



Development of novel assessments for indoor air quality monitoring and impact on children's health

Exploitation & Sustainability Plan (v2)

LEARN

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Project details

Project Title	Development of Novel Assessments for indoor air quality monitoring and impact on children's health
Project Acronym	LEARN
Grant Agreement Number	101057510
Call	HORIZON-HLTH-2021-ENVHLTH-02
Starting date of the project	01/05/2022
Project Duration	48 months

The LEARN Consortium

Participants n°	Participant Organisation Name	Country
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2	Vrije Universiteit Brussel (VUB)	BE
3	Envirometrics Technikoí Symvouloi Etaireia Periorismenis Efthynis (ENV)	EL
4	Katholieke Universiteit Leuven (KUL)	BE
5	Universiteit Hasselt (UH)	BE
6	Mann+Hummel GMBH (M&H)	DE
7	Nanotechnology Industries Association (NIA)	BE
8	Stichting IMEC Nederland (IMEC-NL)	NL
9	Aarhus Universitet (AU)	DK
10	F. Iniciativas España Mas i Mas SLU (FI)	ES
11	AlveoliX (AL)	CH
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Project's aim

LEARNing about the status of air quality in schools and its impact on the cognition of children is a major cornerstone in LEARN. For that, we want to overcome the barriers of the currently existing technologies and take a bold step towards developing and deploying novel sensors to detect the presence of possibly harmful air pollutants such as volatile organic compounds and ultrafine particles.

We will measure and characterize indoor and outdoor air pollutants and evaluate the presence of biomarkers of exposure and their effect on children's cognition while trying to recapitulate those effects using *C.elegans* as a biosensor. Moreover, we will use advanced human-based in vitro models of lung and skin coupled with a revolutionary multi-sensing device to investigate their mechanisms of toxicity in real-time.

Novel remediation strategies will be explored to improve air quality and promote children's quality of life and life expectancy. For that, we will mobilize a group of

eleven leading research teams, unrivalled in their respective fields (environmental epidemiologists, toxicologists, air quality specialists, systems biology, engineers, and citizen/social scientists).

The scientific achievements expected to result from LEARN will unlock a large technology potential in IAQ for decades to come, leading to disruptive societal and economic impacts steaming from a radical improvement in the quality of life of children in Europe.

Project LEARN is part of the European indoor air quality and health cluster.

Document details

Deliverable Type	Report
Deliverable N°	8.6
Deliverable Title	Exploitation & Sustainability Plan (v2)
Name of Lead Partners for this deliverable	NIA
Version	1
Contractual delivery date	31/12/2024
Actual delivery date	16/06/2026
Dissemination Level	PU
Purpose	This document is a deliverable of the LEARN Project - Development of Novel Assessments for indoor air quality monitoring and impact on children's health, funded by the European Union's Horizon Europe Programme under Grant Agreement n° 101057510. This deliverable is performed within Work Package 8 to identify and support identified exploitations emerging from the overall LEARN project. The purpose of this report is to identify the exploitable results from within the project, provide an update of the current position of these exploitations and to outline how these exploitations will be advanced on the conclusion of the LEARN project. Some exploitations have been identified as being potential commercial developments and will be exploited through the establishment of spin-off companies, some will be used in the provision of services, some have contributed to the development of policy recommendations or adjustments to standards, whilst others will be used after the project in the development of future projects or knowledge in future R&D.

Revision History

The following table describes the main changes done in the document since it was created

REVISION	DATE	DESCRIPTION	AUTHOR (ORGANIZATION)
V.0.1	30/04/2026	Initial draft	NIA

V.0.2	09/06/2026	Internal review	VUB
V.0.3	12/06/2026	Internal review	INL
V.0.4	16/06/2026	Final draft	NIA

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Table of contents

Introduction.....	5
1. Task Description.....	5
2. Definitions	5
3. Task Purpose	6
Initial Exploitations.....	6
4. Potential Exploitations Identified by M16	6
4.1. Grouping Initial Exploitations	11
4.2. Exploitations Workshop, June 2024	12
Final LEARN Project Exploitations	14
5. Final Project Exploitations	14
5.1. Combined Table of Final LEARN Exploitations	16
Individual LEARN Project Exploitations	20
6. Individual LEARN Project Exploitations.....	20
6.1. ER1 LEARN Toolkit.....	20
6.2. ER2 Cognitive ability results	21
6.3. ER3 Air quality and health data hub	21
6.4. ER4 Development of alveolar (lower) Lung Barrier on Chip (LBoC) ..	22
6.5. ER5 Development of bronchial (upper) Lung Barrier on Chip (LBoC) 24	
6.6. ER6 Filter unit, ER7 Optimised filter units, ER8 Feedback for optimised filter unit design and ER9 Novel sensors and filter units.....	25
6.7. ER10 IAQ Standards	26
6.8. ER11 Skin-on-chip device	26
6.9. ER12 Multisensing platform	27
6.10. ER13 Dataset of indoor air quality (IAQ) of classroom in primary schools.....	27
6.11. ER14 UFP measurements.....	28
6.12. ER15 Sample Ionization Potential Spectroscopy	29
Conclusion.....	30
7. Conclusion of LEARN Exploitation and Sustainability Plan	30

Introduction

1. Task Description

Deliverable D8.6 is part of Task 8.3 in WP8 Exploitation, Communication and Dissemination in the LEARN project. Task 8.3 is the Development of the Exploitation Strategy and Sustainability Plan:

Task 8.3 | Development of the Exploitation Strategy & Sustainability Plan | NIA; All Consortium | M1-M48

Subtask 8.3.1 Exploitation Strategy. This task will develop and implement the exploitation strategy for the project and define the sustainability plan of the LEARN platform and outcomes beyond the end of the project. The initial Exploitation & Sustainability Plan (D8.3, M16) will outline the potential opportunities for exploitation in collaboration with all LEARN partners. It will map how the project research results, instruments, services and other project results can be exploited and scaled in a sustainable way. The final Exploitation & Sustainability Plan (D8.6, M32), will present the strategy for the identified LEARN exploitable results (LEARN toolkit) describing the way in which they can be exploited in a (non)-commercial sense after the end of the project, by the target users and potential customers. It will also present the individual exploitation plans of the project partners. Subtask 8.3.2. Sustainability Plan. This task focuses on producing a strategic plan to ensure the long-term survival of project results. This task will develop the Mission and Values documents regarding project outcomes and a Business Plan. The Business Plan will include the definition of Business Plan scenarios which will lead to the identification of sustainability scenarios. Results will be collected in the form of a deliverable which will be updated during the project (D8.4, D8.6).

