



The social dimension of air quality community work: a core complement to green and digital skills

Leonardo Triana¹ · Helinä Melkas¹ · Anne Pässilä¹ · Eugenio Morello² · Mikko Happonen³

Received: 6 March 2026 / Accepted: 14 July 2026
© The Author(s) 2026

Abstract

Community-engaged air quality research increasingly requires environmental, digital and social competences, yet skill classifications make social competences less visible than green and digital skills. This study was conducted to clarify the integrated competence profile needed for community-based air quality work and to assess whether the European Skills, Competences, Qualifications and Occupations taxonomy (ESCO) adequately represents that profile. It asks: (1) Which green, digital and social skills appear as emerging, episodic, expanding core and established core skills in community-based air quality work? and (2) Which gaps in existing skill classifications become visible when this work is analysed through ESCO? We analysed 169 full-text articles published from 2015 to 2025 on air quality or air pollution projects involving public, citizen or community engagement. Action-oriented sentences were extracted through a reproducible text-mining workflow and mapped to ESCO using sentence-embedding similarity. Yearly skill frequencies were then used to classify skills by temporal consistency and growth. Results show that expanding core green skills combine air quality management, pollution-prevention advice and behaviour-change functions. Expanding core digital skills support sensing, mapping, research data management and visual communication. Social skills expand around citizen participation, inclusion, community outreach, participatory research and science–policy mediation. The corpus is predominantly participatory and social rather than narrowly technical, indicating that community air quality work depends on relational competences that help make green and digital interventions trusted, meaningful and actionable. The analysis also identifies limits in ESCO: social skills are not organised as a dedicated category comparable to green and digital skills, and AI-related actions are insufficiently described for specialised air quality methods. We argue that skill taxonomies should better represent social, hybrid digital–social and AI-related competences in environmental practice.

Keywords Air quality · Community engagement · Green skills · Digital skills · Social skills · ESCO · Citizen science · Artificial intelligence

Introduction

Air pollution remains a major environmental health threat, and its control increasingly depends on active public engagement alongside regulatory and technical measures (Jha et al. 2025; Chowdhury et al. 2024). Historically, air quality governance relied on expensive fixed monitoring networks and

technocratic, top-down planning. These approaches generated important technical evidence, but they often positioned citizens as data recipients rather than as actors able to shape monitoring priorities, interpret local exposure conditions or influence long-term strategies (Schulte et al. 2025; Ma et al. 2025).

Early community initiatives and first-generation citizen science projects demonstrated that residents could mobilise measurements, complaints and local knowledge to pressure authorities. However, many of these initiatives remained embedded in expert-led systems where professionals retained control over agendas, interpretation and policy engagement (Okello et al. 2020; van Brussel and Huyse 2019; Gignac et al. 2022; Mahajan et al. 2020). More recent work argues that effective air quality interventions

✉ Leonardo Triana
leonardo.triana.cuesta@lut.fi

¹ Lappeenranta-Lahti University of Technology LUT,
Mukkulanankatu 19, Lahti, Finland

² Politecnico di Milano, via Bonardi 3, Milano, Italy

³ Ramboll Finland Oy, Puutarhakatu 9, Kuopio, Finland

must combine low-cost sensing, digital platforms and environmental expertise with attention to social perceptions, unequal capacities, power relations and community trust (Mahajan et al. 2021; Schaefer et al. 2020; Chatzidiakou et al. 2023; Saligari et al. 2025; Mora et al. 2023).

This study focuses on three interrelated skill domains. Green skills refer to knowledge, abilities, values and attitudes that support environmental protection, pollution reduction and sustainable behaviour, such as advising on pollution prevention, managing air quality, encouraging cleaner mobility or promoting environmental awareness (Cedefop, 2012). Digital skills refer to abilities required to use digital technologies for data collection, analysis, communication, modelling and collaboration, such as working with sensors, geographic information systems, dashboards or mobile health tools (Audrin et al. 2024). Social skills refer to abilities for reading, understanding and managing social interactions, including participation, communication, inclusion, trust-building, stakeholder engagement and conflict-sensitive collaboration (Sekiguchi et al. 2017).

Green and digital skills are most effective when anchored in social competences. Low-cost sensors, GIS maps and exposure dashboards may produce valuable data, but communities are more likely to use and trust these tools when they are introduced through inclusive engagement, transparent communication and sensitivity to local priorities. Similarly, pollution-prevention advice is more likely to result in behaviour change when it is communicated through trusted relationships and adapted to social, cultural and economic realities. Social competences are therefore not peripheral to air quality work. They shape whether technical evidence becomes legitimate, actionable and meaningful for affected communities.

Formal recognition of these competences matters because skill classifications influence how competences are named, taught, valued and measured in education, employment and policy systems. The European Skills, Competences, Qualifications and Occupations taxonomy (ESCO) is a European multilingual classification that provides standardised terminology for skills and occupations (European Commission, 2017; le Vrang et al. 2014). Although ESCO is European in origin, it provides a structured reference vocabulary that is useful for international skill analysis. ESCO explicitly identifies green and digital skills, but it does not provide an equivalent structured category for social skills. This matters because community-based air quality work depends heavily on relational competences such as facilitation, trust-building, inclusive communication, advocacy and collaborative problem-solving.

Community-based air quality practice therefore sits at the intersection of technological, behavioural and governance innovation. Green competences connect clean-air objectives

with urban planning, transport, emission reduction, environmental education and health planning; digital competences support low-cost sensing, mobile monitoring, geographic information systems, dashboards and community-generated datasets; and social competences enable residents, researchers, authorities and practitioners to co-define problems, interpret evidence and act on local priorities. Recent research similarly argues that air quality management and digital social innovation should not be treated as separate silos, because effective interventions depend on convergent themes of participation, knowledge co-production, data mediation and collaborative governance (Triana et al. 2026). This integrated perspective is especially important in environmental-justice settings, where organising, negotiation, advocacy and trusted communication can determine whether evidence influences land-use, transport and industrial decisions.

To make the temporal classification accessible, this study distinguishes four types of skills. Expanding core skills are skills that appear consistently across the corpus and increase over time. Established core skills are skills that appear consistently but do not show positive growth. Emerging skills appear less consistently but show positive growth. Episodic skills appear irregularly and do not show positive growth, often because they are tied to specific cases, events or contexts.

The study addresses two research questions:

1. Which green, digital and social skills appear as emerging, episodic, expanding core and established core skills in community-based air quality work?
2. Which gaps in existing skill classifications become visible when community-based air quality work is analysed through ESCO?

The study analyses 169 full-text articles on community participation in air quality and air pollution research between 2015 and 2025. It combines text mining, semantic similarity mapping and temporal frequency analysis to identify skill dynamics across green, digital and social domains. The results inform education, professional development and policy design by showing that community-based air quality work requires integrated competence profiles rather than isolated technical abilities.

Materials and methods

Data

The study is based on scientific articles indexed in Scopus and Web of Science. These databases were selected because they provide broad and complementary coverage of environmental science, public health, urban studies, citizen

science and social-science research. The search was conducted on 4 November 2025 and aimed to identify cases, projects, programmes, pilots, interventions or deployments involving public, citizen or community engagement in air quality or air pollution issues.

The search strategy required “air quality” or “air pollution” in the article title to ensure primary subject relevance. Terms related to public, citizen or community engagement, involvement or participation were included in the title, abstract or keywords to capture participatory dimensions. Additional terms such as “case”, “project”, “programme”, “pilot”, “intervention”, “implementation”, “deployment” and “empirical” were used to focus the corpus on applied and empirical work. Only research articles published in English were included, ensuring a consistent corpus for automated text mining.

Records retrieved from Scopus and Web of Science were merged and deduplicated, resulting in 235 distinct documents. The dataset was then filtered to include only articles published between 2015 and 2025, yielding 184 records. Finally, only documents for which the full PDF could be obtained were included, resulting in a final corpus of 169 full-text articles. The data collection and filtering process is summarised in Fig. 1.

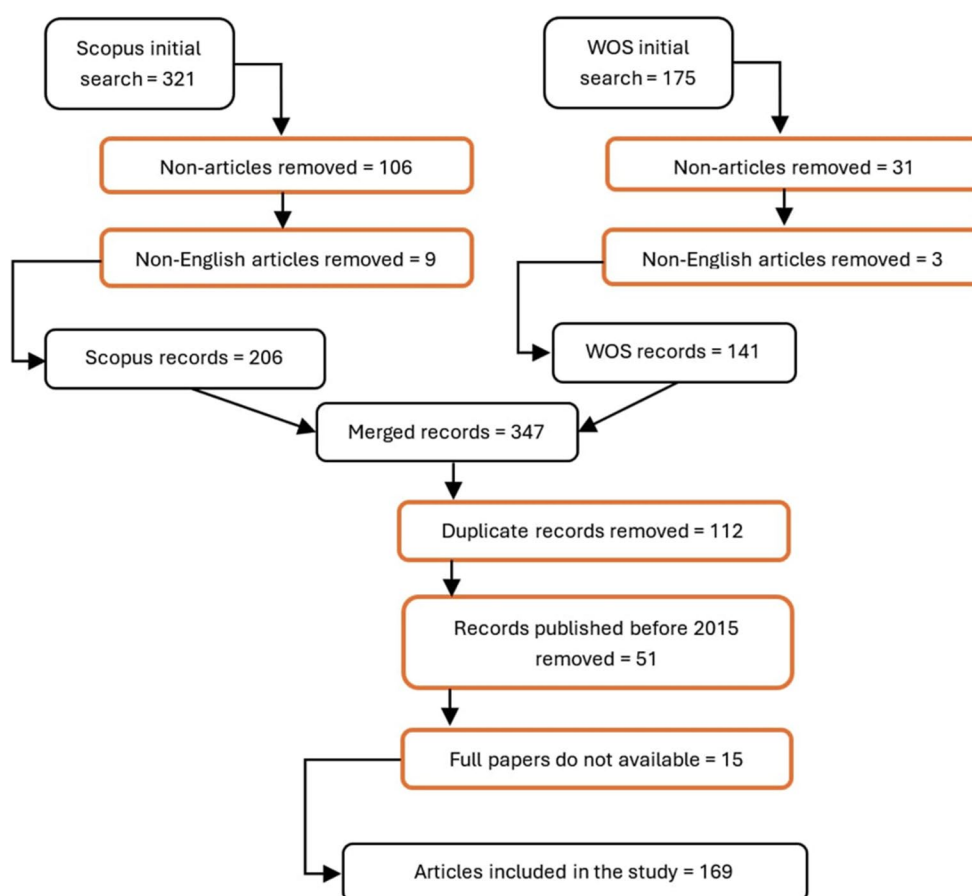
The sentence–skill export used for the analysis contains 42,101 retained sentence–skill matches, 169 unique PDF identifiers, 146 author-name identifiers, 11 publication years and 3,628 unique ESCO skill labels. Because the search strategy intentionally targeted public, citizen and community engagement, the corpus is expected to be predominantly social and participatory rather than representative of the full technical air quality literature. Supplementary information about the corpus and its characteristics is included in Appendix A.

Text extraction and sentence selection

Full-text PDFs were processed using a Python workflow. The workflow extracted text in reading order, handled single- and multi-column layouts where possible and removed common artefacts such as headers, footers, page numbers, URLs, DOIs and figure or table captions. Basic de-hyphenation across line breaks was applied, and duplicate headers and footers were removed.

The cleaned text was segmented into sentences. To focus on action-oriented or functionally meaningful text, sentences were retained when they were sufficiently long, contained a plausible action or process and were not obvious

Fig. 1 Data collection and filtering process for the literature corpus



references, captions, metadata or broken extraction fragments. The retained sentences therefore represent textual descriptions of what actors, projects, institutions or communities did in the air quality cases.

Because PDF extraction can introduce errors, the workflow included spot-checking of extracted text for a subset of documents across publication years and document layouts. This quality check was used to identify common extraction artefacts and to refine cleaning rules before final skill mapping.

ESCO skill mapping

The retained sentences were mapped to ESCO skills using semantic similarity. Sentence embeddings were generated for each retained sentence using the SentenceTransformers model *all-mpnet-base-v2* (Reimers and Gurevych 2019). ESCO skill embeddings were generated from each skill's preferred label and description. Cosine similarity was then used to identify the most similar ESCO skills for each sentence (Erkan and Radev 2004). For each sentence, the top three ESCO matches were retained when their similarity score met the minimum threshold of approximately 0.50.

The sentence–skill export contains similarity scores ranging from approximately 0.50 to 0.883, with an average similarity of approximately 0.552. The most frequent labels in the analytical export include “advise on pollution prevention”, “urban pollution implications”, “pollution legislation”, “adopt ways to reduce pollution”, “manage air quality”, “engage others in environment friendly behaviours” and “promote the participation of citizens in scientific and research activities”.

Validation and quality assurance of sentence–skill mapping

Because the analysis relies on semantic matching between article sentences and ESCO skill labels, a manual validation step was included to assess the plausibility of the automated mapping. A stratified sample of sentence–skill pairs was selected across skill domains, publication years, similarity-score bands and temporal categories. The score bands included low accepted matches close to the threshold, intermediate matches and high-similarity matches. This allowed the validation to test not only the strongest matches but also cases where semantic ambiguity was more likely.

The validation was used as a quality-assurance step rather than as a replacement for the automated procedure. It helped identify recurrent sources of uncertainty, including broad ESCO labels, sentences describing multiple actions and community-based actions that were only partially represented in ESCO. These issues are considered in the interpretation of the results and in the limitations section.

Identification and coding of green, digital and social skills

Green and digital skills were identified using ESCO's own green and digital classifications where available. The identification of social skills required an additional coding step because ESCO does not provide a dedicated social-skills category comparable to its green and digital classifications.

The procedure therefore differed across skill domains. First, all retained action-oriented sentences were mapped to ESCO skill labels through the same semantic-similarity procedure used for the full skill set. Second, ESCO's own green and digital classifications were used to identify green and digital skills. Third, the authors manually reviewed the ESCO-matched skill labels and coded as social those labels that reflected competences for managing social interaction, participation, communication, inclusion, stakeholder engagement, trust-building, advocacy, mediation or community outreach.

Social skills were therefore not created as new non-ESCO labels in the primary analysis. Rather, they were ESCO skill labels with social content that were manually identified because ESCO does not group them under a formal social-skills category. Examples include “promote the participation of citizens in scientific and research activities”, “integrate community outreach”, “promote inclusion”, “communicate with stakeholders”, “work with different target groups” and “manage relationships with stakeholders”. In contrast, labels such as “analyse environmental data” or “use geographic information systems” were not coded as social, even when they appeared in participatory studies, because the ESCO label itself refers primarily to technical or digital action.

Disagreements most often concerned labels that combined social, health-policy and technical dimensions. For example, “advise policy makers in healthcare” was debated because it is formally a health-policy label, but it was coded as social when it represented the translation of air quality evidence into policy or public-health action. Disagreements were resolved by applying the definition consistently: a label was coded as social only when its primary competence involved interaction among people, groups, institutions or communities.

To reduce the risk of missing social competences not well represented by ESCO, the validation also considered excluded or low-similarity sentences and ambiguous cases. This check was important because some socially important actions, such as informal trust-building, emotional labour, conflict management or culturally specific facilitation, may be described in ways that do not map closely to existing ESCO labels. These cases were not added as new skill labels in the main quantitative analysis, because doing so would

have reduced comparability with ESCO-based green and digital classifications. Instead, they are discussed as evidence that ESCO may under-represent social competences in community-based environmental work.

Quantifying skill importance and temporal dynamics

For each skill, yearly frequencies were calculated by counting the number of retained sentence–skill matches for each publication year. A skill was considered present in a year when its yearly frequency was greater than zero.

Temporal consistency was measured using a temporal consistency index, abbreviated as TCI. The TCI combines two dimensions: repeated presence across years and low variability in yearly frequency. First, yearly presence was calculated as:

$$R = \frac{\text{number of years in which the skill is present}}{T}$$

where T is the total number of years in the analysis.

Second, frequency variability was calculated using the coefficient of variation:

$$V = \min\left(1, \frac{\sigma}{\mu}\right)$$

where μ is the mean yearly frequency and σ is the standard deviation of yearly frequencies. This value was capped at 1 so that very high variability did not dominate the index. Because the classification requires a measure where higher values indicate greater consistency, the inverse variability score was calculated as:

$$C = 1 - V$$

The temporal consistency index was then calculated as:

$$TCI = 0.5R + 0.5C$$

A TCI close to 1 indicates that a skill appears repeatedly and with relatively low yearly variability. A TCI close to 0 indicates that a skill appears irregularly or only in isolated years. In the figures, the x-axis is labelled as “Temporal consistency index, TCI: variable or episodic → persistent and stable”.

Growth was estimated using a log-linear model of yearly frequencies:

$$\ln(v_t) = \alpha + \beta t$$

where v_t is the yearly frequency of a skill in year t . The implied annual growth rate was calculated as:

$$g = (e^\beta - 1) \times 100\%$$

Skills were then classified into four categories:

1. Emerging skills: low TCI and positive growth.
2. Episodic skills: low TCI and non-positive growth.
3. Expanding core skills: high TCI and positive growth.
4. Established core skills: high TCI and non-positive growth.

In this study, core refers to skills with $TCI \geq 0.5$, meaning that they appear with sufficient temporal consistency to be considered recurring features of the corpus. Skills with $TCI < 0.5$ are less temporally consistent and are interpreted as emerging or episodic depending on their growth rate.

Findings

Green skill dynamics

The green skills analysis shows that community-based air quality work combines technical environmental management with behaviour-change and advisory competences. The four-quadrant classification of green skills is presented in Fig. 2.

Expanding core green skills include “advise on pollution prevention”, “manage air quality”, “adopt ways to reduce pollution”, “engage others in environment friendly behaviours”, “measure pollution”, “test samples for pollutants” and “analyse environmental data”. These skills show that air quality work is not limited to measuring pollutants or complying with standards. It increasingly involves helping communities, organisations and local authorities understand pollution sources, interpret evidence and adopt cleaner behaviours.

Advisory skills related to pollution prevention and carbon-emissions reduction connect technical knowledge with practical recommendations, while behavioural skills such as engaging others in environmentally friendly behaviours translate environmental knowledge into collective action. “Advise on pollution prevention” and “manage air quality” form the technical backbone of the green-skill profile, while “adopt ways to reduce pollution” and “engage others in environment friendly behaviours” show the increasing importance of behaviour change.

