NL Health~Holland
SHARED CHALLENGES, SMART SOLUTIONS

TKI-LSH (Match) PPP Allowance application form 2022

Basic details

1A. Full project title:
Clean Air for Everyone: aerosols and viral transmission, practical interventions by ventilation and air cleaning

1B. Project acronym (if applicable):
CLAIRE

2. Contact details of main applicant ('project coordinator')
If applicable, please list all co-applicants from one organisation under the same consortium partner in the designated table.

Consortium partner 1	
Name of the organisation	Utrecht University (UU)
Department	Institute for Risk Assessment Sciences (IRAS)
Name of contact person, title(s)	Prof. dr. ir. Lidwien A.M. Smit
Male/female/other	Female
Position	Full professor
Address for correspondence	P.O. Box 80178, 3508 TD Utrecht
Telephone	+31 30 253 8696
E-mail:	L.A.Smit@uu.nl
Type of organisation (for enterprise definition see Appendix A)	Research organization
SME (MKB) - Type of SME (for SME definition see Appendix B)	No
Chamber of commerce number or equivalent	KVK: 30275924
URL of own web page	www.uu.nl/staff/lasmit
(Scientific) excellence and expertise of the main applicant and added value of the main applicant to the quality of the project	Lidwien Smit is a Professor of One Health and Environmental Epidemiology and head of the 'One Health Microbial' group of IRAS, UU. Her interdisciplinary research focuses on environmental and occupational risk factors for human health. She has great expertise in environmental exposure assessment, respiratory health and molecular epidemiology. Since the onset of the COVID-19 pandemic, she is involved in epidemiological research on air pollution and COVID-19, and she has led pioneering studies on environmental factors in SARS-CoV-2 transmission, including environmental characterization of infected mink farms and meat packing companies. She is a principal investigator in a large-scale, long-running study on zoonotic infections and respiratory health in neighboring residents of livestock farms. Prof. Smit is a member of the Health Council of the Netherlands for the Dutch Expert Committee on Occupational Safety. She has contributed to more than 120 scientific publications.
Benefit of this project for the main applicant	This project will build on research initiatives in Prof. Smit's group that were carried out during the first

	two years of the pandemic. (Infectious) airborne SARS-CoV-2 was measured during outbreak situations in mink farms, secondary schools, nursing homes, and meat packing industries. These studies contributed to a thorough understanding of infectious aerosol spread and transmission risk, but fundamental knowledge gaps on prevention remain to be addressed. In the proposed project, the group will further strengthen their bioaerosol sampling and detection strategies, and apply their knowledge and expertise in practical intervention studies. The group and this project will also benefit from a collaboration with the Pandemic & Disaster Preparedness Center (PDPC) consortium (collaboration Erasmus MC and TU-Delft) to optimize sampling and processing of environmental samples. The novel collaboration with consortium partners who have extensive experience regarding ventilation in buildings and air cleaning technologies and their application in buildings will be extremely beneficial to increase the societal impact of the main applicant's research.

Co-applicants from the same organisation as consortium partner 1			
Department	Name of contact person, title(s)	(scientific) excellence and expertise and added value of the co-applicant to the quality of the project	Benefit of this project for the co-applicant
IRAS	Prof. dr. ir. Dick Heederik	Long standing expert in bio-aerosol sampling and exposure assessment for health risk evaluation studies	See main applicant UU
IRAS	Dr. ir. Inge M. Wouters	Expert in development and optimization of (indoor) bio-aerosol exposure sampling and assessment methods and exposure measurement strategies to assess human exposure in epidemiological studies	See main applicant UU
IRAS	Dr. Wietske Dohmen	Expertise in bio-aerosol sampling	See main applicant UU

		and SARS-CoV-2 measurements in nursing home settings (ZonMW COCON project).	
IRAS	Prof. dr. Ana Maria de Roda Husman	Molecular virology spec. SARS-CoV-2, living environment and infectious diseases, system assessment	Collaboration with experts on indoor air cleaning and ventilation technologies
Earth Sciences	Prof. dr. Jack Schijven	Expert on QMRA and transport and fate of microorganisms in the environment	Further development of a generic QMRA computational tool

3. List of consortium partners (co-applicants)[1]

Consortium partner 2	
Name of the organisation	TNO
Department	Building Physics and Systems
Name of contact person, title(s)	Dr. A.A.L. Traversari
Address for correspondence	PO box 6012, 2600 JA Delft
E-mail:	Roberto.traversari@tno.nl
Type of organisation (for enterprise definition see Appendix A)	Contract research organisation for applied sience
SME (MKB) - Type of SME (for SME definition see Appendix B)	No
Chamber of commerce number or equivalent	KvK: 27376655 BTW nummer NL002875718B01
URL of own web page	www.tno.nl
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Roberto Traversari a PhD of Contamination Control within TNO. The research of the group focuses on contamination control and with respect to SARS-CoV-2 research has been performed for the government and private organisations. He has great expertise in indoor exposure assessment. Since the onset of the COVID-19 pandemic, he is involved in research on spread of particles related to COVID-19.
Benefit of this project for the applicant	This project will build on research initiatives in TNO that were carried out during the first two years of the pandemic. These studies contributed to a thorough understanding of aerosol spread. In the proposed project, the TNO Building Physics and Sytems will further strengthen their knowledge and

[1] In case of a potential conflict of interest (at a personal or organizational level), please disclose the situation following Appendix C.

	expertise in practical intervention studies regarding ventilation. The novel collaboration with consortium partners who have extensive experience regarding bioaerosol measurements and air cleaning technologies and their application in buildings will be extremely beneficial to increase the societal impact of the main applicant's research.

Co-applicants from the same organisation as consortium partner 2			
Department	Name of contact person, title(s)	(scientific) excellence and expertise and added value of the co-applicant to the quality of the project	Benefit of this project for the co-applicant
Building Physics and Systems	Drs. M.J. Hinkema	Strategic health care asset management Functional design Process analysis and human interaction	See main applicant TNO.
Building Physics and Systems	Ir. P. Jacobs	Ventilation specialist	See main applicant TNO.

