged as significant. Chronic respiratory disorders like chronic obstructive pulmonary disease (COPD) and chronic ischemic heart disease (CIHD) have a well-established link to air pollution, lifestyle, and socioeconomic position. Specifically, the latter is typified by a range of illnesses whose onset is frequently independent of age but is expedited by exposure to environmental factors [24]. It is thought that the pathophysiological mechanisms are active and gradually develop even in childhood. Given that extensive catalysis of degenerative processes is already occurring in children, appropriate policies must be adopted immediately. It is necessary to investigate these intricate diseases and mechanisms using indicators and incredibly diverse variables, many of which are biologically remote from one another and may not interact. The aim of MISTRAL is to develop an electronic tool that uses artificial intelligence (AI) prediction and classification algorithms to model the health and economic effects of non-communicable diseases with a high Impact on disability (such as dementia, COPD, stroke, and heart disease). Big data from various age groups and individual sources will be used to record lifestyle, socioeconomic status, environmental and geographic factors, and health status in areas with high pollution exposure (such as the steel industry).

In the post-pandemic world, the demand for strategies that integrate the conservation of landscape diversity with the sustainable utilization of land resources is on the rise; issues such as biocultural heritage, access to landscape, and integration of landscape and urban habitat gained substantial attention in scholarly and professional activities. In this context, as well as in the broader one of Landscape and Heritage studies, specifically in regions affected by the steel industry's historical presence, the relevance of Systematic Review becomes exceptionally pronounced. The European Landscape Convention (ELC) further amplifies the significance of this approach. As the legacy of industrialization intertwines with cultural and environmental aspects, the need to comprehensively synthesize existing research is paramount. The ELC emphasizes the intrinsic value of landscapes and their role in people's well-being and identity, making it crucial in safeguarding and enhancing the heritage of steel-industry-impacted areas. The European steel industry's rise

and decline often left behind significant landscapes and heritage sites that tell the story of communities and their economic history.

The impact of industrial pollution over public health is a complex and multidimensional issue. Epidemiological projects have traditionally emphasized the direct health consequences, but it is becoming increasingly apparent that socio-economic factors and community engagement play crucial roles in these investigations. The socio-economic fabric of communities can modulate the effects of industrial pollution. Populations with limited economic resources might lack access to health care or be affected by issues related to structural inequalities. Understanding these socio-economic determinants is crucial for a thorough grasp of the full spectrum of health effects. Local stakeholder and community engagement becomes pivotal to integrating these issues into MISTRAL, aligning the outcomes of the projects with the local stakeholder's and community's needs and demands.

6.2 MISTRAL Focus Group on systematic reviews

As it was described before, the systematic reviews should be undertaken by a team of experts in the topic area under review together with experience in systematic review methodology and statistical methods, ensuring at the same time, that all relevant perspectives will be considered. Performing systematic reviews in research teams ensures also apart obvious efforts spreading also minimizing the likelihood of errors as the selection of studies for eligibility, data extraction, and rating the certainty of the evidence is performed by at least two researchers independently [16].

To ensure these requirements in the MISTRAL project the Focus Group consisting of researchers representing various and adequate areas of expertise to cover all relevant perspectives of the investigated scientific topic in the MISTRAL project was established. The Focus Group consists of 15 experts representing 5 partners namely: APS PLANET (Italy), POLIBA (Italy), USUFF (United Kingdom), UOXF (United Kingdom), and AGH (Poland). These researchers represent the following areas of expertise: environmental science, health risk assessment, landscape, heritage, industrial urbanization, real estate appraisal and investment evaluation, social science and ethics, environmental justice, health geography, environmental and medical anthropology, health and lifestyle, and statistical methods. They also possess previous experience in performing systematic reviews. The details of the MISTRAL Focus Group on systematic reviews are presented in **Appendix 2**.