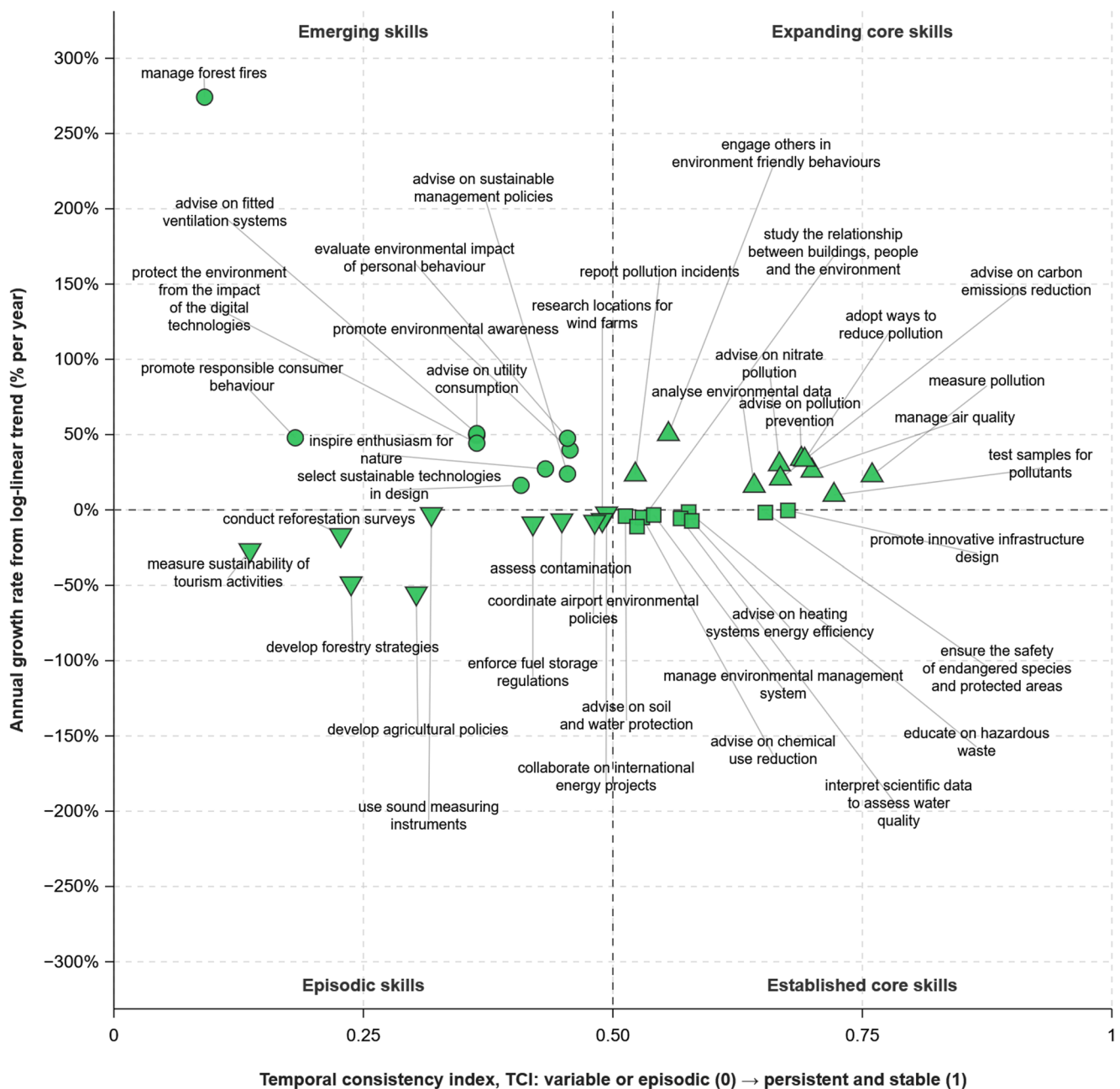


Fig. 2 Four-quadrant model for green skills trend classification

Emerging green skills include “promote environmental awareness”, “evaluate environmental impact of personal behaviour”, “promote responsible consumer behaviour” and “advise on utility consumption”. These skills reflect the increasing connection between air quality, household energy choices, mobility, consumption, education and everyday environmental practices.

Some green skills identified in the corpus are not explicitly air-pollution-specific, including labels related to nature enthusiasm, responsible consumption, forestry, agriculture or

broader environmental awareness. These should not be interpreted as errors in the analysis. Rather, they reflect the fact that community-based air quality work often appears within broader environmental, educational and urban-sustainability initiatives. Air pollution projects may be connected to school-based environmental education, active travel, urban greening, household energy use, wildfire smoke, agricultural emissions, vegetation planning or nature-based solutions. ESCO may therefore map some sentences to broader environmental skills even when the motivating case is air quality or air pollution.

Episodic green skills include skills connected to specific events, policy domains or environmental contexts, such as wildfire management, forestry strategies, agricultural policies or contamination assessment. These appear irregularly because some air quality studies focus on particular sources or events, including wildfire smoke, biomass burning, dust, rural pollution, agricultural emissions or land-use planning. Established core green skills include traditional environmental protection and advisory skills that remain present but do not show strong positive growth.

Digital skill dynamics

Digital skills form the data infrastructure of community-based air quality work. The four-quadrant classification of digital skills is presented in Fig. 3.

Expanding core digital skills include “manage research data”, “collect mapping data”, “use geographic information systems”, “test sensors”, “compare survey computations” and skills related to FAIR data management. These competences support low-cost monitoring, sensor networks, spatial

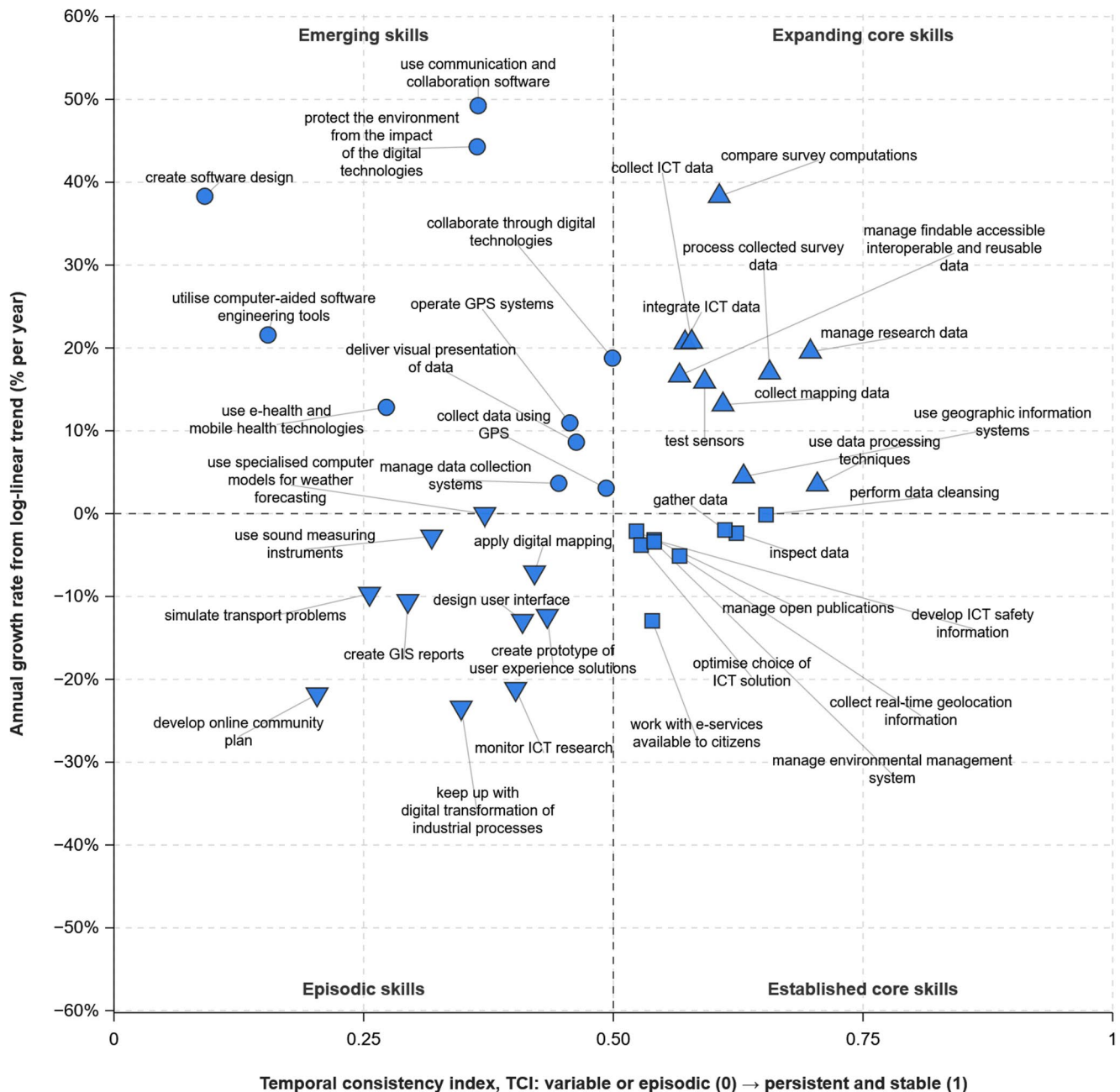


Fig. 3 Four-quadrant model for digital skills trend classification

exposure analysis, citizen science platforms and the translation of environmental measurements into usable evidence.

Emerging digital skills show a shift from purely analytical capacities toward digitally mediated participation and communication. Skills such as “collaborate through digital technologies”, “use communication and collaboration software”, “deliver visual presentation of data”, “operate GPS systems” and “use e-health and mobile health technologies” indicate that digital tools are increasingly used to connect data with public communication, health advice and community decision-making.

Established core digital skills remain important even when they do not show positive growth. These include generic but necessary competences such as data gathering, data cleaning, open-publication management and related data-handling activities. Their established pattern should not be interpreted as evidence that they are unimportant. Rather, some of these skills may have become taken-for-granted components of data workflows. As air quality studies increasingly focus on more complex activities such as sensor deployment, spatial modelling, dashboards, mobile health tools or community-facing visualisations, basic data-cleaning and data-management steps may be performed but not described as explicitly in article narratives.

Artificial intelligence did not appear as a dominant expanding digital skill in the present results. This absence should be interpreted cautiously. AI may already be present in air quality research through specialised methods such as machine-learning-based sensor calibration, exposure prediction, anomaly detection, model optimisation, data fusion or decision-support systems. However, these actions may not map closely to the limited number of ESCO labels that explicitly refer to artificial intelligence. Therefore, the results may under-detect AI-related competences, especially when papers describe specific modelling techniques rather than general AI skills. This suggests that ESCO may require a substantial update to better capture AI-related competences in environmental monitoring and air quality practice.

Social skill dynamics

The social skills analysis identified socially relevant ESCO labels that were manually coded as social skills after the automated ESCO mapping stage. The four-quadrant classification of social skills is presented in Fig. 4.

Expanding core social skills include “promote the participation of citizens in scientific and research activities”, “increase the impact of science on policy and society”, “integrate community outreach”, “conduct participatory research”, “raise awareness on local community’s priorities”, “assess risk factors” and “advise policy makers in healthcare”. These skills demonstrate that social competences are central to contemporary community-based air quality work.

The rise of participation-oriented skills shows that residents are increasingly involved not only as data providers but also as contributors to problem definition, monitoring design, interpretation and policy influence. Science–policy mediation skills show that community-generated evidence must often be translated into institutional decisions, public-health guidance or local planning. Outreach and inclusion skills show that interventions must reach diverse groups, including those facing higher exposure, lower political influence or barriers to participation.

Emerging social skills include “conduct qualitative research”, “work with different target groups”, “promote inclusion”, “set inclusion policies”, “communicate with stakeholders” and “provide improvement strategies”. These skills suggest that community-based air quality work is moving from generic public outreach toward more differentiated engagement with specific groups, vulnerabilities and lived experiences.

Episodic social skills include volunteer-management skills, focus-group interviewing, artistic facilitation and parent- or school-specific engagement. These skills may be mobilised intensively in particular projects, such as school-based monitoring campaigns, arts-based communication workshops or short-term citizen science deployments, but they do not appear consistently across the full corpus.

Established core social skills include generic research interviewing, stakeholder relationship management and negotiation. These skills remain relevant, but they do not expand as strongly as participatory, inclusion-oriented and science–policy mediation skills. Some generic one-way advisory labels are less dynamic than skills that combine advice with participation, outreach, health communication and policy mediation. This should not be read as a decline of all advisory work. Several advisory green skills, including “advise on pollution prevention”, are expanding core skills. The distinction is that expanding advisory roles increasingly appear alongside participatory and translational competences: practitioners are not only giving advice but also working with communities, interpreting local priorities, supporting behaviour change and connecting evidence to policy action.

Discussion

Integrated green, digital and social skill profiles

The results show that community-based air quality work requires an integrated competence ecosystem in which green, digital and social skills reinforce one another. Technical air quality management remains indispensable, but the field is moving beyond a model in which experts simply

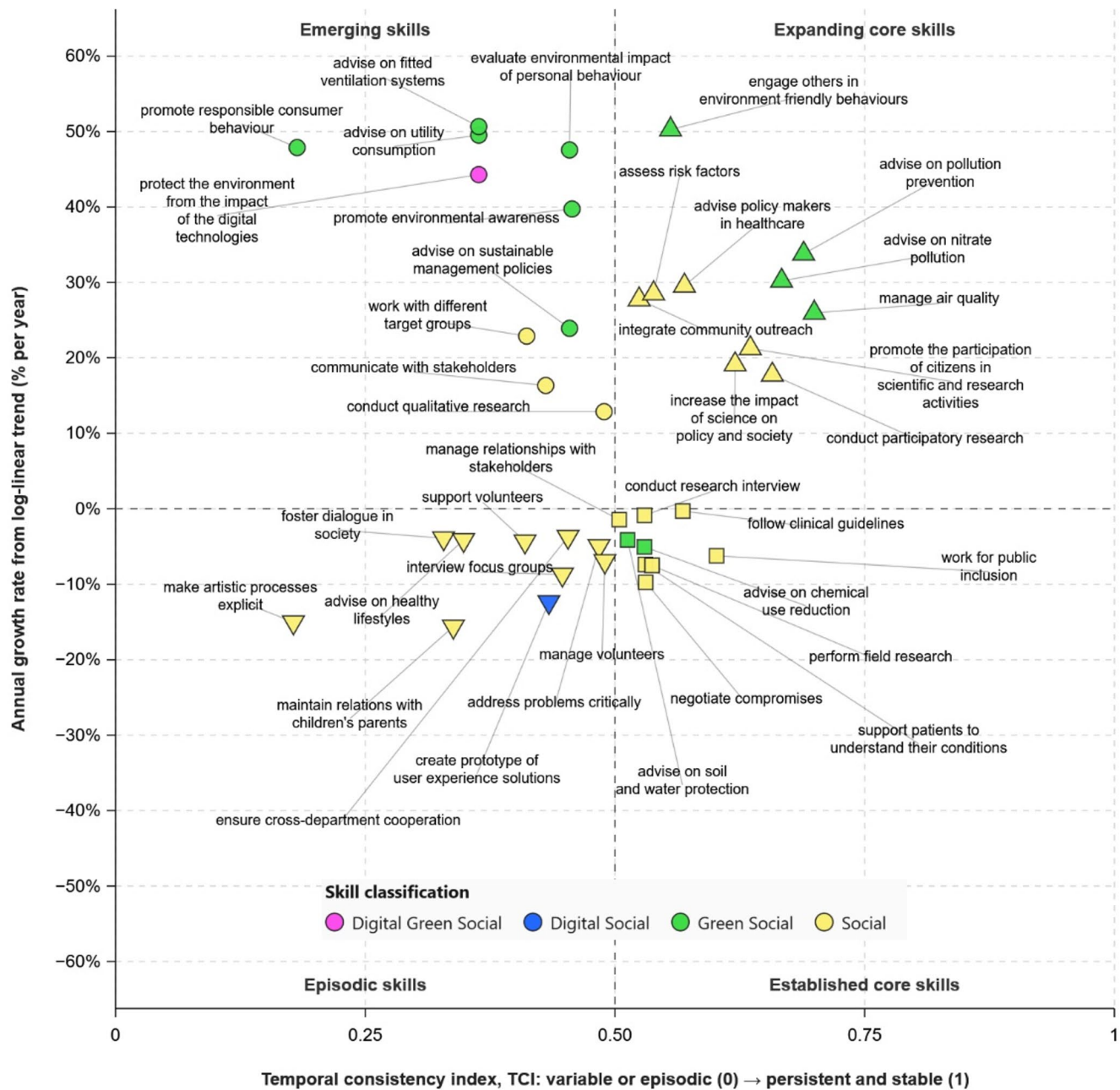


Fig. 4 Four-quadrant model for social skills trend classification

measure pollutants and communicate results. Increasingly, effective work involves helping communities interpret evidence, participate in monitoring, understand health risks, change behaviours and influence policy (Mahajan et al. 2021; Schaefer et al. 2020; Chatzidiakou et al. 2023).

Expanding core green skills provide the environmental foundation of this work. Skills such as advising on pollution prevention and managing air quality remain central because communities and authorities still need technical knowledge to understand sources, emissions, standards and mitigation options (Brunt et al. 2016; Gulia et al. 2015; Li et al. 2024).

These competences underpin actions including emission controls for industry and power plants, fuel switching, low-emission zones and environmental inspection systems (Jha et al. 2025; Winter et al. 2021; Xu et al. 2020; Wan et al. 2020).

However, the strong expansion of skills related to behaviour change and environmental awareness indicates that green skills are increasingly socialised. They are used not only to manage pollution technically but also to support collective learning and everyday action. Interventions promoting active travel, public transport, cleaner household

energy, sustainable consumption and exposure-reducing behaviour all require environmental advice to be translated into socially meaningful action (Vanderbloemen et al. 2025; Beevers et al. 2025; Brakema et al. 2020; Cheng et al. 2022; Peng et al. 2025; McCarron et al. 2023; Park et al. 2023).

Social skills as the expanding core of community air quality work

The most distinctive result is the expansion of social skills. Participatory research, citizen participation in science, community outreach, inclusion and science–policy mediation are not peripheral supports for technical work; they are part of the expanding core of community-based air quality practice (Coelho et al. 2018; van Brussel and Huyse 2019; White and Ekenga 2024).

This finding is important because air pollution exposure and the capacity to avoid or respond to it are often socially unequal. Evidence links disproportionate traffic-related pollution risks to multidimensional structural racism, while inequalities in access to digital air pollution information can also constrain exposure-reducing behaviour (White and Ekenga 2024; Schulte and Hudson 2023). More broadly, convergent research on digital social innovation and air quality management highlights equity, inclusion and collaborative governance as central concerns when communities differ in exposure, resources and institutional influence (Triana et al. 2026). Communities facing high pollution burdens may also face lower institutional trust, fewer resources, language barriers or histories of exclusion from planning decisions. In such contexts, technical evidence alone is insufficient. Social skills are required to build trust, communicate uncertainty, include vulnerable groups, negotiate priorities and translate data into policy action (Gorman et al. 2023; White and Ekenga 2024; Triana et al. 2026).

Citizen-science and environmental-justice initiatives show how residents can collect and interpret data and then use this evidence to influence transport planning, low-emission zones, industrial regulation or local health policy (van Brussel and Huyse 2019; Coelho et al. 2018; Naik et al. 2017; Favorite et al. 2025). Community-based projects in polluted neighbourhoods similarly require organising, advocacy and culturally sensitive communication to address historical marginalisation and unequal exposure (Okello et al. 2020; Kariotis et al. 2022; Derrien et al. 2020).

Social skills also determine whether green and digital interventions are perceived as legitimate. A sensor network may be technically accurate but socially ineffective if residents do not understand the data, distrust the project or feel excluded from decisions about monitoring locations and interpretation. Similarly, behaviour-change advice may fail if it ignores economic constraints, cultural practices or

unequal responsibility for pollution. Advisory skills focused on healthcare and public health connect air quality evidence with clinical practice, risk communication and public responses to pollution episodes (Mao et al. 2024; Barros et al. 2025).

Digital skills, data infrastructures and the under-detection of AI

Digital skills provide the infrastructure through which many contemporary air quality projects operate. Low-cost sensors, GIS tools, exposure dashboards, mobile health applications and online collaboration platforms all require competences in data management, mapping, visualisation and digital communication (Gupta et al. 2018; Tong et al. 2024; Schulte and Hudson 2023; Barros et al. 2025). These skills allow communities and researchers to produce more localised and actionable evidence than traditional fixed monitoring networks alone.

Projects that deploy stationary and mobile sensors to map neighbourhood-level pollution require digital expertise to design monitoring strategies, ensure data quality and integrate community-generated data into policy processes (Mahajan et al. 2020; Rickenbacker et al. 2019; Forni et al. 2019; Morresi et al. 2025). Recent work also demonstrates the importance of incorporating community knowledge into air quality monitoring networks, rather than treating digital data as purely technical evidence detached from local experience (Gardner-Frolick et al. 2025; Makki and Morello 2025).

At the same time, the results show that digital skills are not purely technical. Skills related to collaboration software, visual data presentation and mobile health technologies demonstrate that digital tools increasingly mediate relationships between residents, researchers, practitioners and policy-makers (Audrin et al. 2024). Online platforms, digital mapping, social networks and communication tools can support participatory planning, public engagement and behavioural modification when they are embedded in inclusive social processes (Ekman and Weilenmann 2021; Coelho et al. 2018; Ilie et al. 2022; Trozzi et al. 2018).