Consortium partner 3	
Name of the organisation	Eindhoven University of Technology (TU/e)
Department	Built Environment
Name of contact person, title(s)	Prof. dr. ir. Bert Blocken
Address for correspondence	P.O. Box 513, 5600 MB Eindhoven
E-mail:	b.j.e.blocken@tue.nl
Type of organisation (for enterprise definition see Appendix A)	Higher Education
SME (MKB) - Type of SME (for SME definition see Appendix B)	No
Chamber of commerce number or equivalent	51278871
URL of own web page	www.urbanphysics.net
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Prof. dr. ir. Bert Blocken is a Civil Engineer holding a PhD in Civil Engineering / Building Physics from KU Leuven in Belgium. He is Full Professor in the Department of the Built Environment at Eindhoven University of Technology (TU/e) in the Netherlands and part-time Full Professor in the Department of Civil Engineering at KU Leuven (Leuven University) in Belgium. He has led the design and construction of the Eindhoven Atmospheric Boundary Layer Wind Tunnel and currently acts as its Scientific Director. His main areas of expertise are urban physics, city and building aerodynamics and sports

	aerodynamics. Since April 2020, he has invested most of his time into aerodynamic research on ventilation and air cleaning against COVID-19. He was the leader of two projects on COVID-19 in fitness centers (funded by the Top Team Sports in the Netherlands). He is consortium leader of the LSH-project LSHM20077-H040: Towards safe indoor and semi-indoor sports events during the COVID-19 pandemic, which will end in June 2022. In the framework of LSHM20077-H040, he was awarded an additional 2.5 million dollar grant by the White House HPC Consortium on COVID19 for supercomputer calculations with Microsoft and Ansys. He is the initiator and lead PI of the large "Aircleaning in Classrooms" project in Belgium and the Netherlands, in which high-quality and safe aircleaners are installed in the classrooms, free of charge, by a large number of associated companies. He has published 216 papers in international peer-reviewed journals. His h-index values are 61, 68 and 82 on Web of Science, Scopus and Google Scholar, respectively. He has graduated 24 PhD students. He is listed as 2018, 2019, 2020 and 2021 Highly Cited Researcher by Clarivate Analytics (Web of Science) for production of multiple highly cited papers that rank in the top 1% by citations for field and year in Web of Science Core Collection, ranking him in about the top 0.1% researchers in his field according to Clarivate Analytics. He was listed as one of the 15 engineers world-wide "who mattered in 2020" by Engineering.com (https://new.engineering.com/story/engineers-who-mattered-in-2020). His first paper on COVID-19, ventilation and fitness centers (see ref [1]) was ranked by Altmetric in the top 0.003% of tracked articles (www.altmetric.com/top100/2020/).
Benefit of this project for the applicant	Bert Blocken has so far led four projects on ventilation, air cleaning and COVID-19. Air cleaning could be a very important measure against future waves of COVID-19 and other respiratory virus infections. In addition, it can also help to reduce indoor particulate matter pollution caused by traffic exhaust that is injected into buildings by ventilation, to reduce pollen concentrations and help those suffering from allergies, etc. In spite the fact that air cleaning is a relatively cheap technology (compared to solutions with only mechanical or natural ventilation), very easy to implement and use (plug and play) and very effective, there are still many doubts and even concerns about air cleaing technologies. These doubts and concerns are addressed in detail in this project. The project fits perfectly in the activities of the applicant in terms of building physics and also in

	this recent activities on ventilation, air cleaning and COVID-19. In addition, the interaction with the other organizations in this consortium is expected to yield substantial synergy and additional knowledge for all involved.

Co-applicants from the same organisation as consortium partner 3			
Department	Name of contact person, title(s)	(scientific) excellence and expertise and added value of the co-applicant to the quality of the project	Benefit of this project for the co-applicant
Built Environment	Dr. ir. Twan (A.J.) van Hooff	Twan van Hooff has extensive expertise in both experimental and numerical (CFD) analysis of complex ventilation flows.	The project is a major addition to the previous efforts on COVID-19 by the co-applicant. Large synergy with the other partners is expected.
Built Environment	Dr. ir. Marcel (G.L.C.) Loomans	Marcel Loomans has extensive expertise in both experimental and numerical (CFD) analysis of complex ventilation flows.	The project is a major addition to the previous efforts on COVID-19 by the co-applicant. Large synergy with the other partners is expected.
Built Environment	Ir. Thijs van Druenen	Thijs van Druenen has extensive expertise in aerosol measurements and modeling with CFD	The project is a major addition to the previous efforts on COVID-19 by the co-applicant. Large synergy with the other partners is expected.

Consortium partner 4	
Name of the organisation	Leiden University (LU)
Department	Health, Medical and Neuropsychology
Name of contact person, title(s)	Andrea Evers, prof.dr.
Address for correspondence	Institute of Psychology, Dep. Health, Medical and Neuropsychology, Postbus 9101, 6500 HB Leiden
E-mail:	a.evers@fsw.leidenuniv.nl
Type of organisation (for enterprise definition see Appendix A)	Research organization
SME (MKB) - Type of SME	No

(for SME definition see Appendix B)	
Chamber of commerce number or equivalent	
URL of own web page	https://www.universiteitleiden.nl/medewerkers/andrea-evers#tab-1
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Prof. Dr. Andrea W.W. Evers is professor of Health Psychology and chair of the Institute of Psychology at Leiden University, the Netherlands. She is also affiliated to the Technical University Delft and Erasmus University Rotterdam as Medical Delta Professor Healthy Society. Andrea Evers obtained several personal grants and awards for excellent researchers (e.g. *NWO-Veni, NWO-Vidi, NWO Vici, ERC Consolidator Grant*) for her innovative, interdisciplinary and translational research on psychoneurobiological mechanisms and treatments for health and disease. Since 2020, she is member of the Scientific Advisory Board of the COVID Behavior Unit of the Dutch Institute for Public Health and Environment (RIVM). In 2019, she received the *Stevin Award*, the highest award in the Netherlands for scientific research with societal impact. She was elected as a lifetime member of the *Dutch Royal Academy of Science and Arts (KNAW)* as well as the *Royal Dutch Society of Science (KHMW)*.
Benefit of this project for the applicant	This project will build on research initiatives of the Scientific Advisory Board of the Behavior Unit of the RIVM during the Corona Crisis. The Behavior Unit Consortium will be actively involved in this proposal.

Consortium partner 5	
Name of the organisation	Euromate
Department	
Name of contact person, title(s)	S. (Sjoerd) Gersonius
Address for correspondence	Minervum 7324, 4817 ZD Breda, the Netherlands
E-mail:	Sjoerd.Gersonius@euromate.com
Type of organisation (for enterprise definition see Appendix A)	Company
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME Small
Chamber of commerce number or equivalent	20047630
URL of own web page	https://www.euromate.com/
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Euromate is a top Dutch company providing high-quality air cleaning technology, including advice, installation and service. This company was carefully recruited as a company with top quality products that are safe for classroom and elderly care center environments.
Benefit of this project for the applicant	Euromate wishes to gain more fundamental and applied knowledge on the effectiveness and

	efficiency of their air cleaning units in different indoor environments, either without or in combination with ventilation.