D8.6 updates and replaces the initial plan in D8.4 and highlights the main evolutions.

2. Definitions

Within the LEARN Grant Agreement and the rules of Horizon Europe, project exploitations are defined as:

The use of results in further research and innovation activities other than those covered by the action concerned, including among other things, commercial exploitation such as developing, creating, manufacturing and marketing a product or process, creating and providing a service, or in standardisation activities. ¹

All partners are obliged to use their best efforts to ensure that they exploit the results that they have created and own the IP for, whether directly themselves, indirectly through licensing or transferring them to others whilst ensuring that they

¹ Horizon Europe Programme Guide (Version 5.1 2025)

follow the conditions imposed within the project's Grant Agreement. Where project results are jointly owned, the partners should come to an agreement as to the means of exploitation.

3. Task Purpose

The main purpose of this task was to identify the potential exploitations developed within the LEARN project and to present an initial strategy for their further exploitation at the conclusion of the project. In the initial stages of the task, the main aim was to provide an early identification of the potential exploitation that were being developed within the project. In the final stages of the project, the aim was to further elaborate the road to sustainability for the final exploitations that will be available at the conclusion of the project. Whilst there is often a focus in projects on the use of project exploitations in a commercial setting through either innovations in products that can be sold, it is also important to capture the exploitations that may not be used commercially. Some project results may not be developed to a high enough technology readiness level (TRL) to make them viable commercial propositions and will need to be developed further, other results may be used in the setting of future policy or standards, some will inform and will be used in future research projects, and some will be part of the project legacy and may be used by others in their work but will not have a commercial pathway open to them. LEARN has exploitable results that fit into all of these categories. The requirements for what is the future for all of the exploitations will differ and their future needs for them to be further exploited will be unique to each result.

Initial Exploitations

4. Potential Exploitations Identified by M16

In the first project period (up until M16) fourteen potential exploitations had been identified by partners. These were labelled ER1-ER14 to permit them to be tracked. Allocations of labels are not related to any ranking or prioritisation criteria and were assigned in order of reporting by partners. Partners were surveyed by the Task 8.3 lead using a simple form to gather some basic information for each exploitation including WP and task it had been developed in, LEARN partners contributing to the exploitation, potential audience and when results were anticipated to be ready by. These were gathered together in *D8.4 Exploitation & Sustainability Plan (v1, M16)*. The potential exploitable results identified by partners in the first project phase are listed in Table 1 below. They can be categorised as follows:

- 6 potential new innovations/ patents
- 3 changes to existing practices
- 2 datasets
- 1 standard

- 1 policy
- 1 toolkit/ education resource

Table 1 Potential Exploitable Results from LEARN as Identified at M16 (Reported in D8.4)

Number:	Exploitable Result	Partner(s) (Lead partner in bold)	Description	WP/ Task	Potential Audiences	Timings	Category
ER1	LEARN Toolkit	VUB, FI , INL, UHASSELT, KULEUVEN, MANN&HUMMEL	Awareness raising about indoor air quality through educational resources	WP8 T8.1	Pupils, parents, educators, science organisations	Ready during project for use in pilot studies	Education resource
ER2	Cognitive ability results	UHasselt , WPs 2, 3, 4 partners	Demonstrate links between classroom air quality and children's well-being	WPs 2,3&4	Policymakers	End of project	Policy
ER3	Air quality and health data hub	ENV , all partners	Quicker and more accurate results of air quality testing	WP7 T7.4, 7.5, 7.6	Schools, policymakers	Initial version M41 Final version M44	Dataset
ER4	Development of alveolar (lower) Lung Barrier on Chip (LBoC)	AlveoliX	Development of bronchial (lower) Lung Barrier on Chip (LBoC)	WP5	To be identified	May 2024	Innovation
ER5	Development of bronchial (upper) Lung Barrier on Chip (LBoC)	AlveoliX	Development of bronchial (upper) Lung Barrier on Chip (LBoC)	WP5	To be identified	May 2024	Innovation
ER6	Filter unit	Mann+Hummel	Filter unit with novel filter combination for removal UF particles & VOCs	WP6 T6.1, 6.2	Educational workplaces, and/or other locations, where improving IAQ can improve cognitive performance.	Prototype by August 2024	Innovation
ER7	Optimised filter units	Mann+Hummel , INL, KUL	Optimised filter units for reducing contaminants in	WP6 T6.1, 6.2	Educational institutes	Prototype by August 2024	Innovation



			schools for a hygienic and healthy indoor air quality	WP3 T3.5, 3.6			
ER8	Feedback for optimised filter unit design	Mann+Hummel , VUB, AU, UH	Feedback for optimised filter unit design	WP2 T2.4	M+H future customers	March 2026	Change to practice
ER9	Novel sensors and filter units	Mann+Hummel , ENV, VUB, UH, INL, KUL, IMEC-NL, AU	Purposeful operation of filter device depending on concentration of contaminants through combination of novel sensors and filter units	WP6 T6.1, 6.2, 6.3, 6.4 WP7 T7.4, 7.5	Air filter users	Project end	Change to practice
ER10	IAQ Standards	Mann+Hummel , All	Equipment proven to meet new IAQ regulations for schools in EU	WP8 T8.4	EU educational institutes	Recommendations made- project end Changes to EU recommendations- undetermined	Standard
ER11	Skin-on-chip device	INL	Skin of chip device for a safety assessment of nanomaterials and chemicals	Wp5 T5.3	Researchers in academia and industry	M42	Innovation
ER12	Multisensing platform	INL	Multisensing platform for in vitro cytotoxicity assessment	WP5 T5.4	researchers in academia and industry wanting to track the in vitro biocompatibility of drugs, nanomaterials and other chemicals	M45	Innovation
ER13	Dataset of indoor air quality (IAQ) of classroom in primary schools	KU Leuven	Dataset of urinary biomarker levels of primary schoolchildren	WP3 T3.2, 3.3	For IAQ dataset: Universiteit Hasselt, Aarhus Universitet	Final stages of LEARN	Dataset