6.3 Previously EU-funded projects on environment and health risk factors

To summarize existing research and identify gaps in knowledge in the MISTRAL project we searched the previously funded by the European Commission projects in past and current framework programs until October 2023, when the search was performed using the CORDIS database. Projects, that based on their titles and abstracts were relevant with the environmental pollution/exposure and health effects/risk factors topics were placed on the list. The list of related previously funded EU-projects is presented in **Appendix 3**. Our search revealed 39 projects that according to the main project keyword were divided by us into the following six thematic groups: air pollution (16 projects), environmental health issues (10 projects), microplastic (5 projects), chemicals (4 projects), (electro)magnetic fields (3 projects), and occupational exposure (1 project).

The thematically related projects selected in this search will be further investigated during the project to explicit the knowledge obtained from already finished projects and to follow the discoveries from the ongoing

ones to incorporate the newest scientific findings in the related environmental health issues in our MISTRAL project.

6.4 Planned and performed systematic reviews

6.4.1 Air pollution exposure and related adverse health effects

As the topic of air pollution and negative health effects is very wide, to avoid thousands of results to be involved in the systematic review, we will narrow our search and focus on the key perspectives from the point of view of the MISTRAL project. Through these systematic reviews we would like to align a more focused approach related with specific air pollutant or with specific health effect. Specific systematic review to be performed in the MISTRAL project are as follows:

- **Airborne Particulate Matter Exposure and Adverse Health Effects**. In this systematic review we will specifically focus on negative health effects caused by air pollution, focusing on specifically on particulate matter (PM), as exposure to this pollutant is considered nowadays as the most hazardous air pollutant responsible for various toxic and carcinogenic health effects.
- **Air Pollutants and Ovarian Reserve: A systematic review of the evidence**. This systematic review evaluated the effect of major environmental pollutants (PM_1, $PM_{2.5}$, PM_{10}, NO_2, O_3, SO_2, CO, Polycyclic Aromatic Hydrocarbons (PAHs), Black Carbon (BC), 1,3-butadiene, benzene, diesel particulate matter, formaldehyde, methylene chloride, tetrachloroethylene) on female fertility expressed by recognized markers such as Anti-müllerian hormone (AMH) and antral follicle count (AFC).
- **Air Pollutants and Semen Quality: A systematic review of the evidence**. This research aimed to clarify the association between exposure to environmental fine particulate matter ($PM_{2.5}$) and decline in sperm quality.
- **Air Pollutants and Dementia**. Over 55 million individuals worldwide suffer from dementia, and this number is continually rising. There are, however, few therapies available to postpone or stop dementia from developing. Long-term ambient air pollution has been recognized as a potentially modifiable risk factor for dementia due to a body of research showing a link between air pollution exposure and heart disease, stroke, and, more recently, cognitive impairment. Studies have also demonstrated a link between lower mortality and lower amounts of air pollution. According to recent research, loudness may make dementia more likely. Research has demonstrated that oxidative, neuroendocrine, or neurovascular stressors linked to noise exposure can cause dementia. In addition, the World Health Organization carried out two reviews in 2018 that examined the impact of ambient noise on several aspects of wellness, life quality, and cognitive impairment. However, there is not still enough information regarding the relationship between dementia risk and noise exposure, particularly when combined with air pollution. The objective of this review of the scientific literature is therefore to investigate this potential association.

6.4.2 Landscape and heritage

Our Systematic Review on landscape and heritage offers a structured approach to identify, appraise, and amalgamate available studies, addressing the research gaps pertaining to these areas' preservation, conservation, and revitalization. By systematically reviewing the diverse range of research on steel industry-impacted regions, scholars can uncover the nuanced relationships between industrialization, landscape transformation, and heritage preservation.

Criteria

Drawing from the existing literature and the guidelines set by the Horizon Framework, we can establish some overarching inclusion and exclusion criteria for conducting this type of research. First and foremost, our research scope extends beyond academic literature alone; it also encompasses projects and initiatives documented on Cordis, providing a comprehensive overview of the current state of the art in Europe.

To identify and curate relevant studies and publications, we employ a cross-referencing strategy across five critical databases: Google Scholar, Scopus, Science Direct, and Web of Science. This multi-faceted approach allows us to refine and focus our research, particularly within the field of social sciences. It enables us to accumulate a substantial body of studies to serve as a solid foundational point for our investigation.

The process Involves collecting a significant quantity of research and ensuring that the gathered studies align with our research's specific objectives and criteria.