Consortium partner 6	
Name of the organisation	PlasmaMade
Department	
Name of contact person, title(s)	M. (Martin) van der Sluis, CEO
Address for correspondence	Postbus 162, 7950 AD Staphorst, the Netherlands
E-mail:	info@plasmamade.com
Type of organisation (for enterprise definition see Appendix A)	Company
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME Medium
Chamber of commerce number or equivalent	60745304
URL of own web page	https://www.plasmamade.nl/contact/
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	PlasmaMade is a top Dutch company in high-quality air cleaning technology, including advice, installation and service. In 2017, CEO Martin van der Sluis was awarded the title "Enterpreneur of the year" in the Netherlands. This company was carefully recruited as a company with top quality products that are safe for classroom and elderly care center environments.
Benefit of this project for the applicant	PlasmaMade wishes to gain more fundamental and applied knowledge on the effectiveness and efficiency of their air cleaning units in different indoor environments, either without or in combination with ventilation.

Consortium partner 7	
Name of the organisation	Dolphin Global Trade Holding b.v.
Department	
Name of contact person, title(s)	Peter Hogervorst, CEO
Address for correspondence	De Beemel 13, 5673 PV Nuenen, the Netherlands
E-mail:	peter@dolphinwater.nl
Type of organisation (for enterprise definition see Appendix A)	Company
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME Medium
Chamber of commerce number or equivalent	62453033
URL of own web page	https://www.dolphinair.nl/
(Scientific) excellence and expertise of the main applicant of the organisation and added	Dolphin Air is a top Dutch company in high-quality air cleaning technology, including advice, installation and service. This company was carefully recruited as a company with top quality products

value of the applicant to the quality of the project	that are safe for classroom and elderly care center environments.
Benefit of this project for the applicant	Dolphin Air wishes to gain more fundamental and applied knowledge on the effectiveness and efficiency of their air cleaning units in different indoor environments, either without or in combination with ventilation.

Consortium partner 8	
Name of the organisation	Ultrasun International b.v.
Department	
Name of contact person, title(s)	Mr. Tim (G.H.) Leusink
Address for correspondence	Granaatstraat 6, 7554TR Hengelo, the Netherlands
E-mail:	tleusink@ultrasuninternational.com
Type of organisation (for enterprise definition see Appendix A)	Company
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME Small
Chamber of commerce number or equivalent	06028696
URL of own web page	https://ultrasuninternational.com/
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Ultrasun International B.V. is a top Dutch company in high-quality air cleaning technology, including advice, installation and service. This company was carefully recruited as a company with top quality products that are safe for classroom and elderly care center environments.
Benefit of this project for the applicant	Ultrasun International B.V. wishes to gain more fundamental and applied knowledge on the effectiveness and efficiency of their air cleaning units in different indoor environments, either without or in combination with ventilation.

Consortium partner 9	
Name of the organisation	Noa Air b.v.
Department	
Name of contact person, title(s)	Reinout Engelberts, General Director
Address for correspondence	Populierenweg 39, 3421TX Oudewater, the Netherlands
E-mail:	reinout@noaair.com
Type of organisation (for enterprise definition see Appendix A)	Company
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME Small

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Chamber of commerce number or equivalent	80567576
URL of own web page	https://noaair.com/contact
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Noa Air B.V. is a top Dutch company in high-quality air cleaning technology, including advice, installation and service. This company was carefully recruited as a company with top quality products that are safe for classroom and elderly care center environments.
Benefit of this project for the applicant	Noa Air B.V. wishes to gain more fundamental and applied knowledge on the effectiveness and efficiency of their air cleaning units in different indoor environments, either without or in combination with ventilation.

Consortium partner 10	
Name of the organisation	Fellowes Benelux
Department	
Name of contact person, title(s)	Anouk Huijgens, Marketing Team leader BLX
Address for correspondence	Gesworenhoekseweg 3a, 5047 TM Tilburg, The Netherlands
E-mail:	AHuijgens@fellowes.com
Type of organisation (for enterprise definition see Appendix A)	Company
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME Medium
Chamber of commerce number or equivalent	33.306.002
URL of own web page	https://www.fellowes.com/nl/nl/default.aspx
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Fellowes Benelux is a top Netherlands-based company in high-quality air cleaning technology, including advice, installation and service. This company was carefully recruited as a company with top quality products that are safe for classroom and elderly care center environments.
Benefit of this project for the applicant	Fellowes Benelux wishes to gain more fundamental and applied knowledge on the effectiveness and efficiency of their air cleaning units in different indoor environments, either without or in combination with ventilation.

Consortium partner 11	
Name of the organisation	AL-KO Luchttechniek B.V.
Department	
Name of contact person, title(s)	E. Th. (Eric) van Hilst, Director
Address for correspondence	Dwazziewegen 24, 9301ZR Roden, the Netherlands
E-mail:	eric.vanhilst@al-ko.com
Type of organisation	Company

(for enterprise definition see Appendix A)	
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME Small
Chamber of commerce number or equivalent	04050080
URL of own web page	https://alkonl.com/al-ko/directie
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	AL-KO Luchttechniek B.V. is a top Dutch company in high-quality air cleaning technology, including advice, installation and service. This company was carefully recruited as a company with top quality products that are safe for classroom and elderly care center environments.
Benefit of this project for the applicant	AL-KO Luchttechniek B.V. wishes to gain more fundamental and applied knowledge on the effectiveness and efficiency of their air cleaning units in different indoor environments, either without or in combination with ventilation.

Consortium partner 12	
Name of the organisation	TROX Nederland B.V.
Department	
Name of contact person, title(s)	Thomas Muijsert, Director
Address for correspondence	Veersteeg 11, 4212 LR, Spijk, the Netherlands
E-mail:	Thomas.Muijsert@troxgroup.com
Type of organisation (for enterprise definition see Appendix A)	Company
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME Medium
Chamber of commerce number or equivalent	52574938
URL of own web page	https://www.trox.nl/
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	TROX Nederland B.V. is a top Dutch company in high-quality air cleaning technology, including advice, installation and service. This company was carefully recruited as a company with top quality products that are safe for classroom and elderly care center environments.
Benefit of this project for the applicant	Trox Nederland B.V. wishes to gain more fundamental and applied knowledge on the effectiveness and efficiency of their air cleaning units in different indoor environments, either without or in combination with ventilation.

Consortium partner 13	
Name of the organisation	WOLF Energiesystemen B.V.

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Department	
Name of contact person, title(s)	Rik van der Velden, Account Manager
Address for correspondence	Blauwe Engel 1, 8265 NL Kampen, the Netherlands
E-mail:	Rik.Vandervelden@wolf.eu
Type of organisation (for enterprise definition see Appendix A)	Company
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME Small
Chamber of commerce number or equivalent	24221520
URL of own web page	
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	WOLF Energiesystemen B.V. is a top Dutch company in high-quality air cleaning technology, including advice, installation and service. This company was carefully recruited as a company with top quality products that are safe for classroom and elderly care center environments.
Benefit of this project for the applicant	WOLF Energiesystemen B.V. wishes to gain more fundamental and applied knowledge on the effectiveness and efficiency of their air cleaning units in different indoor environments, either without or in combination with ventilation.