ER14	UFP measurements	IMEC	IMEC-NL will execute UFP measurements in an office environment with a reference sensor. This will contribute to the knowledge of IMEC-NL of UFP concentrations in the office environment, and seasonal and occupational fluctuations thereof.	WP4 T4.4	Companies active in the field of air cleaning and conditioning	Towards the end of the project	Change to practice
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The anticipated exploitations were mostly, with the exception of the LEARN toolkit that was developed for use within the project, expected to be finalised by the end of the project. The LEARN toolkit had been developed within WP8 to be used as part of the work undertaken in WP2 with the school cohorts. The remainder of the exploitations identified at M16 were still in early phases of development and it was not clear at that stage of the project if the anticipated exploitations would be realised by the end of the project or developed enough during the project to remain viable exploitations at project end.

4.1. Grouping Initial Exploitations

It was decided to provisionally group eight of the project exploitations into three distinct groups due to the interdependencies that existed between the various individual exploitations. The groups were designed to provide more focus on the next steps of preparing sustainable business plans for the exploitations that could prepare the exploitations for success post-project. The remaining exploitations were the ones that it was decided would need to be approached differently and would not need so much development as exploitations and could be treated as stand-alone exploitations, or were still at an early stage and would need further development before their future could be better defined into an exploitation plan.

The stand-alone exploitations were:

ER 1 LEARN Toolkit: This was to be fully developed within the project and ready for use in the school cohorts. The route to exploitation for the toolkit would not be commercial, but to make it freely available during and after the project for use by others in education around indoor air quality.

ER Air quality and health data hub: This would be developed during the project to be ready to accept data generated during the project's cohort studies. It would then be made available at the end of the project as part of the work of Envirometrics. The hub would probably not require further work to develop it as an exploitation and Envirometrics would transfer its use into their standard company offering

ER 4 Development of alveolar (lower) Lung Barrier on Chip (LBoC): This was still at an early stage in the first project period and was not developed enough by the initial grouping exercise to be considered. It would likely be linked more to Group 3 as a sensing device.

ER5 Development of bronchial (upper) Lung Barrier on Chip (LBoC): This was still at an early stage in the first project period and was not developed enough by the initial grouping exercise to be considered. It would likely be linked more to Group 3 as a sensing device.

ER13 Dataset of indoor air quality (IAQ) of classroom in primary schools: The datasets were not well developed in the first project period and would be further developed during the project. It was anticipated that datasets would not need specific business plans as they would likely not be commercially exploited, but used by partners in their own further work, such as future research projects.

ER14 UFP measurements: This exploitation was proposed as a change to practice related to the development of novel sensors that was being undertaken in the project.

All of the other exploitable results were collected into 3 groups. Group 1 was exploitable results focussed on standards and policy, Group 2 were innovations focussed on the filter units developed in WP6 and Group 3 were innovations focussed on sensing developed in WP5.



4.2. Exploitations Workshop, June 2024

Following the identification of the initial potential exploitations from LEARN, an exploitations workshop was organised during the project's General Assembly in June 2024. The workshop had the following aims:

- To start to prepare sustainable business plans for the project results that have been identified as potential exploitations with a focus on innovations, policies and standards.
- Produce first drafts of business plans for policy and standards exploitations using a Theory of Change approach.
- Produce first drafts of business plans for exploitable innovations using the LEAN Canvas methodology.
- To produce first initial plans for exploitations that can be developed further during the project.

The exploitation groupings were used to split the partners into 3 groups to work together to develop initial business plans for the groups of exploitations using the Theory of Change Approach (Group 1) or Lean Canvas Approach (Groups 2 and 3). The 3 groups produced some initial business plans which were presented and discussed with all partners.