The limited visibility of AI-related skills in the corpus suggests an important future direction. AI is likely to become more important for sensor calibration, exposure modelling, early-warning systems, automated interpretation, anomaly detection and decision support. However, the current ESCO taxonomy does not fully describe these actions as air-quality-related skills. Therefore, AI-related skills may be underestimated by the mapping process, particularly when research articles use specialised technical vocabulary that does not closely match the few ESCO labels explicitly referring to artificial intelligence.

Why broader environmental skills appear in an air quality corpus

Some skills identified in the green-skill analysis are broader than air pollution alone. This includes skills related to nature enthusiasm, forestry, agriculture, household energy, responsible consumption and general environmental awareness. These results reflect the interdisciplinary character of community-based air quality work. Air quality problems are often embedded in wider issues such as urban greening, mobility, school environments, housing, clean cooking, wildfire smoke, agricultural emissions and land-use planning.

For example, school-based initiatives and educational interventions require communication with students, parents, teachers, municipal authorities and researchers (Chatzidiakou et al. 2023; Saligari et al. 2025; Schaefer et al. 2020). Indoor air and ventilation studies connect air quality to buildings, hospitals and health protection (Mohd Radzuan and Martin 2024; Nyembwe et al. 2024; Chowdhury et al. 2024). Wildfire smoke, desert dust, forestry and agricultural-emission studies connect air quality with land management and environmental-health preparedness (Barros et al. 2025; Kouis et al. 2021; Beaulieu et al. 2023). Therefore, broader environmental labels should be interpreted as evidence of the wider ecological and social contexts in which community air quality work occurs, not simply as irrelevant matches.

Implications for ESCO and future skill taxonomies

The air quality community context exposes a structural gap in ESCO. The results should not be interpreted as showing that ESCO lacks any social content. ESCO contains many individual labels that describe social action, including participation, communication, outreach, inclusion and stakeholder engagement. The limitation is structural: these labels are not organised into a dedicated social-skills category comparable to ESCO's green and digital classifications.

This makes social competences less visible in quantitative skill analysis, curriculum design, job profiling and policy evaluation. In community-based air quality work, this matters because the success of technical and digital interventions often depends on whether communities trust the process, understand the evidence and can participate meaningfully in decisions. A more explicit social-skills layer in ESCO, or in complementary taxonomies, would make it easier to recognise, teach and evaluate the relational competences required for environmental justice, public engagement and collaborative air quality governance.

A second gap concerns hybrid digital–social skills. Many community-based air quality projects require competences

such as facilitating online deliberation, co-interpreting sensor data with residents, communicating uncertainty, managing community-owned data and translating visualisations into policy-relevant action. These skills sit between digital and social domains but are not fully captured when digital skills are framed primarily around data processing, cybersecurity or generic software use.

A third gap concerns artificial intelligence. AI-related actions are not fully described in ESCO skill labels and descriptions, especially in relation to air quality research and environmental monitoring. A major upgrade of ESCO may therefore be needed to distinguish AI-assisted sensor calibration, machine-learning exposure prediction, automated anomaly detection, explainable AI, decision-support systems and community-facing AI communication tools. Without this improvement, AI-related competences may remain invisible or be incorrectly mapped to generic digital skills.

Limitations and future research

Several limitations should be noted. First, the corpus was deliberately selected to capture public, citizen and community engagement in air quality work. The vast majority of papers are therefore more social or participatory in orientation than narrowly technical. This is consistent with the aim of the study, but it means that the results should not be generalised to all air quality research. A corpus focused on atmospheric modelling, emissions inventories, chemical transport models, engineering control technologies or sensor hardware would likely produce a more technical skill profile.

Second, the analysis depends on how published articles describe project activities. Informal trust-building, community negotiation, emotional labour, cultural mediation and conflict management may be under-reported in academic writing. Third, the semantic mapping procedure depends on the coverage and wording of ESCO labels. Some actions may be mapped to broad labels, and some socially important competences may not be fully represented in ESCO. The validation procedure helps assess plausibility, but it cannot remove all ambiguity.

Fourth, AI-related tools and methods in air quality research may be highly specific and may not produce close semantic matches with the limited number of AI-related ESCO labels. As a result, skills related to machine learning, sensor calibration, exposure prediction, anomaly detection, data fusion or explainable decision support may be under-detected. Fifth, the corpus includes only English-language articles for which full PDFs were available, which may under-represent local reports, non-English community studies and grey literature. Finally, sentence-level data extracted from published papers may be subject to copyright

restrictions. Public data sharing should therefore prioritise aggregated frequency tables, article-level metadata, skill labels, code and reproducible procedures rather than unrestricted redistribution of full extracted sentences.

Future research could combine text mining with interviews, ethnography or participatory evaluation to understand how practitioners, community leaders and residents themselves define the skills needed for air quality action. Future studies could also test whether adding dedicated social-skill and AI-skill layers to ESCO improves the visibility of competences central to environmental justice, digital participation and community-based governance.

Conclusions

This study aimed to clarify the integrated green, digital and social competence profile required for community-based air quality work and to identify gaps that become visible when this work is analysed through ESCO. To address this problem, it analysed 169 full-text articles on community engagement in air quality and air pollution research between 2015 and 2025. Using ESCO-based semantic mapping and temporal frequency analysis, it classified green, digital and social skills into emerging, episodic, expanding core and established core categories.

The results show that green and digital skills remain essential foundations of air quality work. Green skills support pollution prevention, air quality management, environmental awareness and behaviour change. Digital skills support sensor use, spatial analysis, research-data management, mobile health tools and collaborative platforms. However, the strongest conceptual contribution of the study is the demonstration that social skills form an expanding core of community-based air quality practice. Participatory research, citizen participation, inclusion, community outreach and science–policy mediation are increasingly central to whether technical and digital interventions become trusted, legitimate and actionable.

The analysis also identifies a classification gap in ESCO. ESCO contains individual skill labels with social content, but it lacks a dedicated structured social-skills classification comparable to its green and digital classifications. This limits the visibility of social competences in education, training, labour-market analysis and environmental policy. The study also shows that AI-related actions are not fully represented in ESCO, particularly when air quality research uses specialised methods that do not match existing AI-related skill descriptions. Recognising social and AI-related skills more explicitly would better align skill taxonomies with the relational, participatory, digital and justice-oriented work required for cleaner air.

Appendix A. Corpus metadata and bibliometric characteristics

	air pollution	air quality	citizen science	particulate matter	public engagement	public health	asthma	air pollution reduction	european cities	urban planning	rhinitis	low-cost sensors	environmental justice	climate change	clarity
United Kingdom	18	4	1	1	4	2	1	2	2	0	0	2	2	1	2
United States of America	10	6	4	4	1	3	1	0	0	1	0	2	3	2	0
China	10	1	0	0	2	1	0	1	0	0	0	0	0	0	0
Italy	4	1	1	0	1	0	1	2	2	1	1	0	0	0	1
Spain	3	2	5	0	1	0	0	0	0	0	0	1	0	0	0
India	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0
Netherlands	2	1	1	0	1	0	1	2	2	0	1	0	0	0	1
Greece	0	2	2	0	0	0	1	0	0	0	0	0	0	0	0
Norway	2	3	2	0	0	0	1	2	2	0	1	0	0	0	1
Sweden	5	1	1	1	0	0	1	0	0	0	1	1	0	0	0
Ireland	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Canada	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0
Portugal	1	0	0	1	0	1	0	2	2	0	0	0	0	0	2
Viet Nam	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0

Fig. 5 Distribution of countries per authors keywords (generated using pyBibX; Pereira et al. 2025)

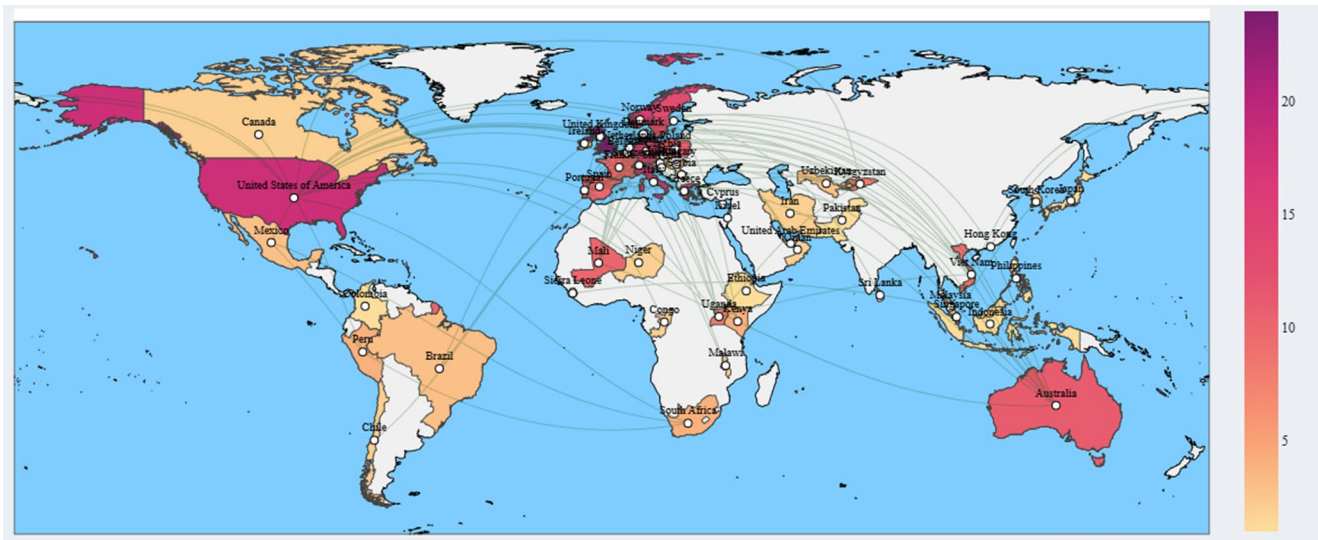


Fig. 6 World map of international collaboration (generated using pyBibX; Pereira et al. 2025)

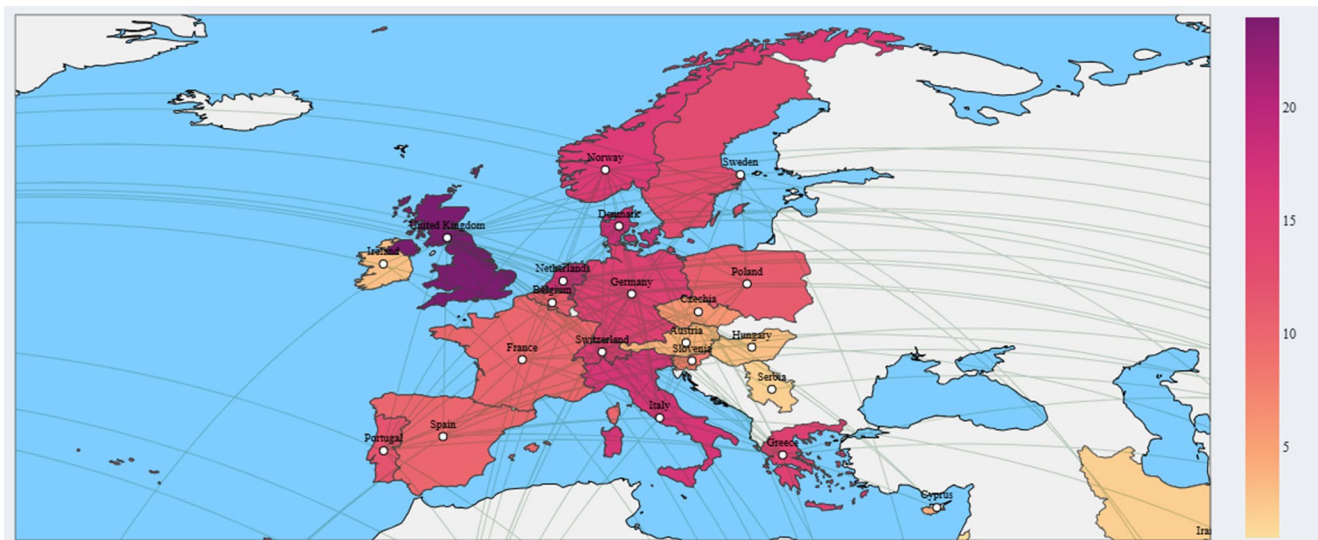


Fig. 7 Europe map of international collaboration (generated using pyBibX; Pereira et al. 2025)

Main Information	Results	Main Information	Results
Timespan	2015–2025	Total Number of Authors	976
Total Number of Countries	58	Total Number of Authors Keywords	635
Total Number of Institutions	317	Total Number of Authors Keywords Plus	1196
Total Number of Sources	108	Total Single-Authored Documents	5
Total Number of References	1207	Total Multi-Authored Documents	163
Total Number of Languages	1	Average Collaboration Index	5.86
--english (# of docs)	169	Max H-Index	5
--/-	--/-	Max J-Index	5.23
Total Number of Documents	169	--/-	--/-
--Article	169	Total Number of Citations	2166
Average Documents per Author	1.08	Average Citations per Author	2.22
Average Documents per Institution	3.33	Average Citations per Institution	6.83
Average Documents per Source	1.56	Average Citations per Document	12.89
Average Documents per Year	15.27	Average Citations per Source	20.06
--/-	--/-	--/-	--/-