Typical Inclusion / Exclusion criteria include the year of publication (typically, a Systematic Review would involve studies no older than 15 years) and areas of interest, excluding elements related immediately to chemistry, engineering, or finance.

The other criteria still need to be defined rigorously. Still, in general, it is essential to establish clear guidelines to ensure the selection of relevant studies while excluding those that do not meet the specific objectives of the review. A first generic set of inclusion and exclusion criteria is shown below:

Inclusion Criteria:

Relevance to Landscape and Heritage: Studies must directly relate to the steel industry's impact on landscapes and heritage within affected areas. This includes but is not limited to, research on industrial landscapes, historical sites, cultural heritage, and environmental transformations resulting from steel industry activities.

Alignment with the European Landscape Convention (ELC): Where possible, studies should reflect the principles and goals of the ELC, emphasizing the significance of landscapes, their intrinsic value, and their role in cultural identity and well-being. This criterion ensures the selected research is in harmony with the ELC's values.

Interdisciplinary Approach: Inclusion criteria should encompass studies from various disciplines, such as history, archaeology, urban planning, environmental science, sociology, and cultural studies. The interdisciplinary nature of research contributes to a holistic understanding of the landscape and heritage in steel-industry-affected regions.

Exclusion Criteria:

Irrelevant Topics: Studies not directly related to the steel industry's impact on landscapes and heritage in affected areas should be excluded. This includes research on unrelated industries or regions.

Methodological Quality: Studies with poor methodology, inadequate data, or a lack of transparency should be excluded. Rigour and reliability are critical to the integrity of the review.

Geographical Relevance: Studies conducted in areas unaffected by the steel industry should be excluded. The focus should be on regions where steel industry activities have had a documented impact.

Non-English Language: For practical reasons, studies in languages other than English may be excluded due to limitations in translation resources. However, if translated summaries are available, exceptional cases of non-English studies with significant contributions may be considered.

Dissertations and Theses: While valuable, unpublished dissertations and theses may only be included if they provide unique and substantial insights into the topic. This criterion ensures that selected studies have undergone peer review.

Process

Conducting a systematic review is a meticulous and structured process involving several well-defined steps, each with its own potential controversies and challenges. In the context of research on Landscape and Heritage, encompassing publications, research projects, and best industry practices, the following steps are critical:

1. Definition of Main Research Areas and Nature of Subjects:

Before embarking on a systematic review, it's essential to clearly define the main research areas, in this case, Landscape and Heritage. Understand the nature of the subjects you're exploring, including publications, ongoing research projects, and notable industry examples. This step sets the stage for the entire process.

2. Identification:

The first step involves identifying relevant sources and data. Across multiple databases, you'll use generic search criteria, including keywords, prominent authors, and specific approaches, to cast a wide net and gather a broad range of materials. Potential controversy may arise when selecting the appropriate keywords and deciding on the comprehensiveness of your search strategy.

3. Screening:

In this phase, you'll sift through the collected materials to remove duplicates. Subsequently, a second set of criteria filters out the most relevant sources. Controversies may arise when determining what constitutes a duplicate or setting criteria for relevance.

4. Eligibility:

Full texts of the remaining sources are assessed for eligibility. This step is where potential controversy intensifies. Methodologically unsound studies, geographically irrelevant ones, or those with contentious findings may need to be excluded. The definition of 'methodologically unsound' or 'geographically irrelevant' can sometimes be debated among reviewers.

5. Inclusion:

The final stage before the systematic study begins is the inclusion of sources. New studies may be discovered while analyzing existing sources, which should be incorporated into the review. The challenge here is to ensure that the inclusion process remains consistent and transparent.

6. Results:

With a curated set of sources, the systematic study can commence. This stage involves identifying research gaps, facilitating evidence-based decision-making, preserving cultural identity, and exploring policy and planning implications. Potential controversies arise in interpreting and weighing the results, especially when multiple sources offer differing viewpoints.

7. Presentation:

The final product of the systematic review is presented to the audience. This presentation should include examples, case studies, and discussions on implementing policies and expected impacts. The controversy might lie in how the findings are interpreted and communicated and the potential implications for decision-makers.