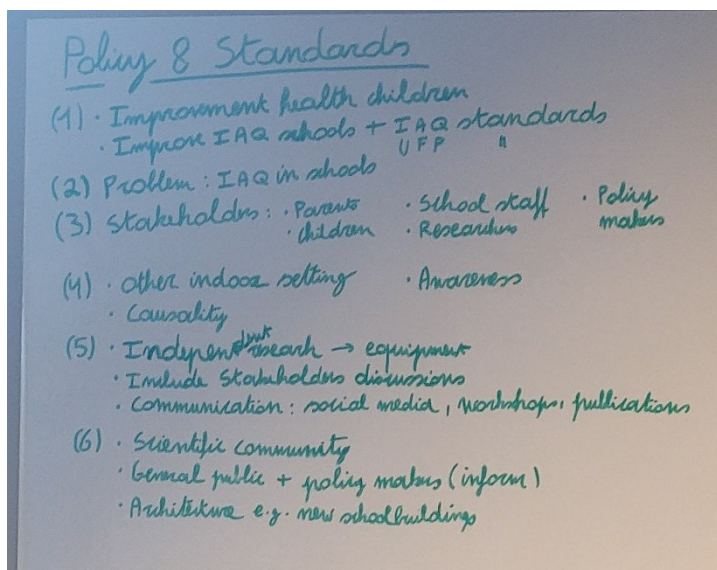


Figure 1 Group 1 Exploitation Workshop Business Plan

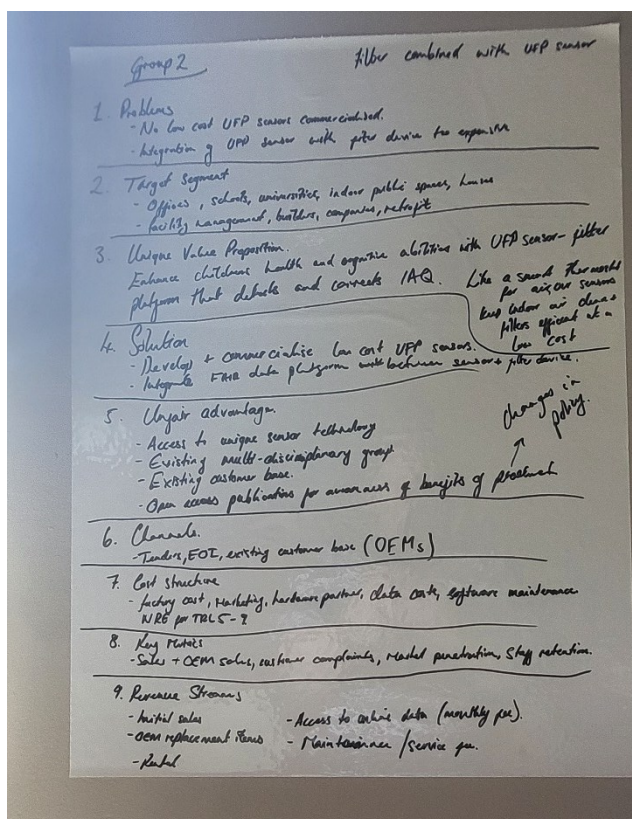


Figure 2 Group 2 Exploitation Workshop Business Plan

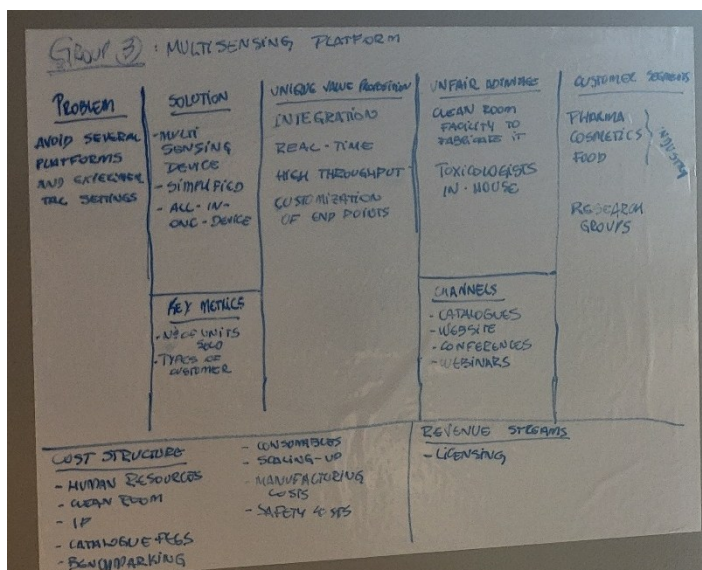


Figure 3 Group 3 Exploitation Workshop Business Plan

At this stage in the project, the business plans were still at an early stage and were based upon predictions of future work that would be undertaken on the exploitable results in the various project work packages.

Final LEARN Project Exploitations

5. Final Project Exploitations

During the final project period, a similar exercise as was undertaken at M16 was performed and partners asked to identify the final project exploitations. Previously identified project exploitations were updated by partners, with more information being requested in the survey. There was also the opportunity for partners to suggest newly identified exploitations in the case of results that had not been anticipated by M16. In the survey distributed to partners, more details were requested than had been asked in the initial survey as by this late stage of the project it would be possible to be more precise on the data provided due to the further work that had been undertaken in the various WPs on the previously identified potential exploitations.

Partners have also worked on developing the final business plans for their individual or joint exploitations to ensure the project results are used after the conclusion of the project. Due to the sensitive nature of the business plans, as they contain information that is confidential and in some instances, data that is limited to the individual partner for commercial reasons, full business plans will not be shared in this report. Instead, this report will be a summary of the business plans and provide the headline information about the future for each of the identified project exploitations and the anticipated actions that will be undertaken after the project to ensure delivery of the exploitable results. It is also the case that some exploitations remain far from being market ready and at a lower TRL. These exploitations still have a value, as many will be further developed into new

projects or R&D and innovation activity at the conclusion of the LEARN project either using partners' own funds or being part of proposals for further funding.

There is one additional exploitable resource reported since D8.4 Exploitation & Sustainability Plan (v1) submitted at M16 of the project, which is **ER15 Sample Ionization Potential Spectroscopy**. One exploitation, ER14 UFP measurements, has suffered from delays due to problems in the development cycle of the novel UFP sensor in the project, so it will not be as developed as anticipated in M16.

5.1. Combined Table of Final LEARN Exploitations

Table 2 Final LEARN Project Exploitations

Number:	Exploitable Result	Partner(s) (Lead partner in bold)	Description	WP/ Task	Potential Audiences	Position at the End of the Project	Category
ER1	LEARN Toolkit	VUB, FI , INL, UHASSELT, KULEUVEN, MANN&HUMMEL	Awareness raising about indoor air quality through educational resources	WP8 T8.1	Pupils, parents, educators, science organisations	Finalised during the project and made available for public use via Creative Common Licence	Education resource
ER2	Cognitive ability results	UHasselt , WPs 2, 3, 4 partners	Demonstrate links between classroom air quality and children's well-being	WPs 2, 3, & 4	Policymakers	Results developed and used in development of the project's policy plan (Task 8.3)	Policy
ER3	Air quality and health data hub	ENV , all partners	Quicker and more accurate results of air quality testing	WP7 T7.4, 7.5, 7.6	Schools, policymakers	Data hub finalised. Needs further investment to allow future data to be added	Dataset
ER4	Development of alveolar (lower) Lung Barrier on Chip (LBoC)	AlveoliX	Development of bronchial (lower) Lung Barrier on Chip (LBoC)	WP5	Researchers, regulators, standardisation bodies	R&D phase complete. Needs further investment and development (6-18 months) to commercialise	Innovation