Consortium partner 14	
Name of the organisation	Binnenklimaat Nederland Participating members of Binnenklimaat Nederland that will participate, but not yet have laid down their commitment letter and thereby formalize their participation as partner of the CLAIRE project: 1. Systemair B.V. 2. Dai Airconditioning Netherlands B.V 3. Airmaster B.V. 4. Rosenberg Ventilatoren BV 5. Klimaatgroep Holland B.V. NB: these members have not yet been included in the budget form of CLAIRE Participating members of Binnenklimaat Nederland that will participate and have laid down a commitment letter and will undersign the Consortium Agreement: 6. AL-KO Luchttechniek BV 7. Wolf Energiesystemen B.V. 8. Trox Nederland B.V.) NB: these members are included in the budget form of CLAIRE
Department	
Name of contact person, title(s)	Remi Hompe
Address for correspondence	Zilverstraat 69

	2718 RP Zoetermeer
E-mail:	remi.hompe@fme.nl
Type of organisation (for enterprise definition see Appendix A)	Association
SME (MKB) - Type of SME (for SME definition see Appendix B)	No
Chamber of commerce number or equivalent	40409938
URL of own web page	https://www.binnenklimaatnederland.nl/
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Binnenklimaat Nederland is an ambitious and active trade association that works together with its members to achieve a healthy indoor climate. Always and everywhere. We do this by setting up various activities from the sectors and the focus groups and by seeking collaboration with other parties in the chain. In this way we combine knowledge and expertise and we work together on the realization of our mission.
Benefit of this project for the applicant	The importance of Binnenklimaat Nederland is to design a method with which a ventilation system can be quickly and properly evaluated to support their members. The project fits one-on-one with Binnenklimaat Nederlands's mission to achieve a healthy indoor climate.

Consortium partner 15	
Name of the organisation	ActiZ
Department	
Name of contact person, title(s)	Penny Senior
Address for correspondence	Oudlaan 4 3515 GA Utrecht
E-mail:	p.senior@actiz.nl
Type of organisation (for enterprise definition see Appendix A)	Association
SME (MKB) - Type of SME (for SME definition see Appendix B)	No
Chamber of commerce number or equivalent	30216479
URL of own web page	https://www.actiz.nl/
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	More is needed to reform aged care than just short-term action programs. Looking further ahead is necessary. According to ActiZ, the fundamental change in care for the elderly deserves a broad, social approach. According to ActiZ, the future of aging is, just like the climate, a social issue that is of vital importance to every Dutch person, young and old.

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Benefit of this project for the applicant	Supporting the members of ActiZ in creating the best and most healthy environment for care and thus preventing the spread and impact of viruses. Locking down care organizations has a major impact on residents, family and staff.

Consortium partner 16	
Name of the organisation	JAGA Konvektco Nederland B.V.
Department	
Name of contact person, title(s)	J.L.S. Verdonck, Specialist New Business, phone 06-13185275
Address for correspondence	De Meerheuvel 6 5221 EA 's-Hertogenbosch
E-mail:	JVerdonck@jaga.nl
Type of organisation (for enterprise definition see Appendix A)	private company
SME (MKB) - Type of SME (for SME definition see Appendix B)	SME
Chamber of commerce number or equivalent	16040109
URL of own web page	https://www.jaga.nl/
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Jaga is committed to developing a healthy indoor climate with as little impact as possible on the outdoor climate. Jaga has extensive knowledge of ventilation systems and the components used in them.
Benefit of this project for the applicant	The importance of Jaga is to design a method with which a ventilation system can be quickly and properly evaluated. The project fits one-on-one with Jaga's mission to achieve a healthy indoor climate. The ventilation systems must be robust in nature, based on user comfort and safety.

Consortium partner 17	
Name of the organisation	Stichting Binnenklimaattechniek
Department	
Name of contact person, title(s)	John Lens
Address for correspondence	Korenmolenlaan 4 3447 GG Woerden
E-mail:	j.lens@tvvl.nl
Type of organisation (for enterprise definition see Appendix A)	Foundation
SME (MKB) - Type of SME (for SME definition see Appendix B)	No

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Chamber of commerce number or equivalent	83768300
URL of own web page	https://www.binnenklimaattechniek.nl/
(Scientific) excellence and expertise of the main applicant of the organisation and added value of the applicant to the quality of the project	Stichting Binnenklimaattechniek offers professionals tools to guarantee the performance of climate installations. For example, the platform offers publications, instruments & tools and quality standards, including the PVE Healthy Offices. The platform is the central source of information for all professionals in the utility sector, such as designers, property managers, housing associations, consultants, maintenance technicians (construction column chain), facility managers, supervisors and the government.
Benefit of this project for the applicant	The importance of Stichting Binnenklimaattechniek is to design a method with which a ventilation system can be quickly and properly evaluated to support their members. The project fits one-on-one with Stichting Binnenklimaattechniek mission to achieve a healthy indoor climate.

4. Consortium agreement and IP
Please describe the main aspects of the consortium agreement and the anticipated plan regarding intellectual property (IP) generated by the project.

Consortium Agreement will be based on the standard template of Health Holland with only minor adaptations. Intellectual Property, academic integrity, options for private parties. Liability will be according to the common PPP principles and conditions of this template.

5. Start date (dd-mm-yyyy): 01-07-2022

6. End date (dd-mm-yyyy): 30-06-2025

7. Duration of the project (max. 48 months): 36 months

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Project content

8A. Summary (max. 300 words)

Please describe the background, objective, design, and anticipated social and economic impact.

Addressing existing knowledge gaps on the actual impact of both fixed ventilation systems and mobile air cleaning technologies on risk reduction of aerogenic SARS-CoV-2 transmission is vital. As other preventive measures are scaled down, ventilation and/or air cleaning systems and technologies may become the main line of defence relied upon to control SARS-CoV-2 infections.

The objective of this multidisciplinary project is therefore to assess the efficacy of ventilation and air cleaning systems in a real-life context, by characterizing their properties (air exchange, clean air delivery rate, air flow pattern) under different combinations of implementation contexts and intervention scenarios, while quantifying airborne (infectious) SARS-CoV-2. Feasibility and acceptability of these interventions will be studied in two different contexts: 1) elementary schools and 2) facilities for care of aged individuals.