Throughout this process, maintaining transparency and adherence to predefined criteria is essential to mitigate controversies. Additionally, involving multiple reviewers and conducting regular consensus meetings can help address potential disputes regarding study inclusion or exclusion, ensuring a robust and reliable systematic review in the field of Landscape and Heritage.

6.4.3 Real estate market and polluting industrial sites: analysis of the most influencing factors on the residential selling prices

Aim of the work

The aim of the systematic review is to i) investigate the existence of relationships between the real estate market and the presence of polluting sites in urban areas and then ii) analyze the typologies of the functional correlation (direct or inverse), in terms of the effects determined on the residential property prices. In particular, the work intends to verify if the real estate market can represent a proxy variable of all the different dynamics generated by polluting sources. The purpose of the review is to provide a systematic analysis of the national and international existent literature for identifying the socio-economic and environmental aspects that are mainly addressed for understanding the processes of property price's formation. Therefore, the work focuses on outlining a framework of the most relevant variables considered by the academic community for the study of the topic.

Methods

The systematic literature review is structured into 5 phases, as follows:

1) Questions formulation according to the purposes of the work;
2) Scopus and Google Scholar searching by keywords identification;
3) Research papers selection by considering the pre-established exclusion criteria;
4) Analysis and synthesis of the contents of the selected research papers;
5) Discussion and conclusion.

The first phase involves the development of two research questions in order to support and better guide the achievement of the research's purposes, indicated below:

Q1: Is it possible to detect a relationship between the real estate market dynamics and the presence of polluting sites?

Q2: Which variables' typology are mainly addressed for the real estate market's impacts due to the presence of the polluting sites?

The second phase concerns the identification of the databases to be consulted and the selection of the keywords to be used for collecting the research papers that meet the aims of the work. The considered databases are Scopus and Google Scholar, whereas the used keywords are: steel plants-real estate market-

environmental impact assessment-stated and revealed preferences-socio-economic data. The mentioned terms are initially applied for identifying papers by considering the Title, the abstract and the keywords.

The third phase applies the exclusion criteria in order to obtain those research papers that are consistent with the aims of the work: so, papers lacking this affinity are excluded. Therefore, the established exclusion criteria relate to i) the language (only English language), ii) the open access reading (only papers with accessible full text) and iii) the consistency with the research questions Q1 and Q2. The application of the exclusion criteria has allowed to acquire a dataset currently composed by 57 research papers.

The fourth phase regards the analysis of the contents of the final set of research papers from the following point of view: goals, type of variables and modalities for the determination, methodology used for the analysis related to real estate market dynamics.

In the fifth phase the discussions of the partial contents' analysis and the conclusions of the work are currently provided.

Partial results

Regarding the analysis of the variables included in the research papers, 167 variables are identified and divided into 3 categories according to the issue that the variable intends to represent. The developed categories are named as follows: i) real estate characteristics, ii) socio-economic issue, iii) environmental aspects.

The real estate characteristics category can be articulated into two sub-categories: intrinsic (i.e. those factors that concern the specific property's features) and extrinsic variables (i.e. those factors that describe the infrastructural, environmental, and social qualification of the surrounding context in which the properties are located). Among the intrinsic ones, the most detected are, for example: i) the unit and/or total sale price of the property, ii) the surface area of the dwelling, iii) the age of the property and iv) the number of bathrooms and bedrooms. In the same way, the most frequently found extrinsic characteristics are, for example: the distance of the properties from i) the nearest green area, ii) the central business districts and iii) the nearest public transport stops.

The socio-economic issue category includes the variables used by the Authors to study the population conditions of the specific geographical context analyzed. The most frequently used variables retrieved in the examined research papers are: i) the income level, ii) the age of the citizens, iii) the number of household members, iv) the unemployment rate.

The category regarding the environmental aspects considers all the variables that aim to investigate the effects caused by the presence of a polluting sites in the reference context. For example, the most recurrent variable is the distance between the property and the polluting site, expressed in kilometers. Other environmental variables, instead, aim to assess the air quality in terms of amount of ozone, carbon monoxide, nitrogen oxides and other pathogens considered dangerous to the human health. It is also possible to note that, according to the features of the polluting site, specific environmental factors are found in the consulted literature. For instance, by analyzing the relationship between incinerators and property values, the considered environmental variables relate to emissions level and air quality degree. Several other studies, for example on the impact of leaking underground oil storage tanks and the effect of this phenomenon on housing prices, include variables that measure the contamination of soil, surface water and groundwater.