ER5	Development of bronchial (upper) Lung Barrier on Chip (LBoC)	AlveoliX	Development of bronchial (upper) Lung Barrier on Chip (LBoC)	WP5	Researchers, regulators, standardisation bodies	R&D phase complete. Needs further investment and development (6-18 months) to commercialise	Innovation
ER6	Filter unit	Mann+Hummel	Filter unit with novel filter combination for removal UF particles & VOCs	WP6 T6.1, 6.2	Educational workplaces, and/or other locations where improving IAQ can improve cognitive performance.	Prototype developed and used during the project. Will need to be determined if commercial proposition exists post-project	Innovation
ER7	Optimised filter units	Mann+Hummel, INL, KUL	Optimised filter units for reducing contaminants in schools for a hygienic and healthy indoor air quality	WP6 T6.1, 6.2 WP3 T3.5, 3.6	Educational institutes	Prototype developed and used during the project. Will need to be determined if commercial proposition exists post-project	Innovation
ER8	Feedback for optimised filter unit design	Mann+Hummel, VUB, AU, UH	Feedback for optimised filter unit design	WP2 T2.4	M+H future customers	Not all feedback possible due to delays in the project plan.	Change to practice
ER9	Novel sensors and filter units	Mann+Hummel, ENV, VUB, UH, INL, KUL, IMEC-NL, AU	Purposeful operation of filter device depending on concentration of contaminants through	WP6 T6.1, 6.2, 6.3, 6.4 WP7	Air filter users	Delays to the development of the novel sensors	Change to practice

			combination of novel sensors and filter units	T7.4, 7.5			
ER10	IAQ Standards	Mann+Hummel , All	Equipment proven to meet new IAQ regulations for schools in EU	WP8 T8.4	EU educational institutes	Recommendations made as part of the LEARN policy recommendations (D8.7)	Standard
ER11	Skin-on-chip device	INL	Skin of chip device for a safety assessment of nanomaterials and chemicals	Wp5 T5.3	Researchers in academia and industry	Proof of concept delivered. Will need further investment to commercialise	Innovation
ER12	Multisensing platform	INL	Multisensing platform for in vitro cytotoxicity assessment	WP5 T5.4	researchers in academia and industry wanting to track the in vitro biocompatibility of drugs, nanomaterials and other chemicals	Still at early stage of development. Needs further enhancements due to issues with effective detection of biomarkers	Innovation
ER13	Dataset of indoor air quality (IAQ) of classroom in primary schools	KU Leuven	Dataset of urinary biomarker levels of primary schoolchildren	WP3 T3.2, 3.3	For IAQ dataset: Universiteit Hasselt, Aarhus Universitet	Dataset completed and used in publications from LEARN. Will be used in future research projects	Dataset
ER14	UFP measurements	IMEC	IMEC-NL will execute UFP measurements in an office environment with a reference sensor. This will contribute to IMEC-NL's knowledge of UFP	WP4 T4.4	Companies active in the field of air cleaning and conditioning	Suffered severe delays due to delays in ER9.	Change to practice

			concentrations in the office environment and their seasonal and occupational fluctuations.				
ER 15	Sample Ionization Potential Spectroscopy	INL	Real-time sensor for molecular selective VOC sensing, including BTEX compounds	WP4	Public safety officers	Has reached TRL 4 during the project and will seek further funding to progress to higher TRL.	Innovation

Individual LEARN Project Exploitations

6. Individual LEARN Project Exploitations

The status of each LEARN project exploitation is outlined below. These are not full business plans, which have been developed for some of the exploitable results, but are rather short summaries of the position of each exploitable result at the conclusion of the project and future plans are for their development or use post-project.

6.1. ER1 LEARN Toolkit

Outline of Exploitation	The aim of the toolkit is to raise awareness about indoor air quality in an accessible, and fun way. The toolkit shares information, guidelines and training materials about how indoor health and well-being can be protected and promoted. The toolkit supports wide-audience knowledge on air contaminants frequently present at schools and how these may or may not harm the health and safety of children in the long-term. The LEARN toolkit has a clear educational goal and was part of a broader awareness raising campaign on IAQ and health within schools. The main product of the LEARN toolkit is a boardgame that was developed by the LEARN project to aid the awareness raising of IAQ in educational settings amongst children, their parents and school teachers.
LEARN Partners Involved (Lead Partner in bold)	VUB, FI, INL
IP Ownership	VUB
Audience/ Stakeholder	Pupils (9-12 years old) and their parents, Schools (teachers), Scientific or research organisations (e.g. science museums, science shops) and other research projects focussed on IAQ.
Innovation in Exploitation	The boardgame is an innovative way to provide education on IAQ in a way that is accessible to children. The boardgame has been used during the LEARN project and has been tested in classrooms and other environments in multiple countries. It has been made available to other IDEAL Cluster projects for use in their work and translated to other languages.
Proposed Business Model and Plan Post Project	The educational toolkit has been made available through the LEARN website and via the IDEAL Cluster website. The boardgame has been translated into different languages by other IDEAL Cluster projects. The game has been made freely available via a Creative Commons License (CCL). There are no plans for the game or the toolkit to be commercialised, but rather it will be retained as a free to use resource for other

	projects so long as they comply with the CCL and acknowledge the LEARN project.
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6.2.ER2 Cognitive ability results

Outline of Exploitation	The cognitive ability test results will demonstrate the links between classroom air quality and children's cognitive ability and well-being.
LEARN Partners Involved (Lead Partner in bold)	UHasselt and all partners working in WP2, 3 and 4.
IP Ownership	IP for the individual results will be owned by the partners producing them.
Audience/ Stakeholder	The results will be of interest to policymakers. They will also be useful to researchers in the field of IAQ.
Innovation in Exploitation	The innovation is in the linkage of measurement of IAQ in schools to the cognitive ability tests that have been taken in a range of classroom settings that show a clear correlation between IAQ and ability.
Proposed Business Model and Plan Post Project	The results have been used in the development of the policy briefing from LEARN and have contributed to the IDEAL Cluster policy briefs. These have been distributed to EU and Member State level policymakers. The results will also be used by LEARN partners in future research applications to develop further funded projects in IAQ.