Appendix B. Supplementary skills trends figures

Fig. 8 Green yearly skill frequency trends

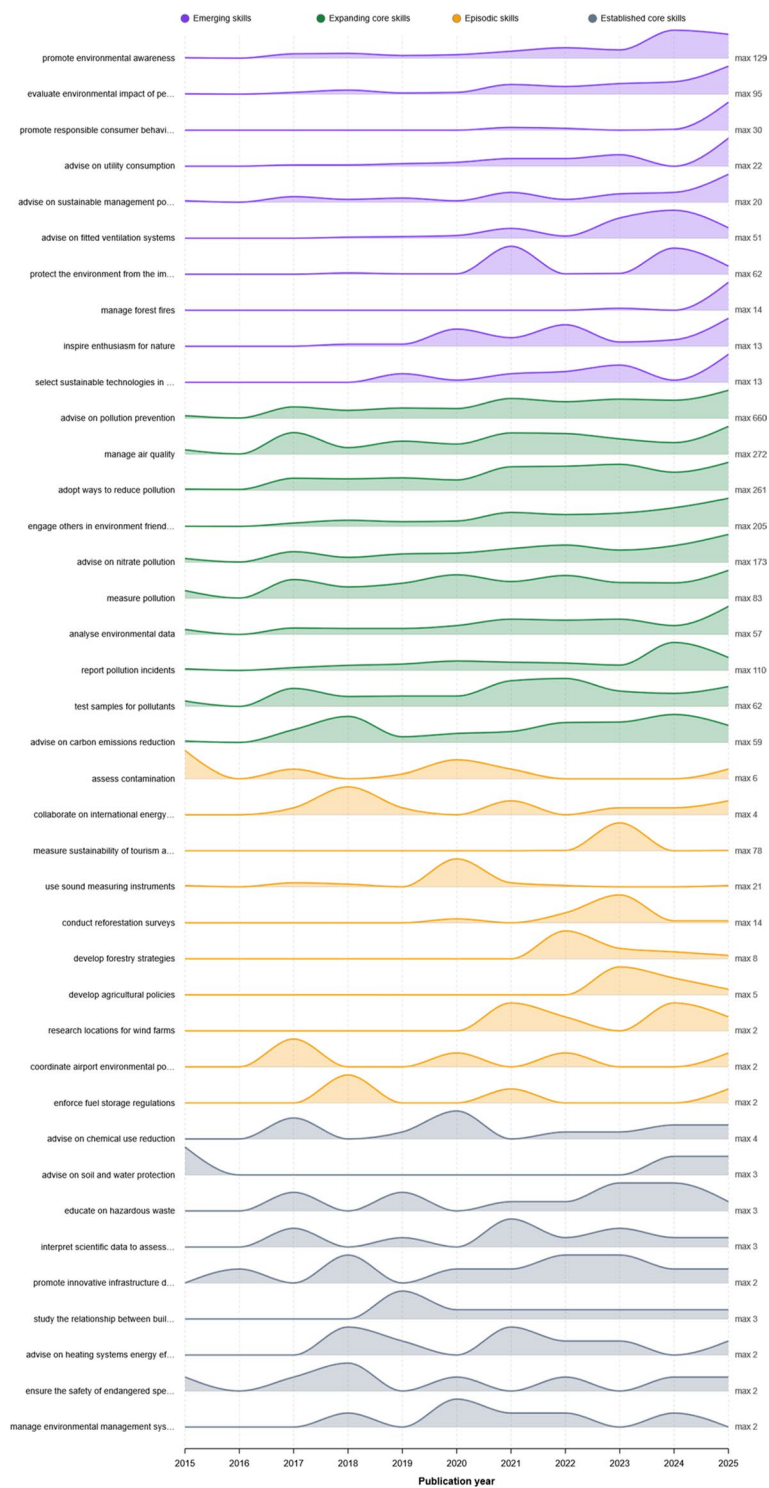


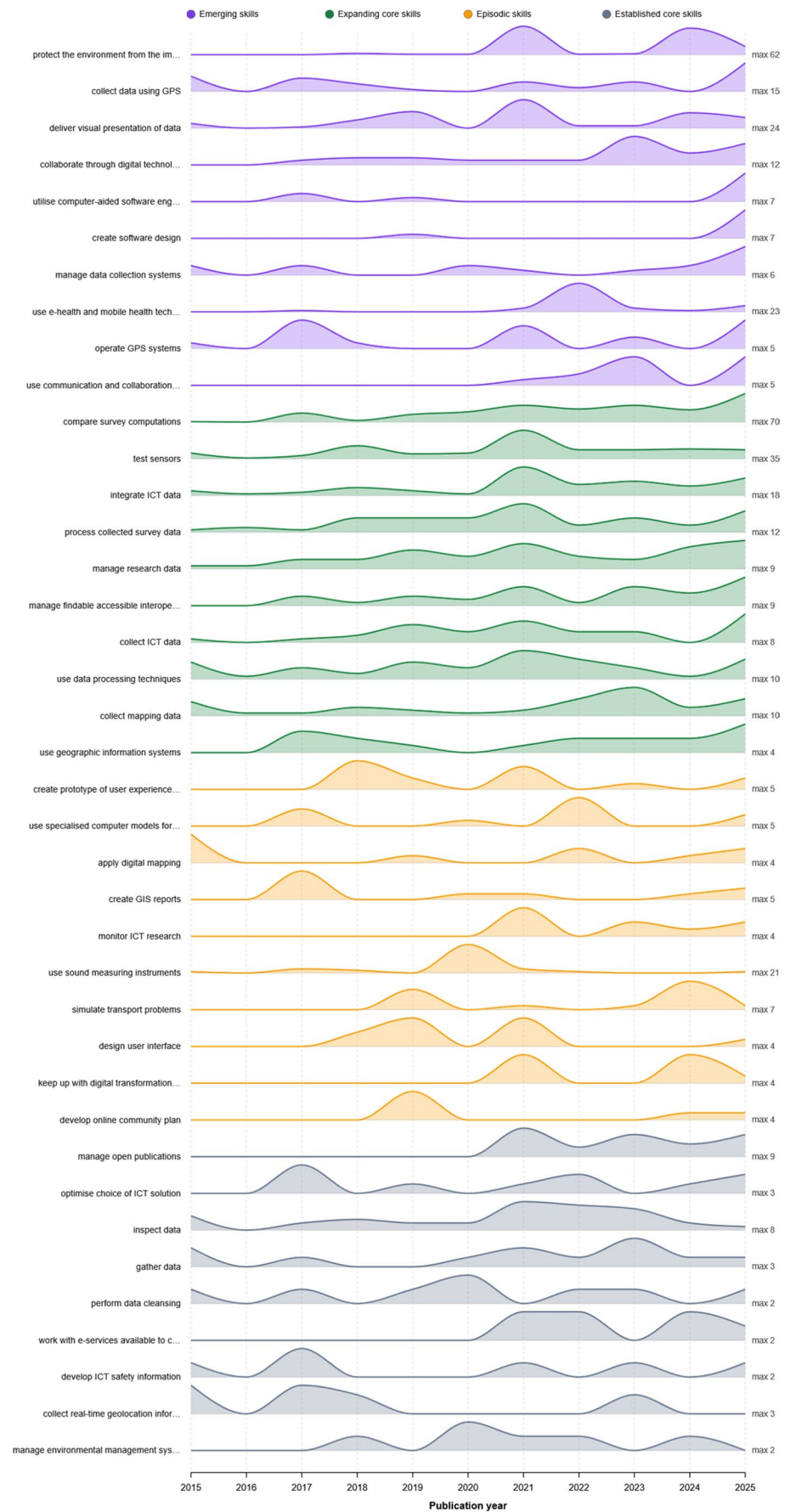
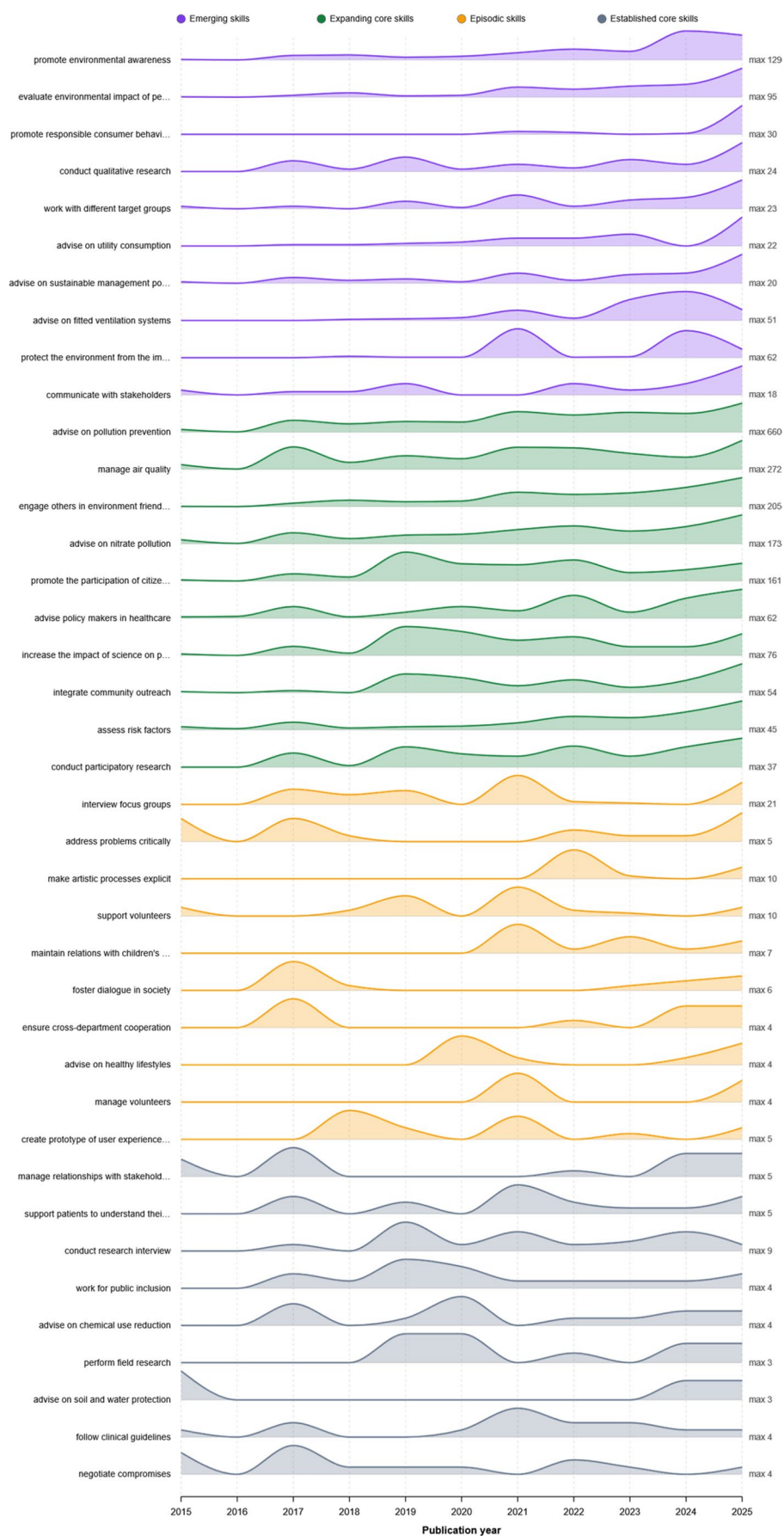
Fig. 9 Digital yearly skill frequency trends

Fig. 10 Digital Social Green yearly skill frequency trends

Appendix C. Documented papers and key identified skills

	Year	DOI	Title	Top 5 skills
Ma, P.; Zhang, M.; Song, Y.	2025	https://doi.org/10.1016/j.sfr.2025.100839	Impact of public environmental participation on air pollution control: A dual examination of we-media attention and government environmental regulation	advise on pollution prevention (33); adopt ways to reduce pollution (12); perform environmental investigations (10); promote environmental awareness (9); report pollution incidents (8)
Huang, Y.; Cui, X.; Liu, M.; Yang, J.; Fang, W.; Ma, Z.; Bi, J.	2025	https://doi.org/10.1016/j.jclepro.2025.146775	Mapping public behavioral intentions for mitigation and adaptation to air pollution in China	adopt ways to reduce pollution (18); advise on pollution prevention (16); engage others in environment friendly behaviours (9); react accordingly to unexpected events outdoors (8); advise on utility consumption (7)
Pramanik, P.; Mondal, T.; Arosh, S.; Saha, M.	2025	https://doi.org/10.3390/su17198924	AirCalypso: A Case Study of Temporal and User-Behaviour Contrasts in Social Media for Urban Air Pollution Monitoring in New Delhi Before and During COVID-19	advise on pollution prevention (19); manage air quality (9); adopt ways to reduce pollution (8); measure pollution (7); advise on nitrate pollution (4)
Wright, O.; Olopade, C.O.; Aifah, A.A.; Fagbemi, T.; Hade, E.M.; Mishra, S.; Onakomaiya, D.O.; Kanneh, N.; Chen, W.; Colvin, C.L.; Ogunyemi, R.; Sogbossi, E.; Erinosh, E.; Ojengbede, O.; Taiwo, O.; Johnson, M.A.; Vedanthan, R.; Wall, S.; Lwelunmor, J.; Idris, O.; Ogedegbe, G.	2025	https://doi.org/10.1136/bmjopen-2024-098483	Community mobilisation for adoption of clean cookstoves and clean fuel to reduce household air pollution and blood pressure in Lagos, Nigeria: protocol for a cluster-randomised trial	provide treatment strategies for challenges to human health (9); advise policy makers in healthcare (8); assess health services within the community (6); formulate findings (6); raise awareness on local community's priorities (6)
Atutxa, E.; Garcia-Torres, S.; Kyfonidis, C.; Karanassos, D.; Kopsacheilis, E.; Tsita, C.; Casado-Mansilla, D.; Emvolidis, A.; Angelis, G.; López-De-Ipiña González-De-Artaza, D.; Puerta-Beldarrain, M.; Drosou, A.; Tzovaras, D.	2025	https://doi.org/10.1007/s10209-023-01072-0	Engagement and accessibility tools for pro-environmental action on air quality: the SOCIO-BEE paradigm	promote the participation of citizens in scientific and research activities (18); engage others in environment friendly behaviours (12); promote inclusion (10); increase the impact of science on policy and society (9); promote environmental awareness (9)
Cibin, R.; Venables, D.S.; Cassarino, M.	2025	https://doi.org/10.1016/j.cacint.2025.100209	Promoting urban air quality resilience through communication: A stakeholder needs mapping and prioritisation study informed by design thinking	advise on pollution prevention (20); engage others in environment friendly behaviours (16); support social service users with specific communication needs (11); adopt ways to reduce pollution (10); analyse community needs (9)
Schulte, K.; Grieve, A.; Barratt, B.; Baker, T.; Coon-jobeecherry, H.; Mead, M.	2025	https://doi.org/10.1016/j.envsci.2025.104092	Advancing participatory sensing and knowledge production methods for city air quality governance: Applying the Breathe London Community Programme model	advise on pollution prevention (36); manage air quality (33); promote the participation of citizens in scientific and research activities (11); increase the impact of science on policy and society (9); conduct participatory research (8)

	Year	DOI	Title	Top 5 skills
Poblete, M.M.; Huaman, E.T.; Ibarra, E.; Mendoza, D.L.; Monge-Rodríguez, F.S.; Horna-Munoz, D.	2025	https://doi.org/10.3390/atmos16070770	Air Pollution in Two Districts of the City of Cusco: An Interdisciplinary Study Based on Environmental Monitoring and Social Risk Perception	advise on pollution prevention (42); advise on nitrate pollution (27); manage air quality (23); increase the impact of science on policy and society (16); adopt ways to reduce pollution (10)
Vanderbloemen, L.; Liamput-tong, P.; Nguyen, O.T.K.; Hoang, K.V.N.; Huynh, H.X.; Hoang, M.P.; Tran, M.G.; Nguyen, P.H.; Pham, T.N.H.; Kapil, D.; Elgebaly, A.; TAYLOR-ROBINSON, A.W.	2025	https://doi.org/10.3390/su17146557	Hanoi Air Quantitative Report: A Cross-Sectional Study of Knowledge, Awareness, and Sustainable Practices Related to Air Pollution Among Residents of Hanoi, Vietnam	advise on pollution prevention (45); adopt ways to reduce pollution (23); engage others in environment friendly behaviours (10); advise on nitrate pollution (7); evaluate psychological health measures (6)
Gardner-Frolick, R.; Jain, S.; Martinussen, N.; Chambliss, S.; Jackson, D.; Zimmerman, N.; Giang, A.	2025	https://doi.org/10.1029/2025GH001378	Incorporating Community Knowledge Into Analysis of Air Quality Monitoring Network Data	manage air quality (23); advise on pollution prevention (19); analyse environmental data (8); measure pollution (8); conduct participatory research (7)
Barros, B.; Oliveira, M.; Morais, S.	2025	https://doi.org/10.1007/s11270-025-08047-2	Air Pollution and Health Impacts of Wildfire Seasons: Insights from Northern Portugal	manage forest fires (14); determine fire risks (11); contain fires (10); advise on nitrate pollution (9); extinguish fires (5)
Erum, N.; Musa, K.; Sari, R.N.; Mohd-Sanusi, Z.M.; Said, J.	2025	https://doi.org/10.1007/s11869-025-01714-7	Quality of governance and urbanization as moderators in the relationship between air quality, inclusive development, and life expectancy	advise on pollution prevention (29); advise on nitrate pollution (14); assess risk factors (12); manage air quality (10); adopt ways to reduce pollution (8)
Morresi, N.; Puerta-Beldar-rain, M.; López-De-Ipiña González-De-Artaza, D.; Barco, A.; Gómez-Carmona, O.; López-Gomollon, C.; Casado-Mansilla, D.; Kotzagianni, M.; Casaccia, S.; Udina, S.; Revel, G.M.	2025	https://doi.org/10.3390/s25123739	A Wearable Sensor Node for Measuring Air Quality Through Citizen Science Approach: Insights from the SOCIO-BEE Project	manage air quality (12); compare survey computations (11); advise on pollution prevention (10); promote the participation of citizens in scientific and research activities (9); measure pollution (8)
Isenaj, Z.S.; Moshammer, H.; Berisha, M.; Weitensfelder, L.	2025	https://doi.org/10.3390/ej15050069	Effect of an Educational Intervention on Pupil's Knowledge, Attitudes, Perceptions, and Behavior on Air Pollution in Public Schools in Pristina	engage others in environment friendly behaviours (49); advise on pollution prevention (48); evaluate environmental impact of personal behaviour (33); promote environmental awareness (20); adopt ways to reduce pollution (11)
Yasin, K.H.; Yasin, M.I.; Iguala, A.D.; Gelete, T.B.; Tulu, D.; Kebede, E.	2025	https://doi.org/10.1007/s42452-025-06723-w	Predictive machine learning and geospatial modeling reveal PM10 hotspots and guide targeted air pollution interventions in Addis Ababa, Ethiopia	advise on pollution prevention (15); manage air quality (7); advise on nitrate pollution (6); adopt ways to reduce pollution (4); assess reliability of data (4)
Phillip, E.; Conroy, R.M.; Walsh, A.; Jumbe, V.; Jewitt, S.; Lee, S.; Stanistreet, D.	2025	https://doi.org/10.1007/s10389-023-02008-x	Using mixed methods and community participation to explore household and ambient air pollution practices in a rural community in Malawi	advise on pollution prevention (14); adopt ways to reduce pollution (11); carry out chimney pressure testing (6); feed charcoal hoppers (6); engage others in environment friendly behaviours (5)
McCormack, D.P.	2025	https://doi.org/10.1080/24694452.2024.2440396	"Laboratory in a Dirty Sky": Aerial Media, Art, and Air Pollution in Project Da Vinci (1974–1979)	advise on pollution prevention (11); design flying movements (5); describe artistic experience (4); enable patients to explore artworks (4); make artistic processes explicit (4)

	Year	DOI	Title	Top 5 skills
Rathnayake, C.; Joshi, S.; Cerratto-Pargman, T.	2025	https://doi.org/10.5334/ctp.695	Exploring Conditions for Designing Citizen Observatories in Sri Lanka: The Case of Air Quality in Rural Areas	advise on pollution prevention (25); promote the participation of citizens in scientific and research activities (24); manage air quality (18); integrate community outreach (10); increase the impact of science on policy and society (9)
Veres, C.; Bacoş, I.-B.; Tănase, M.; Gabor, M.R.	2025	https://doi.org/10.3390/su17020580	Analyzing Urban Air Quality Perceptions: Integrating Socio-Demographic Patterns with Sensor-Based Measurements Using Regression Model and Multidimensional Scaling	advise on pollution prevention (35); manage air quality (23); adopt ways to reduce pollution (22); engage others in environment friendly behaviours (16); promote environmental awareness (10)
Zarandi, M.T.; Moghise, M.	2025	https://doi.org/10.1016/j.trip.2024.101298	Provision of payments for ecosystem services to reduce air pollution: Case of Tehran	advise on pollution prevention (15); adopt ways to reduce pollution (11); apply certification and payment procedures (6); compare survey computations (6); advise on nature conservation (5)
Beevers, S.; Assareh, N.; Beddows, A.; Stewart, G.; Holland, M.; Fecht, D.; Liu, Y.; Goodman, A.; Walton, H.; Brand, C.; Evangelopoulos, D.; Wood, D.; Vu, T.; Dajnak, D.	2025	https://doi.org/10.1016/j.envint.2024.109164	Climate change policies reduce air pollution and increase physical activity: Benefits, costs, inequalities, and indoor exposures	advise on nitrate pollution (17); advise on fitted ventilation systems (8); advise on pollution prevention (5); apply road transport environmental measures (4); promote the use of sustainable transport (4)
Saligari, S.; Nabukwangwa, W.; Mwitari, J.; Anderson De Cuevas, R.; Clayton, S.; Nyongesa, M.; Puzzolo, E.; Pope, D.; Nix, E.	2025	https://doi.org/10.1016/j.healthplace.2024.103398	Whose pollution, whose problem? Understanding perceptions of air pollution and implications for clean cooking (for health) in Nairobi schools	advise on pollution prevention (47); adopt ways to reduce pollution (16); manage air quality (11); advise on nitrate pollution (10); feed charcoal hoppers (4)
Makki, F.; Morello, E.	2025	https://doi.org/10.1016/j.jum.2025.09.001	Living labs and urban governance: Addressing complexity for environmental transition - case study of air pollution in Ferrara, Italy	advise on pollution prevention (12); enable audience participation (10); adopt ways to reduce pollution (8); engage with stakeholders (8); integrate community outreach (8)
Jha, N.; Pandey, A.; Khan, U.; Gupta, A.; Gour, C.P.	2025	https://doi.org/10.1080/10406026.2025.2537092	The Role of Public in Mitigating Air Pollution in Delhi (2004–2024): A Critical Review	advise on pollution prevention (99); adopt ways to reduce pollution (37); advise on nitrate pollution (33); manage air quality (29); report pollution incidents (15)
Ravi, R.K.; Javeth, A.; Edwin, V.; Muthu, P.; Sivan, S.P.	2025	https://doi.org/10.2174/018742130376608250508080038	Individual and Household Practices for Mitigating and Preventing Indoor Air Pollution Among Health Professional Students: A Self-Report Study	advise policy makers in healthcare (15); advise on pollution prevention (11); determine internal air quality parameters (8); engage others in environment friendly behaviours (7); advise on fitted ventilation systems (5)
Favorite, X.; Kendrick, A.; O'Quinn, M.; Schermbeck, J.; Mayo, E.; Sansom, G.; Ma, P.; Johnson, N.	2025	https://doi.org/10.1089/env.2024.0032	Justice for Joppa: A Framework for Community-Engaged Research on Air Quality and Health	collaborate with stakeholders in leading community arts (9); integrate community outreach (9); advise policy makers in healthcare (7); build community relations (5); compare survey computations (5)
Liu, X.; Ding, T.; Zhang, Y.; Vedlitz, A.	2025	https://doi.org/10.1080/09644016.2024.2371768	Tainted trust: air pollution and political trust in China	advise on pollution prevention (9); compare survey computations (8); manage air quality (6); adopt ways to reduce pollution (5); measure pollution (4)

	Year	DOI	Title	Top 5 skills
Kerckhoffs, J; Hofman, J; Khan, J; Adams, MD; Blanco, MN; deSouza, P; Durant, JL; Faridi, S; Fruin, S; Hankey, S; Hassanvand, MS; Hatzopoulou, M; Hoek, G; de Hoogh, K; Hudda, N; Kushwaha, M; Marshall, JD; Minet, L; Patton, AP; Petaja, T; Peters, J; Presto, AA; Shairsingh, K; Sheppard, L; Simon, MC; Vakacherla, S; Van Ryswyk, K; Van Poppe, M; Vermeulen, RCH; Wegener, R; Yuan, ZD; Amini, H	2025	https://doi.org/10.1016/j.envint.2025.109582	Mobile monitoring of air pollution - a position paper on use cases, good practices, challenges, and opportunities	manage air quality (25); collect data using GPS (13); test samples for pollutants (9); measure pollution (7); adjust surveying equipment (6)
Zhou, XL; Wang, RT; Han, MY	2025	https://doi.org/10.3389/fenvs.2025.1580362	Uncovering the black box of public data: the contribution of open government data to air pollution control	promote environmental awareness (7); protect the environment from the impact of the digital technologies (7); develop environmental policy (6); advise on carbon emissions reduction (5); integrate ICT data (5)
Peng, MT; Cai, ZY; Chen, KL; Yin, CX; Ao, CL; Ren, HF	2025	https://doi.org/10.3390/su17062414	How Risk Perception of Air Pollution Influences Consumers' Pro-Environmental Behaviors: An Empirical Study Based on the Extended Theory of Planned Behavior	evaluate environmental impact of personal behaviour (34); engage others in environment friendly behaviours (33); promote responsible consumer behaviour (29); adopt ways to reduce pollution (22); advise on pollution prevention (21)
Li, W.; Xiao, Z.; Huang, Y.; Wu, H.	2024	https://doi.org/10.1016/j.jenvman.2024.123298	Breathing life into equity: How air pollution influences corporate pay gap	advise on pollution prevention (19); promote equal pay (18); advise on nitrate pollution (15); advise on carbon emissions reduction (13); coordinate environmental efforts (10)
Alahmad, B.; Choma, E.F.; Al-Omari, B.; Alefishat, E.; Adem, A.; Evans, J.S.; Koutrakis, P.; Rajasekaran, S.	2024	https://doi.org/10.1186/s41256-024-00383-w	From silos to synergy: a consortium approach to air pollution and public health in Abu Dhabi	advise on pollution prevention (6); engage with stakeholders (5); estimate impact of risks (5); address identified risks (4); advise policy makers in healthcare (4)
Phillip, E.; Walsh, A.; Jewitt, S.; Elnakoury, F.; Simon, J.; Conroy, R.M.; Stanistreet, D.	2024	https://doi.org/10.1186/s12889-024-19614-3	Exploring community-based participatory research for household and ambient air pollution projects: insights from key informants	conduct participatory research (19); promote the participation of citizens in scientific and research activities (14); collaborate with stakeholders in leading community arts (10); conduct research across disciplines (10); advise policy makers in healthcare (8)
Sprague-Martínez, L.; Lerman Ginzburg, S.L.; Ron, S.; Araujo Brinkerhoff, C.A.; Haque, S.; England, S.A.; Khimani, K.; Zamore, W.; Reisner, E.; Lowe, L.; Brugge, D.	2024	https://doi.org/10.1186/s12889-024-17864-9	Communities catalyzing change with data to mitigate an invisible menace, traffic-related air pollution	advise policy makers in healthcare (15); provide treatment strategies for challenges to human health (15); analyse health problems within a given community (8); collaborate with stakeholders in leading community arts (8); communicate with target community (7)
Ou, Y.; Chen, K.; Ma, L.; He, B.-J.; Bao, Z.	2024	https://doi.org/10.1016/j.jenvman.2024.123024	Coordinating public and government responses to air pollution exposure: A multi-source data fusion approach	advise on pollution prevention (19); adopt ways to reduce pollution (12); manage air quality (7); advise on nitrate pollution (6); compare survey computations (4)