The analysis of the papers also reveals that, generally, the common methodology Implemented for assessing the most influencing variables on the residential selling prices is the Hedonic Price method. This allows to

determine the implicit price of a characteristic to be estimated by considering its effect on the real estate price by using a regression technique.

Future steps and expected results.

Future insights of the work will concern the possibility to widen the set of research papers that focus on the topic of the systematic review in order to obtain a more exhaustive and representative framework of the dynamics inherent to the relationships between the real estate market and the presence of polluting sites in different territorial contexts. Furthermore, the expected results concern the possibility of providing a systematized synthesis of what has been found in the literature which is consistent with the aims of the MISTRAL project, with the purpose to provide an adequate decision-making support within the development of sustainable territorial policies.

6.4.4. Local stakeholders and community engagement

Engaging the community ensures a collaborative approach, fostering trust between researchers and the public. In areas affected by industrial pollution, there might be mistrust towards authorities or industries. Actively involving the community can mitigate these barriers, ensuring smoother research processes and more accurate data collection. Participatory methods in research can yield rich qualitative data, offering insights into lived experiences, perceptions, and local narratives. This complements quantitative epidemiological data, providing a fuller picture of the impacts of pollution. Engaging with the community is not just a research tool but also an empowerment strategy. Through participation, communities can voice their concerns, be informed about their risks, and actively contribute to potential solutions.

Recommendations and interventions derived from research that considers socio-economic factors and is rooted in community engagement are more likely to be contextually relevant. They are also more likely to gain public acceptance, making their implementation more effective. For this reason, the literature review proposed considers socio-economic aspects and community engagement not as mere adjuncts but central to the effectiveness, relevance, and ethical grounding of the MISTRAL project.

Aims

This literature review will take an integrative approach to critically review and potentially reconceptualize strategies for local stakeholder and community engagement. Integrative literature reviews are an alternative to systematic approaches prioritizing in-depth engagement with the text and the production of critical insights, fitting better the structural heterogeneity of research outputs of qualitative social science [25]. This systematic review will explore how qualitative and participatory methods have been used to facilitate the engagement of local populations with research on their exposure and response to pollution. Focusing on the European context, and on work undertaken in urban industrial areas, we aim to identify (i) the range of different qualitative and participatory methods which have been applied; (ii) the strengths and limitations of these methods; the extent of existing work in this area; and where there is scope for the MISTRAL project to make a significant novel contribution.

Approach

We will iteratively refine a list of inclusion and exclusion criteria which we will use to identify relevant research outputs in four key databases: Scopus, Web of Science, PubMed, Google Scholar. Through this database exploration, our aim is to generate a comprehensive but manageable dataset of around 50 key papers in this field. In order to narrow down our search, inclusion and exclusion criteria will be applied to our search, based on but not limited to the following:

Must include the following terms:	Must exclude the following terms:
Europe	Quantitative methods
Participatory methods	
Stakeholder Engagement	
Community	
Industrial pollution	
Environmental Health	
Qualitative methods	

Papers will be reviewed and classified in terms of approach, strengths, limitations, and contributions. This will then be cross-referenced with our existing database of relevant research in this field (which takes a more global perspective) to identify further gaps and omissions in terms of work done in the European context.

Anticipated Contribution to the Mistral Project

Critical review: An integrative review of the range of methods used for community and participatory engagement around experiences of industrial pollution and citizen involvement in scientific research on industrial pollution in Europe, which we would aim to publish in *Progress in Environmental Geography* or a similar journal.

Insight provision: Offer a clear picture of the present work involving stakeholder and community engagement approaches within the European urban industrial scenario.

Recommendations: Suggest methodologies that the MISTRAL project should consider for efficient local community and stakeholder involvement.

Contribution Identification: Pinpoint areas where MISTRAL's findings can augment the existing academic conversation about participatory research. This includes insights on community/stakeholder engagement in scientific/medical research, and discussions on industrial pollution experiences and challenges.