6.3.ER3 Air quality and health data hub

Outline of Exploitation	The Data Hub is a centralized, web-based platform designed to manage and analyse diverse environmental dataset. Its primary purpose is to consolidate heterogeneous data into an accessible repository for research, awareness and policy-making. The system supports monitoring, analysis, and visualization of air pollution trends as it includes tracking within educational facilities. The Data Hub serves as a shared resource for stakeholders such as educational staff, parents, policymakers, institutions, researchers and healthcare professionals, providing easy access to data and research findings.
LEARN Partners Involved (Lead Partner in bold)	ENV , INL, M&H, KUL, AU, UH
IP Ownership	ENVIRONMETRICS
Audience/ Stakeholder	The platform is designed to serve a wide range of stakeholders. Educational institutions can use it to monitor air quality within

	their facilities and raise awareness among students and staff. Policymakers can use the platform to support informed decisions on air quality management. Healthcare professionals can analyse the data to understand the environmental impacts on health and plan interventions, while researchers and academic institutions can access consolidated datasets for studies on air quality and environmental trends. Moreover, parents can stay informed about air quality in schools and understand potential impact on their children.
Innovation in Exploitation	The innovation of the Data Hub lies in the ability to integrate heterogenous environmental datasets into a centralized platform that is accessible to various stakeholder groups. By combining air quality data and visualization tools, the platform enables insights of IAQ and facilitates evidence-based decision-making. The Data Hub promotes open access to data and research findings. This approach not only supports scientific research and policy development but also empowers parents and educational staff with transparent information about environments conditions affecting children.
Proposed Business Model and Plan Post Project	The Data Hub will require investment to maintain and scale the digital infrastructure and for the hosting and technical support to ensure access for stakeholders. There is also a need to market and promote the Data Hub, as well as provide user training to encourage stakeholder engagement. The business model would be to either develop the Data Hub as a software as a service (SaaS), offering the platform to schools, municipalities or institutions for access to monitoring, data analytics, and visualization services. An alternative model would be to integrate the Data Hub into the existing environmental consulting services provided by ENV. ENV will actively seek strategic partnerships with relevant stakeholders to continue to grow the Data Hub content and bring in additional datasets and metadata. After the end if LEARN, ENV will also seek additional investment to scale the platform and transition the Data Hub into either a paid for service offering or SaaS model to ensure that it remains a resource for the target audience.

6.4.ER4 Development of alveolar (lower) Lung Barrier on Chip (LBoC)

Outline of Exploitation	The Lung Barrier on a Chip (LBoC) for the lower alveolar is composed of two sub-components. The first is a cell line and primary based cell models which can be provided as a consumable component. The second is a service offering that makes use of the LBoC technology for customers.
LEARN Partners Involved	AlveoliX. INL KLEUVEN support with protocols, SOPs, WI and publications

(Lead Partner in bold)	
IP Ownership	Primary IP owner: AlveoliX (chip design, microfluidic architecture, protocols, and know-how). Background IP from contributing partners remains with each partner for research purpose. Commercial rights only on AlveoliX
Audience/ Stakeholder	Regulators and standardisation bodies (NAMs for inhalation toxicity), CROs and toxicology labs, pharma/biotech (respiratory drug discovery), chemical/consumer goods and materials companies (inhalation safety), academic labs, and technology validation initiatives. Several conferences and events with stakeholders.
Innovation in Exploitation	Physiologically relevant recreation of the distal lung air-blood barrier in a microfluidic format enabling controlled exposure and quantitative barrier integrity readouts. Improved relevance versus conventional methods by combining 3D strain, tissue-level architecture, and compatibility with aerosol/particle exposure workflows.
Proposed Business Model and Plan Post Project	It is anticipated that the innovation will be ready in a commercial version between 6 to 18 months after the end of the project. It will require further work including technical validation against reference data; an inter-lab ring trial with LEARN partners to be run; need to be aligned with exposure modules and relevant readouts; user protocols will need to be defined and acceptance criteria developed. It will also need a manufacturable design developing and following this, quality control tests will be required. Once developed, it is anticipated that early adopters from industry, CROs and regulators will be approached to participate in pilot studies. There will be a need for further investment to undertake work on (i) robustness and inter-lab reproducibility studies, (ii) manufacturing/process development (scalable chip fabrication), (iii) quality management and documentation, and (iv) customer pilots to advance the LBoC to be go to market ready. The funding sources that are planned include follow-on EU or national grants, strategic industrial partnerships, and AlveoliX internal investment/revenue. Some early adaptors have already been approached and it is anticipated that some initial revenue will be possible to help with further development work. The exploitation will be commercialised via the existing AlveoliX product lines, with sales of ER4 chips and associated reagents/consumables, plus service/support packages (training, protocols, application development). Optional co-development/licensing with exposure-technology providers and CROs for integrated testing offerings.