The project recognizes and deals with interdependencies between ventilation systems and air cleaning technologies. It is organized into two distinct but interlinked work streams. Work stream one starts with experimental research to refine our understanding of the performance of ventilation systems. Work stream two runs largely in parallel, but focuses on air cleaning by mobile units, aiming to develop improved insight as well as assessment and validation technologies using experimental deployment of a variety of solutions from different suppliers. Both work streams incorporate air sampling for the collection and quantification of airborne (infectious) SARS-CoV-2 virus and other (mostly viral) pathogens, to move beyond the state of the art in risk assessment modelling under different intervention scenarios.

The improved knowledge base created will greatly expand options for accurate ex-ante and ex-post evaluation of the acceptability and feasibility of different intervention scenarios based on ventilation and air cleaning. This public-private partnership is also essential in order to prepare Dutch society, not only for future waves of SARS-CoV-2 variants, but also for future pandemics.

8B. Public summary in Dutch (max. 300 words, in lay language)

Please describe the background, objective, design, and anticipated social and economic impact.

Hoewel ventilatie en luchtreiniging kunnen bijdragen aan het terugdringen van de verspreiding van het SARS-CoV-2 virus via de lucht in gebouwen, is het niet bekend waar ventilatiesystemen en mobiele luchtreinigers aan moeten voldoen om effectief humane besmettingen te voorkomen.

Binnen dit onderzoekproject wordt de effectiviteit van verschillende interventies met ventilatie en luchtreiniging onderzocht. Eigenschappen van luchtreinigers en ventilatiesystemen (luchtverversing, clean air delivery rate, luchtstromingspatronen, veranderingen van de ventilatie luchtstroming en drukverdelingen in het gebouw) worden onderzocht, terwijl aerosolen en (infectieus) SARS-CoV-2 virus in de lucht worden gekwantificeerd. Naast de bouwkundige, technologische, en virologische aspecten, worden ook de haalbaarheid en aanvaardbaarheid van de interventies onderzocht.

Het onderzoek vindt plaats in praktijksituaties op basisscholen en in verpleeghuizen. Het project bestaat uit twee aparte werkstromen, die onderling sterk verbonden zijn door het toepassen van gezamenlijke interventiescenario’s en meetstrategieën in dezelfde

context. In de eerste werkstroom wordt experimenteel onderzoek opgezet naar de prestaties van ventilatiesystemen. De tweede werkstroom richt zich op de recente ontwikkelingen rond mobiele luchtreinigingsapparaten, waarvoor noodzakelijke nieuwe inzichten en verbeterde evaluatie- en validatiemethoden worden ontwikkeld. Het onderzoek houdt rekening met de afhankelijkheden in werking tussen ventilatiesystemen en luchtreinigers. Tijdens interventie- en controlescenario's wordt de binnenlucht bemonsterd, waarin (infectieus) SARS-CoV-2 en andere mogelijke (met name virale) ziekteverwekkers worden bepaald. Deze metingen kunnen worden gebruikt als input voor risicoanalyse modellen, waarmee het risico op infectie geëvalueerd wordt onder de verschillende interventies.

Deze publiek-private samenwerking levert een wetenschappelijke basis op om ventilatiesystemen en luchtreinigingsapparatuur tijdens verschillende interventiescenario's te evalueren. Het inzetten en valideren van effectieve binnenlucht interventies die voor de gebruiker acceptabel en bruikbaar zijn is van groot belang voor de Nederlandse samenleving: niet alleen voor toekomstige golven van SARS-CoV-2 varianten, maar ook als voorbereiding op toekomstige pandemieën.

8C. Keywords (max. 5)

Aerogenic transmission, exposure, ventilation, air cleaning, pandemic preparedness

9. Research category (see Appendix D)

a. Please indicate per work package the applicable type(s) of research (more than one option possible).

Types of research	yes/no	WP
1. Fundamental research	yes	1,2,3,4,5, 6,7,8
2. Industrial research	yes	2,3,4
3. Experimental development	no	

b. Please give an explanation of the chosen research type(s). Make use of the phrasing that has been used to define the three types of research (see Appendix D).

Based on a best estimate of the character of the activities in the different work packages and the underlying budget form, we conclude a 'weighted' percentage of 68% of this fundamental-industrial PPP.

WP1: "Fundamental research": In this WP, the project is coordinated and a theoretical foundation is developed to outline the study design, intervention scenarios, and implementation context.

WP2: "Fundamental research". The emphasis in this work package is on moving beyond the state of the art in research in understanding the behaviour of aerosol particles and different types of ventilation systems under realistic operational circumstances, develop more sophisticated model-based understanding of effects, interactions and sensitivities, as well as on methodology development. A smaller "Industrial research" component is also involved, as functional requirements for the assessment method to be developed are informed by end-user and industry needs, expectations and competencies.

WP3: "Fundamental research": As mobile air cleaning against spreading of virus infections is fairly new, experimental and theoretical work is urgently required to provide basic new knowledge and insight on its performance, either with or without ventilation systems. In addition, existing products will be evaluated and evaluation methods improved, so an "Industrial research" component is also present.

WP4: This is largely "Fundamental research" by computational fluid dynamics with a minor "Industrial research" component.

WP5: "Fundamental research": The emphasis of WP5 is on moving beyond the state of the art in research in understanding and acquiring new knowledge on (infectious) virus concentrations in air samples in real-life contexts.

WP6: "Fundamental research": The emphasis of WP6 is on theoretical work to acquire new knowledge by improving risk assessment of viral infections in real-life contexts.

WP7: "Fundamental research": The emphasis of WP7 is on theoretical work to acquire new knowledge on acceptability and feasibility.

WP8: "Dissemination": In this WP, the project dissemination is coordinated to share acquired new knowledge, without any direct commercial application or use in view.

10. Project description

Please address items a to d (max. 3500 words) and include relevant literature references. Insert citations in the text and list the references under point 11 in numerical sequence in the order in which they are first mentioned in the text.

a. Describe the research topic/background, objectives and hypothesis, and the operationalisation of the concept(s) tested.
b. Outline the work plan per work package (if more than one) in a table or scheme, including: aim, time schedule, milestones and deliverables. Indicate the role and responsibilities of the applicants in the activities.
c. Describe the coherence between the work packages (if more than one).
d. When will the project be considered successful and which criteria will be used to validate this? Describe the overall outcome of each WP that defines the criterium for success with go/no-go criteria. The mere listing of the milestones and deliverables is not sufficient.