6.5 Expected outcomes

Expected outcomes of performing systematic reviews in the MISTRAL project will be to review, exploit, and systematize the latest evidence of exposure-response functions and causation resulting from published medical and scientific research accumulated data from the past 10-20 years, including results published based on EU-funded research projects. Based on these activities, the gaps in the knowledge on the environment and health risk factors will be identified.

Next, the identified gaps in the environment and health risk factors and health-related tangible and intangible costs will be gathered and used to formulate a list of recommendations on priorities for new data collections in our WP3) entitled *Feature Engineering, Studies' Coordination & Data Collections in three case studies*.

7 Conclusions and next steps

The *Systematic review and evidence synthesis* report being the Deliverable 4.7 of the MISTRAL project presents the clear and the coherent pathway of performing activities on investigating the existing knowledge through evidence synthesis to obtain the aims of the WP4 T4.1. *Systematic Reviews, Identification of Data Gaps and Recommendations on priorities for new data collections* within the lifespan of the project.

In terms of previously funded EU-projects in the next months the already reported findings as well as outcomes of the finished projects will be investigated, and the significant findings will be incorporated in the MISTRAL project if relevant.

The results of systematic reviews, performed in our MISTRAL project, will be demonstrated and the key-finding will be used during the next months in the relevant parts of the project.

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9 Appendices

Appendix 1. METEOR – Workshop on Systematic Reviews in Environmental Health program

METEOR – Workshop on Systematic Reviews in Environmental Health

Venue

Aarhus University, The Climate Chambers, Building 1181, Ole Worms Allé 6, 8000 Aarhus C

Need help?

Contact Jörg Schullehner (jorg.schullehner@ph.au.dk), +45 20595188

PROGRAMME

The programme consists of lectures and hands-on exercises and group work.

Monday, June 26

09:00-09:45	Welcome & Introduction to METEOR by MARCHES PI Mikael Skou Andersen
09:45-10:15	Systematic reviews in the knowledge translation cycle
10:15-10:30	Coffee break
10:30-12:00	Protocol development
12:00-12:45	Lunch break
12:45-16:00	Searches of the literature, databases, library support and software (coffee break in between)

Tuesday, June 27

09:00-10:00	Relevance and Inclusion
10:00-12:00	Data extraction (coffee break in between)
12:00-12:45	Lunch break
12:45-16:00	Risk of bias (Tour of the Climate Chambers and coffee break in between)
18:00	Dinner at ARoS Café and Orangery, Aros Allé 2, 8000 Aarhus C

Wednesday, June 28

09:00-11:00	Analyses (coffee break in between)
11:00-12:00	GRADEing the evidence
12:00-12:45	Lunch break
12:45-13:15	Implications
13:15-14:00	Continue GRADEing the evidence exercise
14:00-15:00	Wrap-up and next steps

Appendix 2. MISTRAL Focus Group on systematic reviews

No.	Expert	Affiliation	Area of expertise	Systematic review
1.	Dr hab. Eng., Prof. AGH Agnieszka Gruszecka-Kosowska	AGH University of Krakow (AGH) Faculty of Geology, Geophysics and Environmental Protection Department of Environmental Protection	Environmental pollution, health risk assessment, environmental exposure, One Health approach	Air pollution exposure and related adverse health effects: - Air Pollutants and Semen Quality: A systematic review of the evidence - Air Pollutants and Ovarian Reserve: A systematic review of the evidence - Air Pollutants, noise, and Dementia - Airborne particulate matter exposure and adverse health effects
2.	MSc Agata Wódkowska			
3.	PhD Eng. Ilaria Bortone	APS Public Health, Environment, and Social Equity – PLANET	Health and lifestyle	
4.	MSc Luisa Lampignano			
5.	MSc Roberta Zupo			
6.	MSc Fabio Castellana			
7.	Dr, ARB, SFHEA Marco Spada	University of Suffolk (USUFF) School of Technology, Business and Arts	Landscape, Heritage, Industrial Urbanization	Policies of Access to Landscape in Heavy-Industrialized areas
8.	Prof. Eng. Pierlugi Morano	Polytechnic University of Bari (POLIBA) Polytechnic Department of Civil, Environmental, Territorial, Construction and Chemical Engineering	Real Estate Appraisal and Investment Evaluation	Real estate market and polluting industrial sites: analysis of the most influencing factors on residential selling prices
9.	Prof. Eng. Marco Locurcio			
10.	Prof. Arch.Debora Anelli			
11.	Prof. Arch. Felicia Di Liddo			
12.	Prof. Beth Greenhough	University of Oxford (UOXF) School of Geography and the Environment	Social science and ethics, environmental justice, health geography, environmental and medical anthropology	Local stakeholder and community engagement
13.	Dr Raffaele Ippolito			
14.	Dr Maaret Jokela-Pansini			
15.	Prof Anna Lora-Wainwright			