	Year	DOI	Title	Top 5 skills
Ali Shah, S.M.; Casado-Mansilla, D.; López-De-Ipiña González-De-Artaza, D.	2024	https://doi.org/10.3390/s24196425	An Image-Based Sensor System for Low-Cost Air-borne Particle Detection in Citizen Science Air Quality Monitoring	advise on pollution prevention (12); measure pollution (6); determine image composition (5); manage air quality (5); adopt ways to reduce pollution (4)
Liu, W.; Liu, T.; Si, X.; Liang, J.; Yan, X.; Zhang, J.; Pang, B.; Luo, W.; Liu, J.; Yang, H.; Shi, P.	2024	https://doi.org/10.1016/j.ecoenv.2024.116939	Multi-omic characterization of air pollution effects: Applications of AirSigOmniTWP Hub	advise on nitrate pollution (4); interpret laboratory data in medical genetics (3); advise on pollution prevention (2); diagnose genetic diseases (2); manage findable accessible interoperable and reusable data (2)
Ying, R.; Wang, X.	2024	https://doi.org/10.3390/su16167153	Influence of Regional Air Pollution Pressure on the Green Transformation of Higher Education: An Empirical Study Based on PM2.5 in Chinese Cities	promote environmental awareness (56); engage others in environment friendly behaviours (42); promote sustainability (20); evaluate environmental impact of personal behaviour (19); advise on pollution prevention (11)
Nyembwe, J.-P.K.B.; Munanga, J.K.; Simões, N.; Gameiro da Silva, M.G.	2024	https://doi.org/10.3390/buildings14071996	Ventilation Strategies to Mitigate Air Pollution Impact on Hospital Professionals in Intensive Care Units in the Democratic Republic of Congo	advise on fitted ventilation systems (49); examine ventilation system (12); determine internal air quality parameters (11); design heating and cooling emission systems (6); operate breathing equipment (5)
Mohd Radzuan, H.S.; Martin, J.	2024	https://doi.org/10.1016/j.heliyon.2024.e31263	An evaluation of air quality impact prediction performance undertaken as part of environmental impact assessment (EIA) in India	assess environmental impact (14); define evaluation objectives and scope (9); evaluate project plans (5); measure pollution (5); monitor the conformance to the project methodology (5)
Chowdhury, S.; Chaudhary, E.; Dey, S.	2024	https://doi.org/10.1007/s13312-024-3163-7	Protecting Child Health From Air Pollution in India	advise on pollution prevention (25); adopt ways to reduce pollution (6); report pollution incidents (3); advise on nitrate pollution (2); advise policy makers in healthcare (2)
Fogg-Rogers, L.; Sardo, A.M.; Csobod, E.; Boushel, C.; Laggan, S.; Hayes, E.	2024	https://doi.org/10.1016/j.envsci.2024.103692	Citizen-led emissions reduction: Enhancing enjoyment and understanding for diverse citizen engagement with air pollution and climate change decision making	engage others in environment friendly behaviours (30); promote the participation of citizens in scientific and research activities (22); advise on carbon emissions reduction (17); advise on pollution prevention (17); promote environmental awareness (14)
Hussein, O.D.; Osman, H.	2024	https://doi.org/10.14445/23488549/IJECE-V11I3P108	IoT-Based Air Quality Management in Somalia	manage air quality (32); measure pollution (14); advise on pollution prevention (11); test samples for pollutants (11); test sensors (11)
He, X.B.; Zhou, K.; Hussain, J.; Akhtar, R.	2024	https://doi.org/10.1007/s00484-023-02603-3	Public perceptions of air pollution and its impacts on fertility desire: a nationwide study in China	advise on pollution prevention (31); advise on nitrate pollution (17); adopt ways to reduce pollution (9); assess risk factors (3); counsel patients on fertility treatments (3)
Romarate, R.A.; Madarcos, J.R.V.; Pacilan, C.J.M.; Bacosa, H.P.; Torres, A.G.	2024	https://doi.org/10.1007/s10668-024-05215-y	When air quality matters: awareness, perception, and attitude of the residents in Metro Manila, Philippines	advise on pollution prevention (51); adopt ways to reduce pollution (16); manage air quality (16); engage others in environment friendly behaviours (8); advise on nitrate pollution (4)

	Year	DOI	Title	Top 5 skills
Antoniou, A.; Ioannidis, G.; Ntziachristos, L.	2024	https://doi.org/10.1016/j.envsoft.2023.105918	Realistic simulation of air pollution in an urban area to promote environmental policies	advise on pollution prevention (14); adopt ways to reduce pollution (12); increase the impact of science on policy and society (10); apply road transport environmental measures (8); deliver visual presentation of data (8)
Altinay, Z.; Crosswell, L.	2024	https://doi.org/10.1080/17538068.2023.2207240	Public perceptions of air pollution and associated health risks in Nevada, USA: applications for health communication	advise on pollution prevention (16); advise policy makers in healthcare (12); engage others in environment friendly behaviours (7); provide treatment strategies for challenges to human health (7); apply health psychological measures (5)
Zhou, XF; Cao, GZ; Peng, BB; Xu, XY; Yu, F; Xu, ZS; Yan, Y; Du, HB	2024	https://doi.org/10.1016/j.jclepro.2023.140319	Citizen environmental complaint reporting and air quality improvement: A panel regression analysis in China	report pollution incidents (80); advise on pollution prevention (53); report on environmental issues (41); advise on nitrate pollution (10); adopt ways to reduce pollution (9)
Tong, J; Tao, L; Luo, SY	2024	https://doi.org/10.1080/17487870.2023.2292223	Does the digital economy reduce air pollution? Evidence from 30 Chinese provinces and municipalities	protect the environment from the impact of the digital technologies (54); advise on pollution prevention (26); adopt ways to reduce pollution (16); advise on carbon emissions reduction (16); adopt ways to reduce negative impact of consumption (9)
Chu, ZZ; Yang, TN; Zhang, ZH	2024	https://doi.org/10.1016/j.scs.2024.105681	Assessing the role of public, media, and government attention on air pollution governance in China	advise on pollution prevention (55); adopt ways to reduce pollution (37); manage air quality (15); advise on nitrate pollution (13); report pollution incidents (9)
Li, Z; Wang, W; Zhang, Z	2024	https://doi.org/10.3390/atmos15121539	The Impacts of Environmental Assessment and Public Appeal on Air Quality: Evidence from the Chinese Provinces	advise on pollution prevention (27); develop environmental policy (26); ensure compliance with environmental legislation (16); engage others in environment friendly behaviours (11); implement environmental protection measures (11)
White, EB; Ekenga, CC	2024	https://doi.org/10.1002/cn.cr.35467	Multidimensional structural racism and estimated cancer risk from traffic-related air pollution	advise on pollution prevention (7); assess risk factors (5); advise on nitrate pollution (3); measure pollution (3); test samples for pollutants (3)
Mao, QS; Zhu, XY; Zhang, XY; Kong, YZ	2024	https://doi.org/10.3389/fmed.2024.1472996	Effect of air pollution on the global burden of cardiovascular diseases and forecasting future trends of the related metrics: a systematic analysis from the Global Burden of Disease Study 2021	advise on pollution prevention (16); manage air quality (8); adopt ways to reduce pollution (6); assess risk factors (5); advise on nitrate pollution (4)
Chatzidiakou, L.; Archer, R.; Beale, V.; Bland, S.; Carter, H.; Castro-Faccetti, C.; Edwards, H.; Finneran, J.; Hama, S.; Jones, R.L.; Kumar, P.; Linden, P.F.; Rawat, N.; Roberts, K.; Symons, C.; Vouriot, C.; Wang, D.; Way, L.; West, S.; Weston, D.; Williams, N.; Wood, S.; Burridge, H.C.	2023	https://doi.org/10.1016/j.dibe.2023.100266	Schools' air quality monitoring for health and education: Methods and protocols of the SAMHE initiative and project	determine internal air quality parameters (34); advise on fitted ventilation systems (31); manage air quality (9); advise on pollution prevention (8); assess energy consumption of ventilation systems (5)

	Year	DOI	Title	Top 5 skills
Schulte, K.; Hudson, B.	2023	https://doi.org/10.1016/j.envint.2023.108236	A cross-sectional study of inequalities in digital air pollution information access and exposure reducing behavior uptake in the UK	advise on pollution prevention (16); adopt ways to reduce pollution (15); evaluate environmental impact of personal behaviour (5); assess risk factors (3); engage others in environment friendly behaviours (3)
Wu, J.; Grande, G.; Triolo, F.; Pyko, A.; Sjöberg, L.; Ljungman, P.; Eneroth, K.; Bellander, T.; Rizzuto, D.	2023	https://doi.org/10.1016/j.envpol.2023.122394	Air pollution, social engagement, and depression in older adults: Results from a Swedish population-based cohort study	evaluate clinical psychological measures (4); advise on pollution prevention (3); evaluate older adults' ability to take care of themselves (2); evaluate psychological health measures (2); advise on healthcare users' informed consent (1)
Mora, S.; deSouza, P.; Duarte, F.; Wang, A.; Paul, S.; Berrones, A.; Ratti, C.	2023	https://doi.org/10.3390/su151612624	Air Quality Monitoring in Coal-Centric Cities: A Hybrid Approach	advise on pollution prevention (14); advise on mining environmental issues (11); measure pollution (9); manage air quality (8); communicate on the environmental impact of mining (7)
Beaulieu, A.; Leblond, J.-P.; Déry, S.; Cao, H.	2023	https://doi.org/10.1016/j.landusepol.2023.106687	Urban air pollution anxieties, forest conservation, and farmland expropriation: State territorialization in the uplands and highlands of northern Thailand	conduct reforestation surveys (14); apply forest legislation (13); make decisions regarding forestry management (11); promote agricultural policies (11); conserve forests (10)
Price, H.D.; Bowyer, C.J.; Büker, P.; Gray, C.M.; Hahn, M.; Lambe, F.; Loh, M.; Medcalf, A.J.; Njoora, T.K.; Waelde, C.; Wainwright, M.; West, S.	2023	https://doi.org/10.1007/s11625-023-01317-0	From reflection diaries to practical guidance for transdisciplinary research: learnings from a Kenyan air pollution project	conduct research across disciplines (27); discuss research proposals (17); advise on pollution prevention (16); evaluate research activities (15); collaborate with stakeholders in leading community arts (13)
Park, Y.M.; Chavez, D.; Sousan, S.; Figueroa-Bernal, N.; Alvarez, J.R.; Rocha-Peralta, J.	2023	https://doi.org/10.1038/s41370-022-00515-9	Personal exposure monitoring using GPS-enabled portable air pollution sensors: A strategy to promote citizen awareness and behavioral changes regarding indoor and outdoor air pollution	advise on pollution prevention (21); adopt ways to reduce pollution (16); manage air quality (12); engage others in environment friendly behaviours (11); test samples for pollutants (6)
McCarron, A.; Semple, S.; Braban, C.F.; Swanson, V.; Gillespie, C.; Price, H.D.	2023	https://doi.org/10.1038/s41370-022-00449-2	Public engagement with air quality data: using health behaviour change theory to support exposure-minimising behaviours	advise on pollution prevention (59); adopt ways to reduce pollution (37); manage air quality (29); analyse health damaging behaviours (13); engage others in environment friendly behaviours (13)
Jiang, N.; Ao, C.; Xu, L.; Wei, Y.; Long, Y.	2023	https://doi.org/10.1016/j.scitotenv.2023.161436	Will information interventions affect public preferences and willingness to pay for air quality improvement? An empirical study based on deliberative choice experiment	advise on pollution prevention (28); adopt ways to reduce pollution (19); make decisions (11); advise on nitrate pollution (8); engage others in environment friendly behaviours (7)
Wang, S.; Zhang, R.; Wan, L.; Chen, J.	2023	https://doi.org/10.1016/j.ecolecon.2023.107750	Has Central Government Environmental Protection Interview Improved Air Quality in China?	advise on pollution prevention (30); adopt ways to reduce pollution (12); develop environmental policy (10); engage others in environment friendly behaviours (7); implement environmental protection measures (7)

	Year	DOI	Title	Top 5 skills
Yang, T.; Gu, T.; Xu, Z.; He, T.; Li, G.; Huang, J.	2023	https://doi.org/10.1016/j.scitotenv.2023.161396	Associations of residential green space with incident type 2 diabetes and the role of air pollution: A prospective analysis in UK Biobank	advise on nitrate pollution (13); evaluate psychological health measures (4); advise on pollution prevention (3); evaluate clinical psychological measures (2); select hazard control (2)
Khalaf, Y.; Salama, C.; Kurorwaho, B.; D'Eon, J.C.; Al-Abadleh, H.A.	2023	https://doi.org/10.1021/acs.jchemed.2c00890	The Clean Air Outreach Project: A Paired Research and Outreach Program Looking at Air Quality Microenvironments around Elementary Schools	advise on pollution prevention (19); manage air quality (10); prepare presentation material (10); investigate pollution (8); encourage students to acknowledge their achievements (7)
Khorsandi, A.; Li, L.	2023	https://doi.org/10.3389/fpubh.2022.1035395	A novel Energy Resources Allocation Management model for air pollution reduction	adopt ways to reduce pollution (30); advise on pollution prevention (25); advise on nitrate pollution (8); identify energy needs (8); measure pollution (7)
Dwivedi, R.; Yaqoob, M.; Khan, A.; Priyadarshi, P.; Ahmad, S.; Attri, S.; Mutharaju, R.	2023	https://doi.org/10.4000/SAIAJ.8768	In Search of a “Social-AQI” Democratic Deficits in the Air Pollution Data Regime in Delhi	advise on pollution prevention (36); manage air quality (20); adopt ways to reduce pollution (15); promote the participation of citizens in scientific and research activities (10); engage others in environment friendly behaviours (6)
Hong, S.J.; Kim, Y.	2023	https://doi.org/10.1080/13669877.2023.2259399	Dread and unknown characteristics of particulate matter pollution: cognitive and affective routes to air pollution prevention	advise on pollution prevention (21); estimate impact of risks (12); recognise the hazards of dangerous goods (12); advise on nitrate pollution (7); evaluate environmental impact of personal behaviour (7)
Gorman, G.; Hellebust, S.; Venables, D.S.; Ryan, K.; Cassarino, M.	2023	https://doi.org/10.1080/13669877.2023.2170453	Introducing forecast-based public health warnings to promote engagement with air quality risk: a survey of citizens' attitudes in Cork, Ireland	advise on pollution prevention (45); engage others in environment friendly behaviours (19); manage air quality (17); adopt ways to reduce pollution (13); evaluate environmental impact of personal behaviour (5)
Liu, Y.; Kwan, M.-P.; Kan, Z.	2023	https://doi.org/10.3390/ijerph20021491	Inconsistent Association between Perceived Air Quality and Self-Reported Respiratory Symptoms: A Pilot Study and Implications for Environmental Health Studies	advise on pollution prevention (5); compare survey computations (5); manage air quality (4); work with different target groups (4); diagnose respiratory diseases (3)
Li, B.; Yang, J.; Sun, W.	2023	https://doi.org/10.3390/ijerph20010642	Can Expanding Cultural Consumption Improve Urban Air Quality? An Analysis Based on China's Cultural Consumption Pilot Policy	adopt ways to reduce pollution (22); advise on pollution prevention (13); develop cultural policies (12); adopt ways to reduce negative impact of consumption (9); engage others in environment friendly behaviours (5)
Wang, JM; Jia, L; He, P; Wang, P; Huang, L	2023	https://doi.org/10.1016/j.jclepro.2023.138074	Engaging stakeholders in collaborative control of air pollution: A tripartite evolutionary game of enterprises, public and government	advise on pollution prevention (41); adopt ways to reduce pollution (27); advise on carbon emissions reduction (22); coordinate environmental efforts (8); develop environmental policy (6)
Zhu, J; Lu, CT; Wei, ZH	2023	https://doi.org/10.3390/atmos14020212	Perception of Air Pollution and the Evaluation of Local Governments' Environmental Governance: An Empirical Study on China	advise on pollution prevention (32); adopt ways to reduce pollution (12); assess environmental impact (12); manage air quality (9); compare survey computations (8)

	Year	DOI	Title	Top 5 skills
Tong, Y; Pang, L; Li, H	2023	https://doi.org/10.1007/s11869-023-01393-2	The air pollution mitigation effect of tourism development and its formation mechanism: new insights from BMA and SEM approaches	measure sustainability of tourism activities (78); advise on pollution prevention (14); provide training in sustainable tourism development and management (10); adopt ways to reduce pollution (9); educate on sustainable tourism (7)
Ilie, A.M.C.; McCarthy, N.; Velasquez, L.; Moitra, M.; Eisl, H.M.	2022	https://doi.org/10.1007/s13412-022-00777-7	Air pollution exposure assessment at schools and playgrounds in Williamsburg Brooklyn NYC, with a view to developing a set of policy solutions	manage air quality (26); advise on pollution prevention (20); measure pollution (14); promote the participation of citizens in scientific and research activities (10); increase the impact of science on policy and society (8)
Wang, B.; Xu, S.; Sun, K.; Chang, X.; Wang, Z.; Zhao, W.	2022	https://doi.org/10.1016/j.resconrec.2022.106553	Government responsive selectivity and public limited mediation role in air pollution governance: Evidence from large scale text data content mining	advise on pollution prevention (33); adopt ways to reduce pollution (12); motivate supporters (12); engage others in environment friendly behaviours (6); report pollution incidents (6)
Gignac, F.; Righi, V.; Toran, R.; Errandonea, L.P.; Ortiz, R.; Nieuwenhuijsen, M.; Creus, J.; Basagana, X.; Balestrini, M.	2022	https://doi.org/10.1186/s12940-021-00826-8	Co-creating a local environmental epidemiology study: the case of citizen science for investigating air pollution and related health risks in Barcelona, Spain	promote the participation of citizens in scientific and research activities (50); advise on pollution prevention (35); increase the impact of science on policy and society (20); discuss research proposals (15); prepare survey report (14)
Woutersen, A.; de Ruiter, H.; Wesseling, J.; Hendrix, W.; Blokhuis, C.; van Ratingen, S.; Vegt, K.; Voogt, M.	2022	https://doi.org/10.3390/s22208053	Farmers and Local Residents Collaborate: Application of a Participatory Citizen Science Approach to Characterising Air Quality in a Rural Area in The Netherlands	advise on nitrate pollution (14); manage air quality (11); advise on pollution prevention (9); measure pollution (6); test sensors (6)
Kumar, A.; Chaudhuri, S.	2022	https://doi.org/10.1177/09754253221122752	Improving Urban Air Quality Monitoring in Delhi, India: Reflections on Low-Cost Air Quality Sensors (LCAQS) and Participatory Engagement	manage air quality (14); advise on pollution prevention (10); adopt ways to reduce pollution (7); calibrate optical instruments (4); calibrate precision instrument (4)
Sun, Y.; Hu, H.; Jin, G.	2022	https://doi.org/10.1016/j.scitotenv.2022.154821	Pollution or innovation? How enterprises react to air pollution under perfect information	promote environmental awareness (23); advise on pollution prevention (21); manage air quality (10); implement environmental protection measures (9); advise on carbon emissions reduction (8)
Kleiman, G.; Anenberg, S.C.; Chafe, Z.A.; Appiah, D.C.; Assefa Woldeamanuel, T.; Bizberg, A.; Coombes, T.; Cuestas, D.; Henze, D.K.; Kessler, A.; Kheirbek, I.; Kinney, P.; Mahlatji, M.; Marshall, J.D.; Naidoo, S.; Potwana, N.; Rodriguez, A.; Tessum, C.W.; Thomas, C.	2022	https://doi.org/10.3389/frsc.2022.934672	Enhanced Integration of Health, Climate, and Air Quality Management Planning at the Urban Scale	adopt ways to reduce pollution (15); advise on carbon emissions reduction (15); advise on pollution prevention (11); manage air quality (11); apply road transport environmental measures (6)
Lu, T.; Liu, Y.; Garcia, A.; Wang, M.; Li, Y.; Bravo-Villasenor, G.; Campos, K.; Xu, J.; Han, B.	2022	https://doi.org/10.3390/ijerph19148777	Leveraging Citizen Science and Low-Cost Sensors to Characterize Air Pollution Exposure of Disadvantaged Communities in Southern California	advise on pollution prevention (13); manage air quality (9); adopt ways to reduce pollution (4); measure pollution (4); promote the participation of citizens in scientific and research activities (3)