Background

The transmission of infectious diseases may occur through ingestion and/or inhalation of or contact with pathogens. The probability of infection upon such exposure depends on the numbers of pathogens, their infectivity and the type of pathogen. Here, we focus on inhalation to bioaerosols as exposure route. There is a lack of knowledge on the actual impact of both fixed ventilation systems on the one hand, and mobile air cleaning technologies on the other, on the (reduction of) concentration and type of airborne infectious SARS-CoV-2 and other virus-containing aerosols in indoor environments. At the same time, there is a growing sense of interest and urgency around the deployment and upgrading of both fixed systems and mobile solutions to reduce the risk of aerogenic SARS-CoV-2 transmission,[2] in particular in schools, bars, restaurants and other crowded venues,[3-6] as well as in long-term care institutions where residents are particularly susceptible to infection and to severe deleterious health effects.[7] **Addressing existing knowledge gaps is vital. As other preventive measures are scaled down, ventilation and/or air cleaning systems and technologies may come to be the main line of defence relied upon to control SARS-CoV-2 transmission and infections.**

The knowledge gaps to be addressed concern both fundamental questions around system performance and virus behaviour under operational circumstances, and more pragmatic but equally vital issues to predict and safeguard effectiveness and safety of use of air cleaning technologies. Answers to both types of questions are needed to allow governments, public health authorities, institutions and building owners to make informed decisions on whether and how to invest in installation, upgrading or deployment of fixed ventilation systems, air cleaning technologies or both. Risk assessment models currently available have quantified the risk of aerogenic transmission for different scenarios,[8,9] but comparison of technological solutions for ventilation and air cleaning with existing guidance (such as opening windows) is lacking.

Hypothesis

Fixed ventilation systems and/or mobile air cleaning technologies, if applied in a safe and quality-controlled manner, can contribute to significant reduction of bioaerosol concentrations and thereby prevention of disease from transmission of airborne pathogens including viruses like SARS-CoV-2 in indoor environments.

Objectives

The overall objective of this project is to provide **currently lacking fundamental knowledge** towards the engagement of ventilation and/or air cleaning systems in different types of elementary school classrooms and common areas in facilities for aged care. This fundamental knowledge includes ventilation performance, air cleaning performance, air sampling optimization, air sampling for the collection and quantification of microbial aerosols including (infectious) virus prior to and during interventions, transmission risk assessment for different intervention scenarios, and acceptability and feasibility of different intervention scenarios, with the applicable restrictions and any additional measures required by the Dutch government. This project is also essential in order to prepare Dutch society, not only for future waves of variants of SARS-CoV-2, but also for future pandemics.

Approach

(Fixed) ventilation systems and (mobile) air cleaning technologies inevitably interact. Mobile air cleaning technologies will normally be deployed in contexts where some form of ventilation system is already present, and their deployment will in turn affect operational parameters for ventilation systems. Both ventilation systems and air cleaning technologies will need to take account of the influence of other air treatment systems (such as heating/cooling systems, humidifiers etc.) on deployment context parameters and compared with application of current guidance. A dominant factor in the resulting air patterns are temperature differences in a room, e.g. supply air temperature, temperature of surfaces, persons present, etc. The project set-up has been defined to recognize and deal with these interdependencies in real-life contexts. It is organized into two distinct but interlinked work streams.

Work stream one starts with research and experimentation to refine our understanding of the performance of ventilation systems under different combinations of implementation context and intervention scenarios to prevent aerogenic transmission of viruses. The hypothesis is that optimal ventilation and air cleaning contribute to reducing exposure to infectious virus. These contexts and scenarios will include analysis of the effect of other air treatment systems on particle behaviour and ventilation system performance.

Work stream two runs largely in parallel with work stream one but focusing on a very different technology: air cleaning by mobile units, either or not in combination with an existing mechanical ventilation system. Also here, the focus is on research and experimentation for the much needed fundamental understanding of the performance of such systems to prevent aerogenic transmission of viruses. The effect of a wide range of existing mobile air cleaning technologies will be studied as a function of space and time.

Both work streams will incorporate innovative deployment of a combination of 1) fluid dynamics, 2) measurements of air flows and aerosol particle concentrations, 3) optimization of air sampling methods, and 4) development of science-based sampling strategies, as well as actual air sampling using those methods for the collection and quantification of (infectious) virus, to move beyond the state of the art in risk assessment modelling under different intervention scenarios. The improved knowledge base on airborne exposure to infectious SARS-CoV-2 created will greatly expand options for accurate ex-ante and ex-post evaluation of the acceptability and feasibility of different intervention scenarios.

The CLAIRE project is organised in eight coherent work packages (WPs):

WP1: **Study design and governance**
WP2: Characterization of **ventilation properties** and performance under different combinations of implementation contexts and intervention scenarios based on proxies e.g. artificial aerosol particles, tracer gasses
WP3: Characterization of mobile **air cleaning properties**, performance including efficiency, effectiveness and safety (e.g. exposure to harmful substances generated by the devices) under different combinations of implementation contexts and intervention scenarios based on proxies e.g. artificial aerosol particles, tracer gasses
WP4: Characterization of **fluid dynamics** in air sampling to optimize bioaerosol sampling
WP5: **Air sampling** for the collection and quantification of microbial aerosols, including airborne (infectious) SARS-CoV-2 virus and other pathogens
WP6: **Quantitative Microbial Risk Assessment (QMRA)** based on different intervention scenarios
WP7: **Acceptability and feasibility** of different intervention scenarios
WP8: **Dissemination**

These WPs will be executed in parallel for ventilation systems and air cleaning technologies, with careful coordination in each WP to maximize interchangeability and generalizability of outcomes and to capitalize on synergies. Figure 1 shows the coherence between WPs, specific inputs and main outcomes/success factors of the project. Time schedule per WP is shown in Figure 2.