Appendix 3. Previously EU-funded projects on environment and health risk factors

No.	Project Acronym	Title	Website	Financing	Status finished (F)/ ongoing (O)
Air pollution					
1	APHENA	Air Pollution and Health: A Combined European and North American Approach	https://cordis.europa.eu/project/id/QLK4-CT-2002-30226	FP5	F
2	CHAI	Cardiovascular Health Effects of Air Pollution in Andhra Pradesh, India	https://cordis.europa.eu/project/id/336167	ERC	F
3	EDIAQI	Evidence Driven Indoor Air Quality Improvement	https://cordis.europa.eu/project/id/101057497	HORIZON EUROPE	O
4	ENVIE	Co-Ordination Action on Indoor Air Quality and Health Effects	https://cordis.europa.eu/project/id/502671	FP6	F
5	ESCAPE	European Study of Cohorts for Air Pollution Effects	https://cordis.europa.eu/project/id/211250	FP7	F
6	EXHAUSTION	Exposure to Heat and Air Pollution in Europe – Cardiopulmonary Impacts and Benefits Of Mitigation and Adaptation	https://cordis.europa.eu/project/id/820655	HORIZON 2020	O
7	ICARUS	Integrated Climate Forcing and Air Pollution Reduction in Urban Systems	https://icarus2020.eu/focus-areas/	HORIZON 2020	F
8	INCHILDHEALTH	Identifying Determinants for Indoor Air Quality and Their Health Impact in Environments for Children: Measures to Improve Indoor Air Quality and Reduce Disease Burdens	https://cordis.europa.eu/project/id/101056883	HORIZON EUROPE	O
9	INQUIRE	Identification of Chemical and Biological Determinants, Their	https://cordis.europa.eu/project/id/101057499	HORIZON EUROPE	O

		Sources, and Strategies to Promote Healthier Homes in Europe			
10	K-HEALTHinAIR	Knowledge for Improving Indoor AIR Quality and HEALTH	https://cordis.europa.eu/project/id/101057693	HORIZON EUROPE	O
11	LEARN	Development of Novel Assessments for Indoor Air Quality Monitoring and Impact on Children's Health	https://cordis.europa.eu/project/id/101057510	HORIZON EUROPE	O
12	MARCHES	Methodologies for Assessing the Real Costs to Health of Environmental Stressors	https://cordis.europa.eu/project/id/101095430	HORIZON EUROPE	O
13	REMEDIA	Impact of Exposome on the Course of Lung Diseases	https://h2020-remedia.eu/	HORIZON 2020	O
14	SynAir-G	Disrupting Noxious Synergies of Indoor Air Pollutants and Their Impact in Childhood Health and Wellbeing, Using Advanced Intelligent Multisensing and Green Interventions	https://cordis.europa.eu/project/id/101057271	HORIZON EUROPE	O
15	TackSHS	Tackling Secondhand Tobacco Smoke and E-Cigarette Emissions: Exposure Assessment, Novel Interventions, Impact on Lung Diseases And Economic Burden in Diverse European Populations	https://www.tackshs.eu/	HORIZON 2020	F
16	TwinAIR	Digital Twins Enabled Indoor Air Quality Management for Healthy Living	https://cordis.europa.eu/project/id/101057779	HORIZON EUROPE	O
Environmental Health Issues					
17	APPARHU	The Effects of Air Pollution and Physical Activity on Respiratory Health in Children in The Context of Urbanization	https://www.projecthelix.eu/	HORIZON 2020	F