	Year	DOI	Title	Top 5 skills
Hopkins, L.P.; January-Bevers, D.J.; Caton, E.K.; Campos, L.A.	2022	https://doi.org/10.1002/pp3.10245	A simple tree planting framework to improve climate, air pollution, health, and urban heat in vulnerable locations using non-traditional partners	plant trees (15); advise on pollution prevention (10); provide treatment strategies for challenges to human health (10); advise on tree issues (9); advise policy makers in health-care (9)
Ganeshwaari, R.G.N.; Mathew, M.N.	2022	https://doi.org/10.46754/jssm.2022.02.010	RESIDENTS' PREFERENCES ON ATTRIBUTES OF URBAN AIR QUALITY IMPROVEMENT IN PETALING JAYA, SELANGOR, MALAYSIA	adopt ways to reduce pollution (20); promote public transport (16); promote the use of sustainable transport (12); advise on pollution prevention (11); apply road transport environmental measures (10)
Han, Y.; Kou, P.; Jiao, Y.	2022	https://doi.org/10.15244/pjoes/141811	How Does Public Participation in Environmental Protection Affect Air Pollution in China? A Perspective of Local Government Intervention	advise on pollution prevention (28); adopt ways to reduce pollution (18); develop environmental policy (8); advise on nitrate pollution (6); engage others in environment friendly behaviours (6)
Oliveira, K.; Rodrigues, V.; Slingerland, S.; Vanherle, K.; Soares, J.; Rafael, S.; Trozzi, C.; Bouman, E.A.; Ferreira, J.; Kewo, A.; Nielsen, P.S.; Diafas, I.; Monteiro, A.; Isabel Miranda, A.I.; Nunes, M.; Hayes, E.	2022	https://doi.org/10.1016/j.jenvman.2021.114047	Assessing the impacts of citizen-led policies on emissions, air quality and health	advise on pollution prevention (19); advise on nitrate pollution (17); adopt ways to reduce pollution (16); apply road transport environmental measures (12); promote public transport (9)
Kariotis, T.; Borda, A.; Winkel, K.; Gray, K.	2022	https://doi.org/10.5334/ctp.531	Citizen Science for One Digital Health: A Rapid Qualitative Review of Studies in Air Quality with Reflections on a Conceptual Model	use e-health and mobile health technologies (23); advise policy makers in healthcare (20); provide treatment strategies for challenges to human health (18); promote the participation of citizens in scientific and research activities (17); manage air quality (16)
Islam, S.; Rashid, R.; Bryant, M.; Schofield, H.; McEachan, R.R.C.	2022	https://doi.org/10.12688/wellcomeopenres.17886.1	The art of Patient and Public Involvement: Exploring ways to research and reduce air pollution through art-based community workshops - a reflective paper	advise on pollution prevention (15); make artistic processes explicit (10); adopt ways to reduce pollution (9); enable patients to explore artworks (6); collaborate with stakeholders in leading community arts (5)
Cheng, Y.; Ao, C.; Mao, B.; Xu, L.	2022	https://doi.org/10.1080/09640568.2021.1973972	Influential factors of environmental behavior to reduce air pollution: integrating theories of planned behavior and psychological distance	engage others in environment friendly behaviours (23); advise on pollution prevention (21); evaluate environmental impact of personal behaviour (19); adopt ways to reduce pollution (17); compare survey computations (4)
Puiu, S.; Udristioiu, MT; Velea, L	2022	https://doi.org/10.3390/ijerph192114613	Air Pollution Management: A Multivariate Analysis of Citizens' Perspectives and Their Willingness to Use Greener Forms of Transportation	advise on pollution prevention (60); adopt ways to reduce pollution (52); manage air quality (18); promote the use of sustainable transport (10); engage others in environment friendly behaviours (9)
Wang, J; Castro-Garcia, L; Jenerette, GD; Chandler, M; Ge, C; Kucera, D; Koutzoukis, S; Zeng, J	2022	https://doi.org/10.1029/2021GH000575	Resolving and Predicting Neighborhood Vulnerability to Urban Heat and Air Pollution: Insights From a Pilot Project of Community Science	promote the participation of citizens in scientific and research activities (14); review meteorological forecast data (12); integrate community outreach (8); analyse weather forecast (5); conduct participatory research (5)

	Year	DOI	Title	Top 5 skills
Chaudhuri, S; Kumar, A	2022	https://doi.org/10.1007/s10661-022-09808-w	Urban greenery for air pollution control: a meta-analysis of current practice, progress, and challenges	advise on pollution prevention (21); adopt ways to reduce pollution (13); design spatial layout of outdoor areas (7); maintain plants' growth (7); manage rainwater (6)
Khalaf, Y; Salama, C; Kurorwaho, B; D'eon, JC; Al-Abadleh, HA	2022	https://doi.org/10.1021/acs.jchemed.2c00890	The? Clean Air Outreach Project?: A Paired Research and Outreach Program Looking at Air Quality Microenvironments around Elementary Schools	advise on pollution prevention (19); manage air quality (10); prepare presentation material (10); investigate pollution (8); encourage students to acknowledge their achievements (7)
Priti, K; Kumar, P	2022	https://doi.org/10.1007/s10661-022-09896-8	A critical evaluation of air quality index models (1960–2021)	manage air quality (44); determine internal air quality parameters (32); test samples for pollutants (27); advise on pollution prevention (23); advise on nitrate pollution (19)
Winter, A.K.; Le, H.; Roberts, S.	2021	https://doi.org/10.1017/S0305741021000588	From Black to Blue Skies: Civil Society Perceptions of Air Pollution in Shanghai	advise on pollution prevention (39); adopt ways to reduce pollution (16); manage air quality (12); engage others in environment friendly behaviours (6); determine internal air quality parameters (5)
Robinson, J.A.; Novak, R.; Kanduč, T.; Maggos, T.; Pardali, D.; Stamatelopoulou, A.; Saraga, D.; Vienneau, D.; Flückiger, B.; Mikeš, O.; Degrendele, C.; Sánka, O.; Dos Santos, S.G.; Visave, J.; Gotti, A.; Persico, M.G.; Chapizanis, D.; Petridis, I.; Karakitsios, S.; Sarigiannis, D.A.; Kocman, D.	2021	https://doi.org/10.3390/ijerph182312544	User-centred design of a final results report for participants in multi-sensor personal air pollution exposure monitoring campaigns	deliver visual presentation of data (14); present reports (13); prepare visual data (12); interview focus groups (11); use methodologies for user-centered design (10)
Barwise, Y.; Kumar, P.; Tiwari, A.; Rafi-Butt, F.; McNabola, A.; Cole, S.; Field, B.C.T.; Fuller, J.; Mendis, J.; Wyles, K.J.	2021	https://doi.org/10.1016/j.scs.2021.103299	The co-development of HedgeDATE, a public engagement and decision support tool for air pollution exposure mitigation by green infrastructure	advise on pollution prevention (12); design questionnaires (11); vegetation control (9); determine visual concepts (7); adopt ways to reduce pollution (6)
Kouis, P.; Papatheodorou, S.I.; Kakkoura, M.G.; Middleton, N.; Galanakis, E.; Michaelidi, E.; Achilleos, S.; Mihalopoulos, N.; Neophytou, M.; Stamatelatos, G.; Kaniklides, C.; Revvas, E.; Tymvios, F.; Savvides, C.; Koutrakis, P.; Yiallourous, P.K.	2021	https://doi.org/10.1186/s12887-020-02472-4	The MEDEA childhood asthma study design for mitigation of desert dust health effects: implementation of novel methods for assessment of air pollution exposure and lessons learned	maintain relations with children's parents (4); monitor interventions in the outdoors (4); test samples for pollutants (4); report the results of treatment (3); analyse health damaging behaviours (2)
Badach, J.; Dymnicka, M.; Załęcki, J.; Brosz, M.; Voordeckers, D.; van Acker, M.	2021	https://doi.org/10.3390/su132111790	Exploring the institutional and bottom-up actions for urban air quality improvement: Case studies in antwerp and gdańsk	advise on pollution prevention (52); adopt ways to reduce pollution (32); manage air quality (17); advise on fitted ventilation systems (9); advise on nature conservation (6)
Wróblewski, M.; Suchomska, J.; Tamborska, K.	2021	https://doi.org/10.3390/su132011406	Citizens or consumers? Air quality sensor users and their involvement in sensor community. results from qualitative case study	promote the participation of citizens in scientific and research activities (34); manage air quality (26); advise on pollution prevention (19); increase the impact of science on policy and society (17); maintain sensor equipment (9)

	Year	DOI	Title	Top 5 skills
Dardier, G.; Jabot, F.; Pouliquen, F.	2021	https://doi.org/10.3390/ijerph181910046	Can air quality citizen-sensors turn into clean air ambassadors? Insights from a qualitative study	advise on pollution prevention (23); engage others in environment friendly behaviours (13); manage air quality (11); promote the participation of citizens in scientific and research activities (11); enable audience participation (8)
Cao, J.; Chen, J.	2021	https://doi.org/10.3390/ijerph18179301	The impact of an authoritarian personality on pro-environmental behaviour for air pollution mitigation through interactions with social norms	adopt ways to reduce pollution (35); advise on pollution prevention (35); engage others in environment friendly behaviours (21); evaluate environmental impact of personal behaviour (14); report pollution incidents (10)
Bharath Kumar Reddy, K.R.B.K.; Gupta, N.; Bhat-tacharya, B.G.; Deka, N.M.; Chandane, P.; Kapoor, R.; Gupta, S.; Nagarajan, S.A.; Basavaraja, G.V.; Parekh, B.J.	2021	https://doi.org/10.1007/s13312-021-2288-1	Impact of Air Pollution on Allergic Rhinitis and Asthma: Consensus Statement by Indian Academy of Pediatrics	advise on nitrate pollution (9); advise on pollution prevention (9); manage air quality (6); diagnose respiratory diseases (3); adopt ways to reduce pollution (2)
Rashid, R.; Chong, F.; Islam, S.; Bryant, M.; McEachan, R.R.C.	2021	https://doi.org/10.1186/s12889-021-11337-z	Taking a deep breath: a qualitative study exploring acceptability and perceived unintended consequences of charging clean air zones and air quality improvement initiatives amongst low-income, multi-ethnic communities in Bradford, UK	advise on pollution prevention (19); promote public transport (18); adopt ways to reduce pollution (16); advise on nitrate pollution (9); apply road transport environmental measures (9)
Myeong, S.; Shahzad, K.	2021	https://doi.org/10.3390/su13137168	Integrating data-based strategies and advanced technologies with efficient air pollution management in smart cities	advise on pollution prevention (51); adopt ways to reduce pollution (25); manage air quality (19); measure pollution (8); test samples for pollutants (5)
Mahajan, S.; Gabrys, J.; Armitage, J.	2021	https://doi.org/10.3390/s21124044	Airkit: A citizen-sensing toolkit for monitoring air quality	manage air quality (26); test sensors (12); advise on pollution prevention (8); measure pollution (6); assemble sensors (5)
Park, Y.M.; Sousan, S.; Streuber, D.; Zhao, K.	2021	https://doi.org/10.3390/s21113761	Geoair—A novel portable, GPS-enabled, low-cost air-pollution sensor: Design strategies to facilitate citizen science research and geospatial assessments of personal exposure	manage air quality (9); advise on pollution prevention (4); measure pollution (4); collect data using GPS (3); engage others in environment friendly behaviours (3)
Castell-Balaguer, N.; Grossberndt, S.; Gray, L.; Fredriksen, M.F.; Skaar, J.S.; Hoiskar, B.A.K.	2021	https://doi.org/10.3389/fc-lim.2021.639128	Implementing Citizen Science in Primary Schools: Engaging Young Children in Monitoring Air Pollution	promote the participation of citizens in scientific and research activities (16); advise on pollution prevention (14); increase the impact of science on policy and society (13); test samples for pollutants (13); manage air quality (10)
De Vito, L.; Barnes, J.; Longhurst, J.; Williams, B.; Hayes, E.	2021	https://doi.org/10.1080/23748834.2020.1796422	The legacy of COVID-19: lessons and challenges for city-scale air quality management in the UK	advise on pollution prevention (14); adopt ways to reduce pollution (13); apply road transport environmental measures (6); manage air quality (6); advise on nitrate pollution (5)

	Year	DOI	Title	Top 5 skills
Kuiper, I.; Svanes, C.; Markevych, I.; Accordini, S.; Bertelsen, R.J.; Bråbäck, L.; Heile Christensen, J.; Forsberg, B.; Halvorsen, T.; Heinrich, J.; Hertel, O.; Hoek, G.; Holm, M.; de Hoogh, K.; Janson, C.; Malinowski, A.; Marcon, A.; Nilsen, R.; Sigsgaard, T.; Johannessen, A.	2021	https://doi.org/10.1016/j.envint.2020.106219	Lifelong exposure to air pollution and greenness in relation to asthma, rhinitis and lung function in adulthood	advise on nitrate pollution (6); compare survey computations (3); advise on pollution prevention (2); manage air quality (2); test samples for pollutants (2)
Ekman, K.; Weilenmann, A.	2021	https://doi.org/10.1080/09640568.2020.1787129	Behind the scenes of planning for public participation: planning for air-quality monitoring with low-cost sensors	promote the participation of citizens in scientific and research activities (14); manage air quality (12); test sensors (8); advise on pollution prevention (7); investigate pollution (7)
Fogg-Rogers, L.; Hayes, E.; Vanherle, K.; Pápics, PI; Chatterton, T.; Barnes, J; Slingerland, S; Boushel, C; Laggan, S; Longhurst, J	2021	https://doi.org/10.3390/su13063406	Applying Social Learning to Climate Communications- Visualising 'People Like Me' in Air Pollution and Climate Change Data	engage others in environment friendly behaviours (16); adopt ways to reduce pollution (13); advise on pollution prevention (9); evaluate environmental impact of personal behaviour (8); advise on carbon emissions reduction (7)
Delmas, MA; Kohli, A	2021	https://doi.org/10.1177/1086026619837690	Engagement With Air Quality Information: Stated Versus Revealed Preferences	advise on pollution prevention (24); manage air quality (17); inform clients of healthy lifestyle benefits (8); adopt ways to reduce pollution (7); compare survey computations (6)
Rosario, NA; Urrutia-Pereira, M; D'Amato, G; Cecchi, L; Ansotegui, IJ; Galán, C; Pomés, A; Murrieta-Aguttes, M; Caraballo, L; Rouadi, P; Annesi-Maesano, I; Pawankar, R; Chong-Neto, HJ; Peden, DB	2021	https://doi.org/10.1016/j.waojou.2020.100499	Air pollution and indoor settings	advise on pollution prevention (26); advise on nitrate pollution (7); determine internal air quality parameters (7); advise on fitted ventilation systems (6); demonstrate awareness of health risks (4)
Yang, XD; Wu, HT; Ren, SY; Ran, QY; Zhang, JN	2021	https://doi.org/10.1016/j.strueco.2020.12.001	Does the development of the internet contribute to air pollution control in China? Mechanism discussion and empirical test	protect the environment from the impact of the digital technologies (58); advise on pollution prevention (55); adopt ways to reduce pollution (12); advise on nitrate pollution (12); report pollution incidents (12)
Lynch, KM; Mirabelli, MC	2021	https://doi.org/10.1016/j.jadohealth.2020.07.040	Outdoor Air Quality Awareness, Perceptions, and Behaviors Among US Children Aged 12–17 Years, 2015–2018	advise on pollution prevention (38); adopt ways to reduce pollution (18); manage air quality (10); assess the development of youth (5); compare survey computations (5)

	Year	DOI	Title	Top 5 skills
Brakema, E.A.; van Gemert, F.A.; Williams, S.; Sooronbaev, T.; Emilov, B.; Mademilov, M.; Tabyshova, A.; Le An, P.L.; Quynh, N.N.; Hong, L.H.T.C.; Dang, T.N.; van der Kleij, R.M.J.J.; Chavannes, N.H.; de Jong, C.; Anastasaki, M.; Akylbekov, A.; Barton, A.; Bertsias, A.; Binh, P.D.U.; van Boven, J.F.M.; Burges, D.; Cartwright, L.; Chatzea, V.E.; Cragg, L.; Dautov, I.; Ferarrio, I.; Hedrick, B.; Hopkinson, N.; Isaeva, E.; Jones, R.; van Kampen, S.; Katagira, W.; Kjaergaard, J.; Kocks, J.; Lan, L.T.T.; Linh, T.T.D.; Lionis, C.; Loan, K.X.; McEwen, A.; Musinguzi, P.; Nantanda, R.; Ndeezi, G.; Papadakis, S.; Pinnock, H.; Pooler, J.; Poot, C.C.; Postma, M.J.; Poulsen, A.; Powell, P.; Reventlow, S.; Sifaki-Pistolla, D.; Singh, S.; de Sousa, J.C.; Stout, J.; Ostergaard, M.S.; Tsiligianni, I.; Tuan, T.D.; Tumwine, J.; Van, L.T.; Vinh, N.N.; Walusimbi, S.; Warren, L.	2020	https://doi.org/10.1038/s41533-020-00201-z	Implementing a context-driven awareness programme addressing household air pollution and tobacco: a FRESH AIR study	participate in health personnel training (19); advise policy makers in healthcare (13); provide treatment strategies for challenges to human health (12); design training programmes for individuals and animals (10); promote health in specialised care (7)
Derrien, M.M.; Zuidema, C.; Jovan, S.; Bidwell, A.; Brinkley, W.; López, P.; Barnhill, R.; Blahna, D.J.	2020	https://doi.org/10.3390/ijerph17197278	Toward environmental justice in civic science: youth performance and experience measuring air pollution using moss as a bio-indicator in industrial-adjacent neighborhoods	promote the participation of citizens in scientific and research activities (27); integrate community outreach (21); assess the development of youth (12); conduct participatory research (8); engage others in environment friendly behaviours (8)
Xu, F.; Tian, M.; Yang, J.; Xu, G.	2020	https://doi.org/10.3390/SU12083316	Does environmental inspection led by the central government improve the air quality in China? The moderating role of public engagement	advise on pollution prevention (64); adopt ways to reduce pollution (42); perform environmental investigations (37); measure pollution (33); report pollution incidents (22)
Schaefer, T.; Kieslinger, B.; Fabian, C.M.	2020	https://doi.org/10.5334/ctp.245	Citizen-based air quality monitoring: The impact on individual citizen scientists and how to leverage the benefits to affect whole regions	advise on pollution prevention (25); promote the participation of citizens in scientific and research activities (17); advise on nitrate pollution (15); manage air quality (14); increase the impact of science on policy and society (9)
Silvaggio, R.; Curcuruto, S.; Mazzocchi, E.; Borch, F.; Bartalucci, C.; Governi, L.; Carfagni, M.; Bellomini, R.; Luzzi, S.; Colucci, G.; Cattani, G.; Gaeta, A.; Leone, G.; Di Menno Di Bucchianico, A.; Cusano, M.; Algieri, A.; Colombi, C.; Cuccia, E.; Dal Santo, U.	2020	https://doi.org/10.1515/noise-2020-0015	Life Monza: Comparison between ante and post-operam noise and air quality monitoring activities in a Noise Low Emission Zone	ensure compliance with noise standards (22); use sound measuring instruments (20); apply road transport environmental measures (6); measure pollution (6); advise on pollution prevention (5)