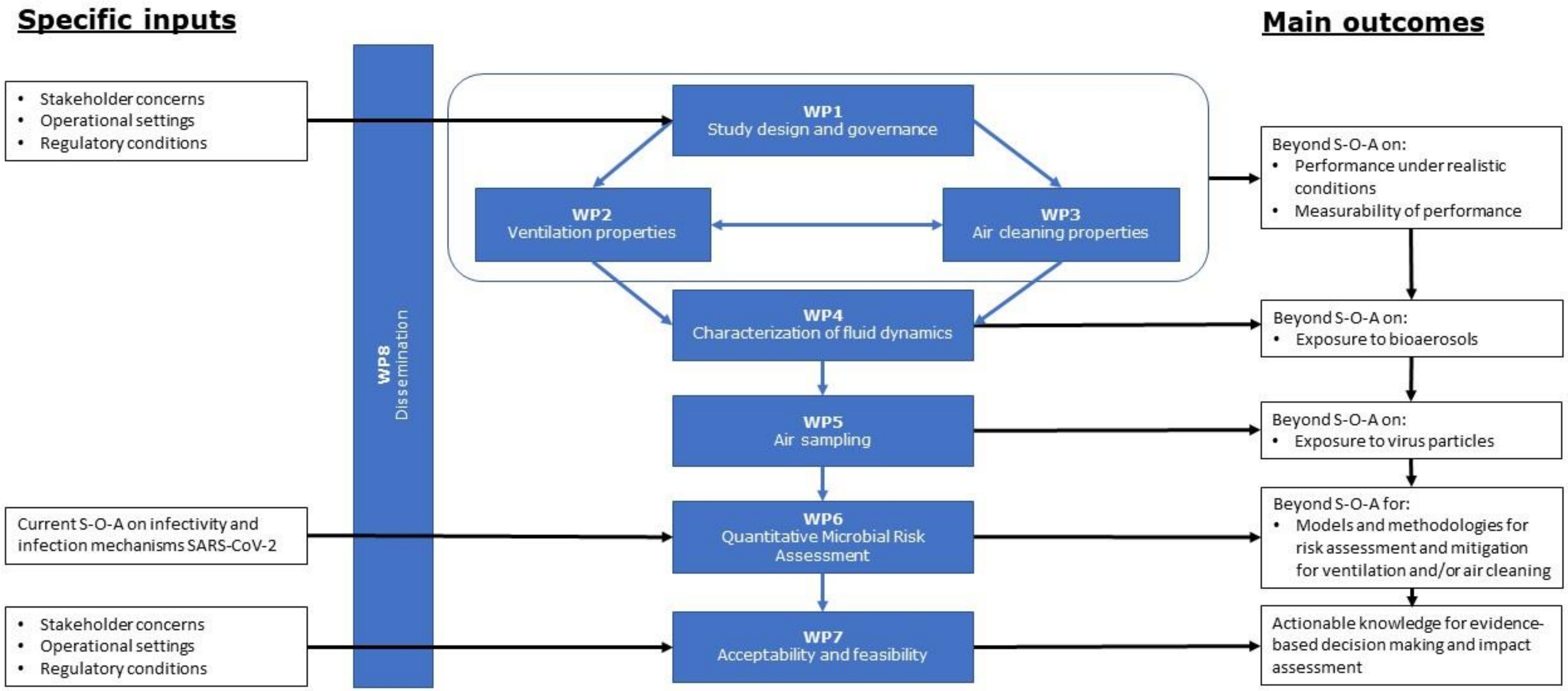

Figure 1. Coherence between the eight WPs, and main outcomes of the CLAIRE project. S-O-A:State of the art

		Year 1												Year 2												Year 3											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP1	Study design and governance			D	M		D						D						D						D						D						D
WP2	Ventilation properties							M				M	D	M				M	D																		
WP3	Air cleaning properties								D M				D M		D M				D M						D M						D M						
WP4	Fluid dynamics														M		D M												D M								
WP5	Air sampling									M								M						M	D						D						
WP6	QMRA												D M						D						D M						D						
WP7	Acceptability and feasibility																																				D
WP8	Dissemination																		D																		D

Figure 2. Time schedule per WP. Milestones(M), deliverables(D), aims, and approach are described in detail below.

WP1: Study design and governance

WP leader: UU (Smit/Heederik)
Participants: All

Deliverables:
- Data Management Plan (M3)
- Annual progress reports (M12/M24/M36)
- Stakeholder advisory meetings (M6/M18/M30)

Milestones:
- General work plan (M4)

Aims: To coordinate the project activities and optimize interaction between WPs.

In WP1, UU leads the overall project coordination and management, and ensures that WPs interact efficiently. All WP leaders will participate in a steering committee that takes project-wide decisions and drafts a general work plan that outlines the study design, intervention scenarios, and implementation context. The hypothesis, methodology and criteria for the different WPs are determined jointly.
UU will be responsible for preparation of consortium meetings and stakeholder advisory group meetings, progress reports, a Data Management Plan and a collaborative central online data repository.

WP2: Ventilation properties

WP leader: TNO (Traversari)
Participants: TNO, TU/e, BinnenklimaatNederland, Stichting Binnenklimaattechniek, Jaga.

Main deliverable: Method for assessing ventilation performance in confined environments (M18)
Supporting deliverables:
- Report on baseline assessment of ventilation efficiency at critical positions and recovery rate in test environments (M12)
- Report on assessment of ventilation efficiency and recovery rate in selected test environments under different ventilation systems (M18)
- Assessment method description and guidance (M18)

Milestones:
- Basic data set and critical measurement positions established (M7)
- Baseline measurements conducted (M11)
- Sites for second round of measurements selected (M13)
- Measurements under different ventilation systems conducted (M17)

Aims: Evaluate the performance of ventilation systems in relation to a source of airborne (bio)contaminants and the exposure at different locations.

The objective of WP2 is to develop a method that allows quick and accurate assessment of the performance of ventilation systems under operational conditions. In WP2, the performance of different ventilation systems in different environments (long-term care facilities and elementary school classrooms) at critical positions throughout the room will be investigated. Not only the amount of air is important, but also the distribution of the air throughout the room. This so-called ventilation efficiency, an important outcome measure for the performance of the ventilation system, can be measured. A related method requires determining the recovery time after injection of an aerosol at different locations in space. However, these measuring methods are laborious and therefore time-consuming. There is a need for a method to more easily determine the performance of a ventilation system in terms of its handling capacity and its uniformity. These quantities determine to a large extent what a person's exposure level is. This data is also necessary to determine the performance of air cleaners in a particular set-up and to estimate the transmission risk.

Approach

Step 1: Selection of ventilation systems and determining the basic data of the ventilation system such as type, positions, air volumes, type of grilles and position, air velocity, etc.
Step 2: Determining the critical positions for measurements
Step 3: Measuring the ventilation efficiency and recovery rate at the critical positions
Step 4: Implementing air cleaners or, if applicable, a ventilation system adapted within the framework of the specific benefit for ventilation in schools (SUVIS)
Step 5: Measuring the ventilation efficiency and recovery rate at the critical positions with the interventions
Step 6: Evaluating the outcome variables in the control and intervention group
Step 7: Develop a simplified (proxy) method for assessing ventilation performance in confined environments
Step 8: Reporting

WP2 is considered successful if the assessment method developed performs better than existing methods in predicting and explaining exposure to aerosol particles using different ventilation systems in selected experimental settings. Comparison will be incorporated into steps 5-7. Another success factor is favourable outcome of usability testing among potential end-users. WP2 outcomes will be used as input for acceptability analysis in WP7.

WP3: Air cleaning properties

WP leader: TU/e (Blocken)
Participants: TU/e, PlasmaMade, Euromate, DolpinAir, Ultrasun, NoaAir, Fellowes, Trox, AL-KO, WOLF.