6.5. ER5 Development of bronchial (upper) Lung Barrier on Chip (LBoC)

Outline of Exploitation	AlveoliX is developing a bronchial (upper-airway) lung barrier-on-chip prototype (ER5) that recreates key features of the human conducting airway epithelium in a microphysiological system. The platform is intended to support inhalation-relevant exposure and toxicology testing, respiratory infection/inflammation studies, and drug efficacy screening by enabling robust epithelial barrier integrity and functional readouts under controlled microfluidic conditions.
LEARN Partners Involved (Lead Partner in bold)	AlveoliX. Other LEARN partners supporting cell sourcing/biology, exposure systems, readouts, validation, and case studies: [INL]
IP Ownership	Primary IP owner: AlveoliX (chip design, microfluidic architecture, protocols, and know-how). Background IP from contributing partners remains with each partner for research purpose. Commercial rights owned by AlveoliX.
Audience/ Stakeholder	Regulators and standardisation bodies (NAMs for inhalation toxicity), CROs and toxicology labs, pharma/biotech (respiratory drug discovery), cosmetics/ chemical/consumer goods and materials companies (inhalation safety), and academic labs—especially groups focused on upper-airway biology, mucus/cilia function, and infection/inflammation.
Innovation in Exploitation	Microphysiological recreation of the bronchial epithelial barrier in a controllable microfluidic format, enabling more physiologically relevant assessment of upper-airway responses than static Transwell assays. Supports inhalation-relevant exposures and quantification of barrier integrity and functional endpoints relevant to the conducting airways.
Proposed Business Model and Plan Post Project	It is anticipated that the prototype that was validated during the project will be developed into a commercial ready version between 6 to 18 months after the conclusion of the project. There will be the need for technical validation against upper airway datasets, run inter-lab ring trials with LEARN partners and confirm compatibility with inhalation-relevant exposure modules; define SOPs and acceptance criteria for bronchial barrier function; develop manufacturable design and quality control tests; engage early adopters in industry, CROs, and regulators for pilots in upper-airway use cases; identify follow-on funding and go-to-market partners. There will be a need for investment for (i) robustness and inter-lab reproducibility studies, (ii) development/qualification of upper-airway functional endpoints (e.g., mucus/cilia-related readouts where applicable), (iii) manufacturing and process development (scalable chip fabrication), and (iv) customer pilots. The funding sources that will be utilised will include EU and national grants, engaging in strategic partnerships with industry, and AlveoliX's own internal investment in R&D using its own revenue.

	The plan for commercialisation is via the existing AlveoliX product line. Including sale of ER5 chips and associated reagents/consumables, plus service/support packages for customers including training, protocols and application development. Optional co-development/licensing with exposure-technology providers, infection models, and CROs for integrated testing offerings#
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6.6.ER6 Filter unit, ER7 Optimised filter units, ER8 Feedback for optimised filter unit design and ER9 Novel sensors and filter units

Outline of Exploitation	This group of exploitations have been addressed jointly as they are interrelated and are all aimed at the development of new filter units to improve indoor air quality. The filter units include new filter media, enhanced designs of the filter units and smart connectivity with the air purifiers.
LEARN Partners Involved (Lead Partner in bold)	M&H
IP Ownership	M&H
Audience/ Stakeholder	The main initial stakeholder would be educational institutions. This could include schools directly, but could also include regional authorities that manage schools, or also either the authorities that contract the building of new schools or refurbishment of existing schools, of the companies that install air handling equipment into schools. Further interested customers could include other stakeholders that have responsibility of looking after indoor public spaces that use air purifiers.
Innovation in Exploitation	The filter units use the results from other WPs 2,3,4 and 7 to help create innovation in the design of new filter units for existing M&H air purifiers. The filter units have new filter prototypes that contain new innovative filter media that are designed to remove particular matter and gasses, new optimised filter designs that fit with M&H's mobile <i>OurAir</i> air purifier and feedback from testing to effect new product design.
Proposed Business Model and Plan Post Project	There have been several issues with the filter designs in LEARN. Firstly, it has been difficult to measure the effectiveness of the filters as the air purifiers were not being used in the pilot schools in a consistent manner. Secondly, the data that has been gathered during the pilot testing phases has not yet been fully processed due to delays in the running of some of the school pilot studies. Lastly, without the compulsion of regulation around IAQ in schools, it is difficult to propose an effective business model for supplying air purifiers into schools with new filters as there is no incentive for schools to invest in air purification.

	The new filter designs are still at an early stage of testing inside M&H and it is likely that they will remain so for some time. The proposed future for the exploitation at this stage would be for M&H to continue to work on it as part of its in-house R&D using its own funds. The new filter design is not yet market ready and it is currently thought that the school buildings market is ready for such an innovation at the scale required to make it profitable for M&H, so the new design may end up being repurposed for use in other sectors where M&H supply air purifiers.
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6.7.ER10 IAQ Standards

Outline of Exploitation	The exploitation would be the recommendation for new standards for indoor air quality that could lead to new regulations at either an EU or Member State level.
LEARN Partners Involved (Lead Partner in bold)	M&H and all partners contributing
IP Ownership	No IP created
Audience/ Stakeholder	Policymakers, school authorities, stakeholders designing or building new schools needing air purification
Innovation in Exploitation	Recommendations have been made to policymakers and standards bodies around measuring and mitigating IAQ in schools. These recommendations have been based upon the work undertaken within the LEARN project.
Proposed Business Model and Plan Post Project	The recommendations have been included in the LEARN policy briefing that was shared with relevant stakeholders (D8.7 <i>Policy Recommendations Indoor Air Quality Monitoring and Standards</i>). M&H will use these recommendations, especially those relevant to standardisation, in its ongoing standardisation activities. This will include sharing the policy briefing with relevant standards bodies at a global, EU or Member State level.

6.8.ER11 Skin-on-chip device

Outline of Exploitation	Skin-on-chip (SoC) model for safety assessment of air pollutants. The SoC will be connected with electrochemical sensors however this innovation will just be a proof of concept.
LEARN Partners Involved (Lead Partner in bold)	INL
IP Ownership	INL
Audience/ Stakeholder	The SoC model and device will be useful to researchers and, once fully developed, could be useful to regulators as well.

Innovation in Exploitation	The innovation is that this will be a dynamic model for the assessment of nanoparticle safety and will allow studies to be undertaken without the use of animals.
Proposed Business Model and Plan Post Project	There has already been an article published on the early stage (around TRL 4) development of the SoC model. This is currently being tested using LEARN pollutants. There is a need to raise substantial investment (probably around €2.5m) to advance the innovation developed here into a fully working device and to raise it to around TRL 6. The initial aim at the end of LEARN will be to develop a spin-off company from INL that will be able to raise the investment required to advance the model and develop a full device.