	Year	DOI	Title	Top 5 skills
Bulto, T.W.	2020	https://doi.org/10.1177/1178630220943204	Impact of Open Burning Refuse on Air Quality: In the Case of “Hidar Sitaten” at Addis Ababa, Ethiopia	advise on pollution prevention (21); manage air quality (17); advise on nitrate pollution (10); adopt ways to reduce pollution (5); determine internal air quality parameters (5)
Okello, N.O.; Okello, T.W.; Zunckel, M.	2020	https://doi.org/10.17159/CAJ/2020/30/1.8001	Public perceptions of air quality status and suggestions for improvement: The case of Richards Bay and its surroundings, uMhlathuze Local Municipality, South Africa	advise on pollution prevention (38); manage air quality (18); adopt ways to reduce pollution (17); advise on nitrate pollution (14); prepare survey report (10)
Nurwidyaningrum, D.; Kusnopranto, H.; Moersidik, S.S.	2020	https://doi.org/10.21660/2020.73.96794	Occupants’ engagement for indoor air quality of middle income housing in Jakarta-Indonesia	determine internal air quality parameters (8); advise policy makers in healthcare (6); empower individuals, families and groups (6); analyse health problems within a given community (5); handle tenant changeover (5)
Mahajan, S.; Kumar, P.; Pinto, J.A.; Riccetti, A.; Schaaf, K.; Camprodon, G.; Smári, V.; Passani, A.; Forino, G.	2020	https://doi.org/10.1016/j.scs.2019.101800	A citizen science approach for enhancing public understanding of air pollution	advise on pollution prevention (46); promote the participation of citizens in scientific and research activities (40); manage air quality (16); engage others in environment friendly behaviours (13); design questionnaires (11)
Niu, XJ; Wang, XH; Gao, J; Wang, XJ	2020	https://doi.org/10.1016/j.jenvman.2019.109698	Has third-party monitoring improved environmental data quality? An analysis of air pollution data in China	perform environmental investigations (6); manage air quality (5); measure pollution (5); carry out environmental audits (4); advise on pollution prevention (3)
Hashad, K; Yang, B; Baldauf, RW; Deshmukh, P; Isakov, V; Zhang, KM	2020	https://doi.org/10.1016/j.scitotenv.2020.137136	Enhancing the local air quality benefits of roadside green infrastructure using low-cost, impermeable, solid structures (LISS)	vegetation control (30); minimise environmental impact on the surrounding area (9); maintain plants’ growth (8); advise on pollution prevention (3); adopt ways to reduce pollution (2)
Wan, K; Shackley, S; Doherty, RM; Shi, ZB; Zhang, PQ; Golding, N	2020	https://doi.org/10.1016/j.envsci.2020.03.003	Science-policy interplay on air pollution governance in China	increase the impact of science on policy and society (35); advise on pollution prevention (20); conduct research on climate processes (14); promote the participation of citizens in scientific and research activities (12); manage air quality (10)
Carratù, M.; Chiarini, B.; D’Agostino, A.; Marzano, E.; Regoli, A.	2019	https://doi.org/10.1108/JES-03-2019-0116	Air pollution and public finance: evidence for European countries	adopt ways to reduce pollution (7); advise on nitrate pollution (5); apply road transport environmental measures (5); advise on pollution prevention (3); assess environmental plans against financial costs (3)
Lam, J.C.K.; Cheung, L.Y.L.; Wang, S.; Li, V.O.K.	2019	https://doi.org/10.1016/j.envsci.2019.07.007	Stakeholder concerns of air pollution in Hong Kong and policy implications: A big-data computational text analysis approach	advise on pollution prevention (31); identify new words (13); manage air quality (11); adopt ways to reduce pollution (9); advise on nitrate pollution (8)
L’Her, G.; Servièrès, M.; Siret, D.	2019	https://doi.org/10.4018/IJEP.2019100103	Citizen as sensors’ commitment in urban public action: Case study on urban air pollution	manage air quality (24); promote the participation of citizens in scientific and research activities (19); advise on pollution prevention (18); investigate pollution (11); measure pollution (9)

	Year	DOI	Title	Top 5 skills
Soria-Lara, J.A.; Tarriño-Ortiz, J.; Bueno Cadena, P.; Ortega Hortelano, A.; Vassallo, J.M.	2019	https://doi.org/10.1016/j.cities.2019.03.017	A collaborative appraisal framework to evaluate transport policies for improving air quality in city centres	analyse transport studies (15); apply road transport environmental measures (10); engage with stakeholders (10); develop urban transport studies (9); use questioning techniques for assessment (9)
Forni, E.; Negro, E.; Carlucci, C.; Nasso, A.; Struppek, M.	2019	https://doi.org/10.1080/23748834.2019.1596045	Actions against air pollution in Turin for a healthy and playable city	advise on pollution prevention (8); adopt ways to reduce pollution (6); manage air quality (4); monitor the conformance to the project methodology (3); promote public transport (3)
Rickenbacker, H.; Brown, F.; Bilec, M.	2019	https://doi.org/10.1016/j.scs.2019.101473	Creating environmental consciousness in underserved communities: Implementation and outcomes of community-based environmental justice and air pollution research	conduct participatory research (18); integrate community outreach (18); promote the participation of citizens in scientific and research activities (12); raise awareness on local community's priorities (10); advise policy makers in healthcare (8)
van Brussel, S.; Huyse, H.	2019	https://doi.org/10.1080/09640568.2018.1428183	Citizen science on speed? Realising the triple objective of scientific rigour, policy influence and deep citizen engagement in a large-scale citizen science project on ambient air quality in Antwerp	promote the participation of citizens in scientific and research activities (51); increase the impact of science on policy and society (26); advise on pollution prevention (10); integrate community outreach (10); engage others in environment friendly behaviours (9)
Oliveira, K.; Rodrigues, V.; Coelho, S.; Patrícia Fernandes, A.; Rafael, S.; Faria, C.; Ferreira, J.; Borrego, C.; Husby, T.; Dias, I.; Nielsen, P.S.; Liu, X.; Kewo, A.; Trozzi, C.; Piscitello, E.; Vanherle, K.; Knudsen, S.; Bouman, E.A.; Barnes, J.; Slingerland, S.; Hayes, E.; Bolscher, H.; Nunes, M.	2019	https://doi.org/10.2495/AIR190091	Assessment of source contributions to the urban air quality for the Bristol claircity pilot case	advise on pollution prevention (11); advise on nitrate pollution (7); adopt ways to reduce pollution (3); advise on carbon emissions reduction (3); simulate transport problems (3)
Rachman, H.O.; Barus, L.S.	2019	https://doi.org/10.21660/2019.62.8286	Impact of Car-Free Day on air pollution and its multifarious advantages in Sudirman-Thamrin Street, Jakarta	advise on pollution prevention (6); manage air quality (5); adopt ways to reduce pollution (4); measure pollution (4); determine internal air quality parameters (3)
Golumbic, Y.N.; Fishbain, B.; Baram-Tsabari, A.	2019	https://doi.org/10.1080/21548455.2019.1597314	User centered design of a citizen science air-quality monitoring project	promote the participation of citizens in scientific and research activities (52); increase the impact of science on policy and society (30); manage air quality (18); advise on pollution prevention (17); deliver visual presentation of data (10)
Tu, WL	2019	https://doi.org/10.1215/18752160-7,267,447	Combating Air Pollution through Data Generation and Reinterpretation: Community Air Monitoring in Taiwan	advise on pollution prevention (64); manage air quality (44); adopt ways to reduce pollution (27); promote the participation of citizens in scientific and research activities (25); increase the impact of science on policy and society (15)
Wang, B; Hong, G; Qin, T; Fan, WR; Yuan, XC	2019	https://doi.org/10.1016/j.jclepro.2019.07.046	Factors governing the willingness to pay for air pollution treatment: A case study in the Beijing-Tianjin-Hebei region	advise on pollution prevention (66); adopt ways to reduce pollution (41); design questionnaires (15); revise questionnaires (10); advise on nitrate pollution (8)

	Year	DOI	Title	Top 5 skills
Gupta, S.; Pebesma, E.; Deg-belo, A.; Costa, A.C.	2018	https://doi.org/10.3390/ijgi7120468	Optimising citizen-driven air quality monitoring networks for cities	manage air quality (30); measure pollution (20); advise on pollution prevention (13); test sensors (8); advise on nitrate pollution (5)
Robinson, J.A.; Kocman, D.; Horvat, M.; Bartoňová, A.	2018	https://doi.org/10.3390/s18113768	End-user feedback on a low-cost portable air quality sensor system — Are we there yet?	manage air quality (10); test samples for pollutants (9); promote the participation of citizens in scientific and research activities (8); interview focus groups (7); use methodologies for user-centered design (6)
Dong, H.; Yu, Y.; Yao, S.; Lu, Y.; Chen, Z.; Li, G.; Yao, Y.; Yao, X.; Wang, S.-L.; Zhang, Z.	2018	https://doi.org/10.1136/bmjopen-2017-020425	Acute effects of air pollution on ischaemic stroke onset and deaths: A time-series study in Changzhou, China	advise on nitrate pollution (6); advise on pollution prevention (3); formulate findings (3); manage the neuropsychiatric sequelae of stroke (2); provide stroke rehabilitation services (2)
Calvillo, N.	2018	https://doi.org/10.1177/0306312718784656	Political airs: From monitoring to attuned sensing air pollution	adopt ways to reduce pollution (15); advise on pollution prevention (15); react accordingly to unexpected events outdoors (11); manage air quality (9); identify poisons (7)
Trozzi, C.; Vaccaro, R.; Trozzi, M.	2018	https://doi.org/10.2495/SDP180071	Social networks, awareness and behavioral modification to reduce air pollution and carbon footprints: The claircity project in the Liguria region of Italy	adopt ways to reduce pollution (11); advise on pollution prevention (9); apply social media marketing (7); engage others in environment friendly behaviours (6); evaluate environmental impact of personal behaviour (5)
Vito, L.D.E.; Chatterton, T.; Namdeo, A.; Shiva Nagendra, S.; Gulia, S.; Goyal, S.; Bell, M.; Goodman, P.; Longhurst, J.; Hayes, E.; Kumar, R.; Sethi, V.; Gitakrishnan Ramadurai, S.B.; Majumder, S.; Menon, J.S.; Turamari, M.N.; Barnes, J.	2018	https://doi.org/10.2495/AIR180411	Air pollution in Delhi: A review of past and current policy approaches	advise on pollution prevention (35); advise on nitrate pollution (9); develop environmental policy (9); adopt ways to reduce pollution (7); manage air quality (7)
Coelho, S.; Rodrigues, V.; Barnes, J.; Boushel, C.; Devito, L.; Nunes, M.	2018	https://doi.org/10.2495/AIR180241	Air pollution in the Aveiro region, Portugal: A citizens' engagement approach	adopt ways to reduce pollution (24); advise on pollution prevention (22); advise on carbon emissions reduction (7); engage others in environment friendly behaviours (7); inform customers environmental protection (3)
Hayes, E.; King, A.; Callum, A.; Williams, B.; Vanherle, K.; Boushel, C.; Barnes, J.; Chatterton, T.; Bolscher, H.; Csobod, E.; Fogg-Rogers, L.; Slingerland, S.; Longhurst, J.	2018	https://doi.org/10.2495/AIR180221	Clairecity project: Citizen-led scenarios to improve air quality in European cities	advise on pollution prevention (18); adopt ways to reduce pollution (16); advise on carbon emissions reduction (5); evaluate environmental impact of personal behaviour (5); engage others in environment friendly behaviours (4)
Prestwood, E.; Longhurst, J.; Townsend, I.; Haines, T.; Tsiarapa, E.	2018	https://doi.org/10.2495/AIR180461	Facilitating stakeholder dialogues on a carbon neutral city: We need to talk about carbon (and air quality)	advise on carbon emissions reduction (27); create social alliances (15); advise on pollution prevention (14); engage others in environment friendly behaviours (13); promote environmental awareness (11)
Li, L.; Xia, XH; Chen, B; Sun, LX	2018	https://doi.org/10.1016/j.jclepro.2018.08.046	Public participation in achieving sustainable development goals in China: Evidence from the practice of air pollution control	advise on pollution prevention (23); adopt ways to reduce pollution (14); report pollution incidents (10); develop environmental policy (7); engage others in environment friendly behaviours (7)

	Year	DOI	Title	Top 5 skills
Shen, YD; Ahlers, AL	2018	https://doi.org/10.1080/23812346.2018.1486347	Local environmental governance innovation in China: staging 'triangular dialogues' for industrial air pollution control	advise on pollution prevention (33); adopt ways to reduce pollution (11); develop environmental policy (8); advise on carbon emissions reduction (6); promote communication between parties (5)
Lenschow, A.; Becker, S.T.; Mehl, C.	2017	https://doi.org/10.1080/1523908X.2017.1388739	Scalar dynamics and implications of ambient air quality management in the EU	advise on pollution prevention (9); adopt ways to reduce pollution (8); apply road transport environmental measures (7); develop environmental policy (4); advise on nitrate pollution (3)
Commodore, A.; Wilson, S.; Muhammad, O.; Svendsen, E.; Pearce, J.	2017	https://doi.org/10.1007/s10661-017-6063-7	Community-based participatory research for the study of air pollution: a review of motivations, approaches, and outcomes	manage air quality (68); measure pollution (39); advise on pollution prevention (38); promote the participation of citizens in scientific and research activities (20); test samples for pollutants (20)
Hu, L.; Zhu, L.; Xu, Y.; Lyu, J.; Imm, K.; Yang, L.	2017	https://doi.org/10.1007/s12529-017-9647-2	Relationship Between Air Quality and Outdoor Exercise Behavior in China: a Novel Mobile-Based Study	create exercise programmes for health risks (9); advise on pollution prevention (7); adopt ways to reduce pollution (5); prescribe exercises for controlled health conditions (5); promote sport activities in public health (5)
Oltra, C.; Sala, R.; Boso, À.; Asensio, S.L.	2017	https://doi.org/10.1007/s10661-017-6011-6	Public engagement on urban air pollution: an exploratory study of two interventions	advise on pollution prevention (44); adopt ways to reduce pollution (26); investigate pollution (12); engage others in environment friendly behaviours (10); manage air quality (9)
de Moura Xavier, J.C.; Sousa Júnior, W.C.; Martins, M.P.P.	2017	https://doi.org/10.18472/ustDeb.v8n1.2017.18846	Air quality public policies and their implications for densely populated urban areas in Brazil	apply road transport environmental measures (14); adopt ways to reduce pollution (13); manage air quality (12); advise on pollution prevention (9); evaluate vehicle ecological footprint (7)
Hong, S.	2017	https://doi.org/10.1007/s41324-016-0077-z	Design of air quality information service based upon geographic context information model in ISO19154	manage air quality (64); determine internal air quality parameters (32); advise on pollution prevention (16); adopt ways to reduce pollution (4); measure pollution (4)
Naik, Y.; Jones, S.; Christmas, H.; Roderick, P.; Cooper, D.; McGready, K.; Gent, M.	2017	https://doi.org/10.3390/cli5030062	Collaborative health impact assessment and policy development to improve air quality in West Yorkshire-A case study and critical reflection	advise on pollution prevention (23); engage with stakeholders (12); adopt ways to reduce pollution (10); advise on nitrate pollution (10); manage air quality (8)
Liu, H.-Y.; Dunea, D.; Oprea, M.; Savu, T.; Iordache, S.	2017	https://doi.org/10.37358/rc.17.4.5563	Improving the protection of children against air pollution threats in Romania-The RokidAIR project approach and future perspectives	advise on pollution prevention (21); manage air quality (16); adopt ways to reduce pollution (5); advise on nitrate pollution (3); compile GIS-data (3)
Kotaki, K.; Ikeda, H.; Fukuda, T.; Yuki, F.; Hasuo, K.; Kawano, Y.; Kawasaki, M.	2017	https://doi.org/10.1136/bmjopen-2016-012923	Effectiveness of diagnostic screening tests in mass screening for COPD using a cooperative regional system in a region with heavy air pollution: A cross-sectional study	diagnose respiratory diseases (31); provide strategies of differential diagnosis (9); undertake genetic risk assessment (3); advise on nitrate pollution (2); compare survey computations (2)

	Year	DOI	Title	Top 5 skills
Ngo, NS; Kokoyo, S; Klopp, J	2017	https://doi.org/10.1016/j.puhe.2015.07.014	Why participation matters for air quality studies: risk perceptions, understandings of air pollution and mobilization in a poor neighborhood in Nairobi, Kenya	advise on pollution prevention (58); manage air quality (25); adopt ways to reduce pollution (18); advise on nitrate pollution (16); interview focus groups (8)
Hu, Y; Pratt, CB	2017	https://doi.org/10.1016/j.pubrev.2017.03.002	Grounding civic engagement in strategic communication for China's public-health programs: Air-quality campaigns as a case study	advise on pollution prevention (19); create social alliances (10); motivate supporters (8); adopt ways to reduce pollution (7); carry out training in environmental matters (5)
von Schneidemesser, E; Kutzner, RD; Schmale, J	2017	https://doi.org/10.1525/elementa.126	A survey on the perceived need and value of decision-support tools for joint mitigation of air pollution and climate change in cities	utilise decision support system (25); advise on pollution prevention (24); advise on carbon emissions reduction (20); compare survey computations (15); advise on nitrate pollution (9)
Brunt, H; Barnes, J; Longhurst, JWS; Scally, G; Hayes, E	2016	https://doi.org/10.1016/j.envsci.2016.01.009	Local Air Quality Management policy and practice in the UK: The case for greater Public Health integration and engagement	advise policy makers in healthcare (4); provide treatment strategies for challenges to human health (4); address public health issues (3); advise on pollution prevention (2); apply the concept of Flexible Use of Airspace (2)
Ortolani, C; Vitale, M	2016	https://doi.org/10.1016/j.scs.2016.06.001	The importance of local scale for assessing, monitoring and predicting of air quality in urban areas	adopt ways to reduce pollution (8); advise on pollution prevention (5); apply road transport environmental measures (5); promote public transport (5); analyse transport studies (4)
Mahoney, G.; Stewart, A.G.; Kennedy, N.; Whitely, B.; Turner, L.; Wilkinson, E.	2015	https://doi.org/10.1007/s10653-015-9717-9	Achieving attainable outcomes from good science in an untidy world: case studies in land and air pollution	advise on pollution prevention (31); manage air quality (22); advise on nitrate pollution (11); engage with stakeholders (8); assess contamination (6)
Sîrbu, A.; Becker, M.; Caminiti, S.; De Baets, B.; Elen, B.; Francis, L.; Gravino, P.; Hotho, A.; Ingarra, S.; Loreto, V.; Molino, A.; Mueller, J.; Peters, J.; Ricchiuti, F.; Saracino, F.; Servedio, V.D.P.; Stumme, G.; Theunis, J.; Tria, F.; van den Bossche, J.	2015	https://doi.org/10.1371/journal.pone.0136763	Participatory patterns in an international air quality monitoring initiative	manage air quality (11); advise on pollution prevention (8); measure pollution (7); analyse environmental data (6); adopt ways to reduce pollution (4)
Rodríguez, L.; Mendez, D.	2015	https://doi.org/10.2495/AIR150111	Pollution spots: A novel method for air pollution monitoring	measure pollution (8); collect data using GPS (5); advise on pollution prevention (3); apply digital mapping (3); collect mapping data (3)
Gulia, S.; Shiva Nagendra, S.; Khare, M.; Khanna, I.	2015	https://doi.org/10.5094/APR.2015.033	Urban air quality management-A review	advise on pollution prevention (19); advise on nitrate pollution (11); manage air quality (8); adopt ways to reduce pollution (6); apply road transport environmental measures (6)

Acknowledgements This publication uses the ESCO classification of the European Commission.