18	ATHLETE	Advancing Tools for Human Early Lifecourse Exposome Research and Translation	https://athleteproject.eu/	HORIZON 2020	O
19	BEST-COST	Burden of Disease Based Methods for Estimating the Socio-Economic Cost of Environmental Stressors	https://cordis.europa.eu/project/id/101095408	HORIZON EUROPE	O
20	CATALYSE	Climate Action to Advance Healthy Societies in Europe	https://cordis.europa.eu/project/id/101057131	HORIZON EUROPE	O
21	FRESHER	Foresight and Modelling for European Health Policy and Regulation	https://www.foresight-fresher.eu/	HORIZON 2020	F
22	HBM4EU	European Human Biomonitoring Initiative	https://www.hbm4eu.eu/what-we-do/exposure-and-health/	HORIZON 2020	F
23	MARCHES	Methodologies for Assessing the Real Costs to Health of Environmental Stressors	https://cordis.europa.eu/project/id/101095430	HORIZON EUROPE	O
24	TRIGGER	Solutions for Mitigating Climate-Induced Health Treaths	https://cordis.europa.eu/project/id/101057739	HORIZON EUROPE	O
25	UBDPOLICY	The Urban Burden of Disease Estimation for Policy Making	https://cordis.europa.eu/project/id/101094639	HORIZON EUROPE	O
26	VALESOR	Valuation of Environmental Stressors	https://cordis.europa.eu/project/id/101095611	HORIZON EUROPE	O
Occupational Exposure					
27	EPHOR	Exposome Project for Health and Occupational Research	https://www.ephor-project.eu/	HORIZON 2020	O
Electromagnetic Fields					
28	ETAIN	Exposure to Electromagnetic Fields and Planetary Health	https://cordis.europa.eu/project/id/101057216	HORIZON EUROPE	O
29	GOLIAT	5G Exposure, Causal Effects, And Risk Perception Through Citizen Engagement	https://cordis.europa.eu/project/id/101057262	HORIZON EUROPE	O

30	SEAWave	Scientific-Based Exposure and Risk Assessment of Radiofrequency and Mm-Wave Systems from Children to Elderly (5G and Beyond)	https://cordis.europa.eu/project/id/101057622	HORIZON EUROPE	O
Microplastic					
31	AURORA	Actionable European Roadmap for Early-Life Health Risk Assessment of Micro- and Nanoplastics	https://auroraresearch.eu/	HORIZON 2020	O
32	IMPTOX	Innovation in Research on Micro- and Nanoplastics and Their Effects on Human Health	http://www.imptox.eu/	HORIZON 2020	O
33	PLASTICHEAL	Innovative Tools to Study the Impact and Mode of Action of Micro and Nanoplastics on Human Health: Towards a Knowledge Base for Risk Assessment	https://www.plasticheal.eu/en	HORIZON 2020	O
34	PLASTICSFATE	An Innovative Analytical Platform to Investigate the Effect and Toxicity of Micro and Nano Plastics Combined with Environmental Contaminants on the Risk of Allergic Disease in Preclinical and Clinical	https://www.plasticsfate.eu/	HORIZON 2020	O
35	POLYRISK	Understanding Human Exposure and Health Hazard of Micro- and Nanoplastic Contaminants in Our Environment	https://polyrisk.science/	HORIZON 2020	O
Chemicals					
36	EDC-MixRisk	Integrating Epidemiology and Experimental Biology to Improve Risk Assessment of Exposure to Mixtures of Endocrine Disruptive Compounds	https://edcmixrisk.ki.se/	HORIZON 2020	O

37	FRANKIE	Impact of Exposure to Chemicals to the Onset and Progression of Lewy Body Dementia	https://cordis.europa.eu/project/id/101130769	HORIZON EUROPE	O
38	PARC	Partnership for the Assessment of Risks from Chemicals	https://www.eu-parc.eu/	HORIZON EUROPE	O
39	SPRINT	Sustainable Plant Protection Transition: A Global Health Approach	https://sprint-h2020.eu/	HORIZON 2020	O