6.9. ER12 Multisensing platform

Outline of Exploitation	The multisensing platform is comprised of multisensing chips that have been designed and fabricated at INL. The chips are functionalised to detect TNF α , a biomarker of inflammation.
LEARN Partners Involved (Lead Partner in bold)	INL
IP Ownership	INL
Audience/ Stakeholder	Potential audience would be researchers in academia and industry wanting to track the in vitro biocompatibility of drugs, nanomaterials and other chemicals.
Innovation in Exploitation	Each sensor is composed of a working electrode, a counter electrode and a reference electrode. Each electrochemical chip includes 4 to 6 sensors depending on the required design. The multifunctional chips have been functionalised to detect TNF α , a biomarker of inflammation.
Proposed Business Model and Plan Post Project	The multifunctional chips are still at an early stage of development and there are still some challenges that need to be met before they can be commercialised in any way. Currently they cannot detect between 2 consecutive biomarkers and there is a need to optimise them to improve resolution and ensure the re-useability of the chips to allow for a better "real-time" approach. It is anticipated that the device will be further developed in future projects to develop the technology and to add a fluidic module that would allow them to be integrated with the skin on a chip model (ER 11). Future grants, such as Horizon Europe, will be applied for to help develop further INL work in this are.

6.10. ER13 Dataset of indoor air quality (IAQ) of classroom in primary schools

Outline of Exploitation	Dataset of indoor air quality (IAQ) of classroom in primary schools based upon the LEARN project pilot studies. In
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	addition, a specific data set of urinary biomarker levels of primary schoolchildren.
LEARN Partners Involved (Lead Partner in bold)	KU Leuven , Universiteit Hasselt, Aarhus Universitet
IP Ownership	KU Leuven
Audience/ Stakeholder	For IAQ dataset: School managers, school staff and teachers, children and their families, prevention advisors of schools, and anyone who would like to know the indoor air quality of schools where they work/attend every day For biomarker dataset: Children and their families, medical doctors, physicians, and anyone who would like to know the internal dose of indoor pollutants in children.
Innovation in Exploitation	The dataset has been compiled from the various pilot studies in the LEARN project. It is unique because of the number of schools within the LEARN pilot studies and the availability of supplementary data that allows this dataset to be contextualised.
Proposed Business Model and Plan Post Project	The dataset will be used in several publications from the project. Post-project, large parts of the data will be publicly shared through publications, meaning that there will be little exploitable IPR in the data set itself. The dataset will be used by KU Leuven in future funding applications for grants at both an EU and national level.

6.11. ER14 UFP measurements

Outline of Exploitation	IMEC has taken measurement of ultrafine particles (UFP) in an office environment
LEARN Partners Involved (Lead Partner in bold)	IMEC The Netherlands (IMEC-NL) ,
IP Ownership	IMEC
Audience/ Stakeholder	Companies active in the field of air cleaning and conditioning
Innovation in Exploitation	Due to delays in the development of tailored sensors (ER9) during the project, the UFP dataset has been validated using a different, off-the-shelf sensor that was bought from outside of the project. This has allowed the creation of vital know-how which will be used by IMEC in the delivery of future services.
Proposed Business Model and Plan Post Project	The UFP reference data that has been developed during the project has been validated using a commercially available sensor. The dataset will be used by IMEC in its service offering to companies on indoor air quality sensing as part of its living lab offering, the Workplace Vitality Hub.

6.12. ER15 Sample Ionization Potential Spectroscopy

Outline of Exploitation	Real-time sensor for molecular selective VOC sensing, including BTEX compounds
LEARN Partners Involved (Lead Partner in bold)	INL
IP Ownership	INL
Audience/ Stakeholder	The main stakeholder for this exploitation would be public safety officers. However, it would also be of interest to researchers and potentially industry as well.
Innovation in Exploitation	The innovation in the proposed sensor is to provide real-time information on the concentration of selective VOCs.
Proposed Business Model and Plan Post Project	Currently the exploitation is at TRL4 and an investment of around €2.5m would be needed to bring it to TRL6. After this, another similar sized investment would be required to fully develop the technology and bring it to the market by 2030-2032. The initial exploitation route is through a spin-off company AirTox, which will look to be developed. The business model for this company would be to both sell new devices using the technology and to develop a software as service (SaaS) model that would also exploit the technology. AirTox will start to seek funding and investment to allow it to develop the technology further. Initially it will be targeting an EIC Transition award as a first step.

Conclusion

7. Conclusion of LEARN Exploitation and Sustainability Plan

There have been a total of 15 potential exploitations developed during the LEARN project. They can be divided into the following categories:

Innovations	7
Datasets	2
Changes to practice	3
Standards	1
Policy	1
Educational Resources	1

Not all innovations have reached high enough TRL to be commercialised without further investment being required. Some will require more effort than others to bring to the market in some way. Some of the anticipated exploitations (ER6, 7, 8, & 9) have not been developed as first thought due to both difficulties in their practical use in a classroom environment and due to the lack of coherent EU level regulation of schools' IAQ which would encourage their uptake for use in schools. However, the experiences developed during the LEARN project is still of value and may, in the future, lead to innovations in filter design for use in other occupational settings. The LEARN project has also delivered already some exploitations, including the policy briefing that was produced based upon much of the work achieved in LEARN. These exploitations have already contributed to the discussions in Europe both at a Commission and Member State level around IAQ in schools. The policy recommendations from LEARN have also informed the IDEAL Cluster's policy work.

There are also plans in many of the LEARN partners to further develop the exploitations from the project. This includes their use in future research projects, some of which will lead to future grant applications or to enhance internal R&D activity. One of the most immediately successful exploitations from LEARN has been the educational resources that have been created. Although initially thought of as a project resource that would be useful in setting-up and delivering the school pilot studies, the resources have already been shared widely outside of LEARN. The boardgame especially, has already been shared with other partners in the IDEAL Cluster who have translated it into other languages and used it in their own outreach and pilot study work.