Author contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Leonardo Triana, Helinä Melkas, Anne Pässilä, Eugenio Morello and Mikko Hoppo. The first draft of the manuscript was written by Leonardo Triana, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Open Access funding provided by LUT University (previously Lappeenranta University of Technology (LUT)). This work has received funding from the European Union through Marie Skłodowska-Curie Actions, project number 101081466: SEED – Systems and Engineering Science Doctorate.

Data availability Data available on request from the authors.

Declarations

Ethics approval and consent to participate This study did not involve direct research with human participants, animals or identifiable personal data. It analysed published scientific literature and derived skill classifications from article text. Ethics approval and participant consent were therefore not required.

Consent for publication Not applicable.

Competing interests The authors declare that they have no competing interests.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Audrin B, Audrin C, Salamin X (2024) Digital skills at work: Conceptual development and empirical validation of a measurement scale. *Technol Forecast Soc Chang* 202:123279. <https://doi.org/10.1016/j.techfore.2024.123279>
- Barna O, Szalmáné Cséte M (2025) Competence framework-based assessment to foster sustainability management. *Periodica Polytech Social Manage Sci* 33(2):166–177. <https://doi.org/10.3311/PPso.22416>
- Barros B, Oliveira MMM, Morais SB (2025) Air pollution and health impacts of wildfire seasons: Insights from northern Portugal. *Water Air Soil Pollut* 236(7). <https://doi.org/10.1007/s11270-025-08047-2>
- Beaulieu A, Leblond J-P, Déry S, Cao H (2023) Urban air pollution anxieties, forest conservation, and farmland expropriation: State territorialization in the uplands and highlands of northern Thailand. *Land Use Policy* 131:106687. <https://doi.org/10.1016/j.landusepol.2023.106687>
- Beevers SD, Assareh N, Beddows AV, Stewart GB, Holland MR, Fecht D, Liu Y, Goodman AC, Walton HA, Brand C, Evangelopoulos D, Wood D, Vu TV, Dajnak D (2025) Climate change policies reduce air pollution and increase physical activity: Benefits, costs, inequalities, and indoor exposures. *Environ Int* 195:109164. <https://doi.org/10.1016/j.envint.2024.109164>
- Brakema EA, van Gemert FA, Williams S, Sooronbaev TM, Emilov B, Mademilov MZ, Tabyshova AK, Le An P, Quynh NN, Hong LHTC, Dang T, van der Kleij MRJ, Chavannes NH, de Jong C, Anastasaki M, Akyzbekov A, Barton AG, Bertias AK, Binh PDU, Warren L (2020) Implementing a context-driven awareness programme addressing household air pollution and tobacco: A FRESH AIR study. *NPJ Prim Care Respiratory Med* 30(1). <https://doi.org/10.1038/s41533-020-00201-z>
- Brunt H, Barnes J, Longhurst JWS, Scally G, Hayes E (2016) Local air quality management policy and practice in the UK: The case for greater public health integration and engagement. *Environ Sci Policy* 58:52–60. <https://doi.org/10.1016/j.envsci.2016.01.009>
- Cedefop (2012) Green skills and environmental awareness in vocational education and training. https://www.cedefop.europa.eu/files/5524_en.pdf
- Chatzidiakou L, Archer R, Beale VJ, Bland S, Carter HE, Castro-Facchetti CF, Edwards H, Finneran J, Hama SM, Jones RL, Kumar P, Linden PF, Rawat N, Roberts K, Symons C, Vouriot CV, Wang D, Way L, West SE, Burridge HC (2023) Schools' air quality monitoring for health and education: Methods and protocols of the SAMHE initiative and project. *Developments Built Environ* 16:100266. <https://doi.org/10.1016/j.dibe.2023.100266>
- Cheng Y, Ao C, Mao B, Xu L (2022) Influential factors of environmental behavior to reduce air pollution: Integrating theories of planned behavior and psychological distance. *J Environ Planning Manage* 65(13):2490–2510. <https://doi.org/10.1080/09640568.2021.1973972>
- Chowdhury S, Chaudhary E, Dey S (2024) Protecting child health from air pollution in India. *Indian Pediatr* 61(4):375–379. <https://doi.org/10.1007/s13312-024-3163-7>
- Coelho S, Rodrigues V, Barnes JH, Boushel C, Devito L, Nunes M (2018) Air pollution in the Aveiro region, Portugal: A citizens' engagement approach. *WIT Trans Ecol Environ* 230:253–262. <https://doi.org/10.2495/AIR180241>
- Derrien MM, Zuidema C, Jovan SE, Bidwell AL, Brinkley WR, López P, Barnhill R, Blahna DJ (2020) Toward environmental justice in civic science: Youth performance and experience measuring air pollution using moss as a bio-indicator in industrial-adjacent neighborhoods. *Int J Environ Res Public Health* 17(19):7278. <https://doi.org/10.3390/ijerph17197278>
- Ekman K, Weilenmann AH (2021) Behind the scenes of planning for public participation: Planning for air-quality monitoring with low-cost sensors. *J Environ Planning Manage* 64(5):865–882. <https://doi.org/10.1080/09640568.2020.1787129>
- Erkan G, Radev DR (2004) LexRank: Graph-based lexical centrality as salience in text summarization. *J Artif Intell Res* 22:457–479. <https://doi.org/10.1613/jair.1523>
- European Commission (2017) ESCO handbook: European skills, competences, qualifications and occupations. <https://ec.europa.eu/esc/oportal/home>
- Favorite X, Kendrick A, O'Quinn M, Schermbeck J, Mayo E, Sansom GT, Ma P, Johnson NM (2025) Justice for Joppa: A framework for community-engaged research on air quality and health. *Environ Justice*. <https://doi.org/10.1089/env.2024.0032>
- Forni E, Negro E, Carlucci C, Nasso A, Struppek M (2019) Actions against air pollution in Turin for a healthy and playable city.

- Cities Health 3(1–2):53–58. <https://doi.org/10.1080/23748834.2019.1596045>
- Gardner-Frolick R, Jain S, Martinussen N, Chambliss SE, Jackson D, Zimmerman N, Giang A (2025) Incorporating community knowledge into analysis of air quality monitoring network data. *Geo-Health* 9(7):e2025GH001378. <https://doi.org/10.1029/2025GH01378>
- Gignac F, Righi V, Toran R, Errandonea LP, Ortiz R, Nieuwenhuijsen MJ, Creus J, Basagaña X, Balestrini M (2022) Co-creating a local environmental epidemiology study: The case of citizen science for investigating air pollution and related health risks in Barcelona, Spain. *Environ Health* 21(1):3. <https://doi.org/10.1186/s12940-021-00826-8>
- Gorman G, Hellebust S, Venables DS, Ryan K, Cassarino M (2023) Introducing forecast-based public health warnings to promote engagement with air quality risk: A survey of citizens' attitudes in Cork, Ireland. *J Risk Res* 26(6):594–609. <https://doi.org/10.1080/13669877.2023.2170453>
- Gulia S, Nagendra SMS, Khare M, Khanna I (2015) Urban air quality management: A review. *Atmospheric Pollution Res* 6(2):286–304. <https://doi.org/10.5094/APR.2015.033>
- Gupta S, Pebesma EJ, Degbelo A, Costa AC (2018) Optimising citizen-driven air quality monitoring networks for cities. *ISPRS Int J Geo-Information* 7(12):468. <https://doi.org/10.3390/ijgi7120468>
- Ilie AM, McCarthy N, Velasquez L, Moitra M, Eisl HM (2022) Air pollution exposure assessment at schools and Playgrounds in Williamsburg, Brooklyn (NYC), with a view to developing a set of policy solutions. *J Environ Stud Sci* 12(4):838–852. <https://doi.org/10.1007/s13412-022-00777-7>
- Jha N, Pandey A, Khan U, Gupta A, Gour CP (2025) The role of public in mitigating air pollution in Delhi (2004–2024): A critical review. *Environ Claims J*. <https://doi.org/10.1080/10406026.2025.2537092>
- Kariotis TC, Borda A, Winkel KD, Gray KM (2022) Citizen science for one digital health: A rapid qualitative review of studies in air quality with reflections on a conceptual model. *Citiz Science: Theory Pract* 7(1):25. <https://doi.org/10.5334/cstp.531>
- Kouis P, Papatheodorou SI, Kakkoura MG, Middleton N, Galanakis E, Michaelidi E, Achilleos S, Mihalopoulos N, Neophytou MK, Stamatiatos G, Kaniklides C, Revvas E, Tymvios FS, Savvides C, Koutrakis P, Yiallourous PK (2021) The MEDEA childhood asthma study design for mitigation of desert dust health effects: Implementation of novel methods for assessment of air pollution exposure and lessons learned. *BMC Pediatr* 21(1):24. <https://doi.org/10.1186/s12887-020-02472-4>
- le Vrang M, Papantoniou A, Pauwels E, Fannes P, Vandensteen D, De Smedt J (2014) ESCO: Boosting job matching in Europe with semantic interoperability. *Computer* 47(10):57–64. <https://doi.org/10.1109/MC.2014.283>
- Li W, Xiao Z, Huang Y, Wu H (2024) Breathing life into equity: How air pollution influences corporate pay gap. *J Environ Manage* 372:123298. <https://doi.org/10.1016/j.jenvman.2024.123298>
- Ma P, Zhang M, Song Y (2025) Impact of public environmental participation on air pollution control: A dual examination of we-media attention and government environmental regulation. *Sustainable Futures* 10:100839. <https://doi.org/10.1016/j.sfsr.2025.100839>
- Mahajan S, Kumar P, Pinto JA, Riccetti A, Schaaf K, Campardon G, Smári V, Passani A, Forino G (2020) A citizen science approach for enhancing public understanding of air pollution. *Sustainable Cities Soc* 52:101800. <https://doi.org/10.1016/j.scs.2019.101800>
- Mahajan S, Gabrys J, Armitage JL (2021) AirKit: A citizen-sensing toolkit for monitoring air quality. *Sensors* 21(12):4044. <https://doi.org/10.3390/s21124044>
- Mahoney G, Stewart AG, Kennedy N, Whitely B, Turner L, Wilkinson EA (2015) Achieving attainable outcomes from good science in an untidy world: Case studies in land and air pollution. *Environ Geochem Health* 37(4):689–706. <https://doi.org/10.1007/s10653-015-9717-9>
- Makki F, Morello E (2025) Living labs and urban governance: Addressing complexity for environmental transition: Case study of air pollution in Ferrara, Italy. *J Urban Manage*. <https://doi.org/10.1016/j.jum.2025.09.001>
- Mao Q, Zhu X, Zhang X, Kong Y (2024) Effect of air pollution on the global burden of cardiovascular diseases and forecasting future trends of the related metrics: A systematic analysis from the Global Burden of Disease Study 2021. *Front Med* 11:1472996. <https://doi.org/10.3389/fmed.2024.1472996>
- McCarron A, Semple SE, Braban CF, Swanson V, Gillespie C, Price HD (2023) Public engagement with air quality data: Using health behaviour change theory to support exposure-minimising behaviours. *J Expo Sci Environ Epidemiol* 33(3):321–331. <https://doi.org/10.1038/s41370-022-00449-2>
- Mohd Radzuan HS, Martin J (2024) An evaluation of air quality impact prediction performance undertaken as part of environmental impact assessment (EIA) in India. *Heliyon* 10(11):e31263. <https://doi.org/10.1016/j.heliyon.2024.e31263>
- Mora S, deSouza PN, Duarte F, Wang A, Paul S, Berrones A, Ratti C (2023) Air quality monitoring in coal-centric cities: A hybrid approach. *Sustainability* 15(16):12624. <https://doi.org/10.3390/su151612624>
- Morresi N, Puerta-Beldarrain M, López-De-Ipiña González-De-Artaza D, Barco A, Gómez-Carmona O, López-Gomollon C, Casado-Mansilla D, Kotzagianni M, Casaccia S, Udina S, Revel GM (2025) A wearable sensor node for measuring air quality through citizen science approach: Insights from the SOCIO-BEE project. *Sensors* 25(12):3739. <https://doi.org/10.3390/s25123739>
- Naik Y, Jones S, Christmas H, Roderick P, Cooper D, McGready K, Gent M (2017) Collaborative health impact assessment and policy development to improve air quality in West Yorkshire: A case study and critical reflection. *Climate* 5(3):62. <https://doi.org/10.3390/cli5030062>
- Nyembwe JPKB, Munanga JK, Simões NA, Gameiro da Silva MC (2024) Ventilation strategies to mitigate air pollution impact on hospital professionals in intensive care units in the Democratic Republic of Congo. *Buildings* 14(7):1996. <https://doi.org/10.3390/buildings14071996>
- Okello NO, Okello TW, Zunckel M (2020) Public perceptions of air quality status and suggestions for improvement: The case of Richards Bay and its surroundings, uMhlathuze Local Municipality, South Africa. *Clean Air J* 30(1):1–10. <https://doi.org/10.1715/9/CAJ.2020/30/1.8001>
- Oliveira K, Rodrigues V, Coelho S, Fernandes AP, Rafael SIM, Faria CH, Ferreira J, Borrego CS, Husby TG, Dias I, Nielsen PS, Liu X, Kewo A, Trozzi C, Piscitello E, Vanherle K, Knudsen S, Bouman EA, Barnes JH, Nunes M (2019) Assessment of source contributions to the urban air quality for the Bristol ClairCity pilot case. *WIT Trans Ecol Environ* 236:89–98. <https://doi.org/10.2495/AIR190091>
- Park YM, Chavez D, Sousan S, Figueroa-Bernal N, Alvarez JR, Rocha-Peralta J (2023) Personal exposure monitoring using GPS-enabled portable air pollution sensors: A strategy to promote citizen awareness and behavioral changes regarding indoor and outdoor air pollution. *J Expo Sci Environ Epidemiol* 33(3):347–357. <https://doi.org/10.1038/s41370-022-00515-9>
- Peng M, Cai Z, Chen K, Yin C, Ao C, Ren H (2025) How risk perception of air pollution influences consumers' pro-environmental behaviors: An empirical study based on the extended theory of planned behavior. *Sustainability* 17(6):2414. <https://doi.org/10.3390/su17062414>
- Pereira V, Basilio MP, Santos CHT (2025) PyBibX—a Python library for bibliometric and scientometric analysis powered with artificial

- intelligence tools. *Data Technol Appl* 59(2):302–337. <https://doi.org/10.1108/DTA-08-2023-0461>
- Reimers N, Gurevych I (2019) Sentence-BERT: Sentence embeddings using Siamese BERT-networks. *arXiv*. <https://doi.org/10.48550/arXiv.1908.10084>
- Rickenbacker HJ, Brown F, Bilec MM (2019) Creating environmental consciousness in underserved communities: Implementation and outcomes of community-based environmental justice and air pollution research. *Sustainable Cities Soc* 47:101473. <https://doi.org/10.1016/j.scs.2019.101473>
- Saligari S, Nabukwangwa W, Mwitari JM, Anderson de Cuevas R, Clayton S, Nyongesa M, Puzzolo E, Pope DP, Nix E (2025) Whose pollution, whose problem? Understanding perceptions of air pollution and implications for clean cooking (for health) in Nairobi schools. *Health Place* 91:103398. <https://doi.org/10.1016/j.healthplace.2024.103398>
- Schaefer T, Kieslinger B, Fabian CM (2020) Citizen-based air quality monitoring: The impact on individual citizen scientists and how to leverage the benefits to affect whole regions. *Citiz Science: Theory Pract* 5(1):6. <https://doi.org/10.5334/cstp.245>
- Schulte K, Hudson B (2023) A cross-sectional study of inequalities in digital air pollution information access and exposure reducing behavior uptake in the UK. *Environ Int* 181:108236. <https://doi.org/10.1016/j.envint.2023.108236>
- Schulte K, Grieve AP, Barratt BM, Baker T, Coonjobeeharry H, Mead MI (2025) Advancing participatory sensing and knowledge production methods for city air quality governance: Applying the Breathe London Community Programme model. *Environ Sci Policy* 170:104092. <https://doi.org/10.1016/j.envsci.2025.104092>
- Sekiguchi T, Li J, Hosomi M (2017) Predicting job crafting from the socially embedded perspective: The interactive effect of job autonomy, social skill, and employee status. *J Appl Behav Sci* 53(4):470–497. <https://doi.org/10.1177/0021886317727459>
- Sprague-Martínez LS, Ginzburg L, Ron S, Araujo Brinkerhoff S, Haque C, England S, Khimani SA, Zamore K, Reisner W, Lowe E, L., Brugge DM (2024) Communities catalyzing change with data to mitigate an invisible menace, traffic-related air pollution. *BMC Public Health* 24(1):17864. <https://doi.org/10.1186/s12889-024-17864-9>
- Subrahmanyam S (2025) Developing green skills for sustainable careers. In *Integrating AI and sustainability in technical and vocational education and training (TVET)* (pp. 101–126). IGI Global. <https://doi.org/10.4018/979-8-3693-5630-6.ch005>
- Tong J, Tao L, Luo S (2024) Does the digital economy reduce air pollution? Evidence from 30 Chinese provinces and municipalities. *J Economic Policy Reform* 27(3):331–354. <https://doi.org/10.1080/17487870.2023.2292223>
- Triana L, Melkas H, Pässilä A, Morello E, Happonen M (2026) Beyond separate silos: identifying convergent themes in digital social innovation and air quality management. *J Environ Manage* 405:129604. <https://doi.org/10.1016/j.jenvman.2026.129604>
- Trozzi C, Vaccaro R, Trozzi M (2018) Social networks, awareness and behavioral modification to reduce air pollution and carbon footprints: The ClairCity project in the Liguria region of Italy. *WIT Trans Ecol Environ* 217:73–85. <https://doi.org/10.2495/SDP180071>
- van Brussel S, Huyse H (2019) Citizen science on speed? Realising the triple objective of scientific rigour, policy influence and deep citizen engagement in a large-scale citizen science project on ambient air quality in Antwerp. *J Environ Planning Manage* 62(3):534–551. <https://doi.org/10.1080/09640568.2018.1428183>
- Vanderbloemen L, Liampittong P, Nguyen OTK, Hoang KVN, Huynh HX, Hoang MP, Tran MG, Nguyen PH, Pham TNH, Kapil D, Elgebaly AS, Taylor-Robinson AW (2025) Hanoi air quantitative report: A cross-sectional study of knowledge, awareness, and sustainable practices related to air pollution among residents of Hanoi. *Vietnam Sustain* 17(14):6557. <https://doi.org/10.3390/su17146557>
- Veres C, Bacoş IB, Tănase M, Gabor RM (2025) Analyzing urban air quality perceptions: Integrating socio-demographic patterns with sensor-based measurements using regression model and multidimensional scaling. *Sustainability* 17(2):580. <https://doi.org/10.3390/su17020580>
- Wan K, Shackley S, Doherty RM, Shi Z, Zhang P, Golding N (2020) Science-policy interplay on air pollution governance in China. *Environ Sci Policy* 107:150–157. <https://doi.org/10.1016/j.envsci.2020.03.003>
- White EB, Ekenge CC (2024) Multidimensional structural racism and estimated cancer risk from traffic-related air pollution. *Cancer* 130(21):3699–3707. <https://doi.org/10.1002/ncr.35467>
- Winter AK, Le H, Roberts S (2021) From black to blue skies: Civil society perceptions of air pollution in Shanghai. *China Q* 248:1059–1080. <https://doi.org/10.1017/S0305741021000588>
- Xu F, Tian M, Yang J, Xu G (2020) Does environmental inspection led by the central government improve the air quality in China? The moderating role of public engagement. *Sustainability* 12(8):3316. <https://doi.org/10.3390/SU12083316>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.