Deliverables/Milestones:

- Method for novel and unbiased laboratory assessment of air cleaning performance in varying indoor environments (M8)
- Large-scale laboratory evaluation of existing air cleaning technologies in terms of safety and efficiency over time (M14)
- Large-scale in-situ evaluation of air cleaning technologies in 250 elementary school classrooms and elderly care centers (M12-18-24)
- Relationship CO_2–aerosol particle concentration (M18)
- Guideline document on the interaction between mobile air cleaning technologies and existing ventilation systems (M24)
- Guideline document for schools and elderly care centers to help them in acquiring and installing safe and efficient air cleaners with the right capacity (M24-30)

Aims: Fundamental and applied insights in the performance of different types of mobile air cleaning systems in both laboratory and in-situ environments and providing guidelines

WP3 focuses on the characterization of mobile air cleaning systems, with application for elementary school classrooms and elderly care centers. Mobile air cleaning in the framework of COVID-19 is relatively unexplored, and key question to address are the performance of different types of technologies, proper laboratory testing methods and standardisation, fundamental insight in their interaction with indoor airflow including ventilation systems, on-site analysis of aerosol concentration reduction performance for a wide range of different scenarios and the establishment of guideline documents based on undisputed fundamental scientific insights, which are currently lacking worldwide. Note that in air cleaning, CO_2 is not a valid proxy anymore, as most air cleaners do not affect CO_2 concentrations. This opens up the challenge to accurately measure aerosol particle concentrations, which is also included here. This work is the logical and much needed expansion of earlier work by the same team on air cleaning.[1,10]

Approach
Step 1: Investigating different elements of air cleaning technology in laboratory setting.
Step 2: Developing new testing methodology that is more realistic, reliable, robust together with Dutch branch organization "Binnenklimaat Nederland" and the air cleaning manufacturers in this project.
Step 4: Evaluate new testing methodology for laboratory rooms of different sizes.
Step 5: Large-scale installation of safe and efficient air cleaners in 250 classrooms and elderly care centers (without costs for schools & care centers).
Step 6: Measuring CO_2 and aerosol particle concentrations in those 250 rooms versus 250 control rooms without air cleaners for at least 1 but preferably 1.5 up to 2 years.
Step 7: Measuring the differences in viral load in the air and the (aggregated) number of COVID-19 infections .
Step 8: Study the interaction between existing ventilation systems and mobile air cleaners both in lab and on site.
Step 9: Guideline document on ventilation – mobile air cleaner interaction.
Step 10: Guideline document for schools and elderly care centers for selecting and installing safe and efficient air cleaners with the right capacity.

Figure 3. Different types of mobile air cleaners.

Figure 4. Method of artificial saliva aerosol generation for laboratory tests.

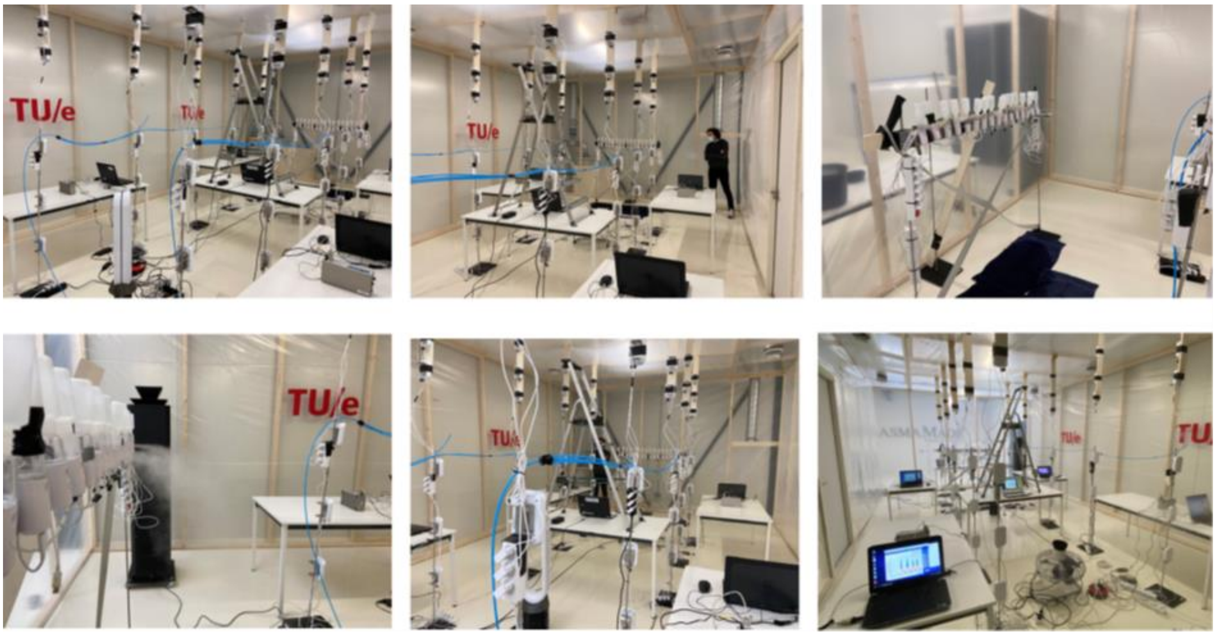

Figure 5. Air cleaning test laboratory exploited by PlasmaMade in partnership with TU Eindhoven.

WP4: Characterization of fluid dynamics (CFD)

WP leader: TU/e (van Hooff/Loomans)
Participants: TNO, UU

Deliverables:

- Model to optimize positioning for microbiologic sampling for test environments (M16)
- Procedure to determine measurement location for microbiologic sampling for the test environments (M28)

Milestones:

- Validated CFD approach (using measurements from WP2) (M14)
- Optimal positions for microbiological sampling for defined situations (from WP2) (M16)
- Procedure to identify sampling positions for the investigated confined environments (M28)

Aims: Development of, and analysis of results from, CFD models for a selection of the rooms investigated in WP2, to identify optimal positions for microbiological sampling.

Approach:
The room configuration and boundary conditions, for a selection of the rooms as investigated in WP2, are modeled in CFD to determine optimal positions for microbiological sampling in WP5. The available data (WP2) is used for validation and potentially for calibration. The CFD model results identify the ventilation effectiveness and are used for determining optimal positions for microbiological sampling.[11-14]

The CFD model should be as simple as possible but reliable and accurate enough. Therefore, the model won't resemble in detail the rooms investigated, i.e. with detailed furniture/persons. However, flow obstructing and inducing phenomena are modeled such that they affect the flow field in a similar manner as a complex representation would. The same accounts for boundary conditions, especially the supply, and contaminant sources. The aim is to reside at an as simple as possible approach, i.e. (steady) 3D Reynolds-averaged Navier-Stokes and an Eulerian instead of a Lagrangian approach[15] for modeling contamination.[16,17] This should allow for sufficient detail for the level of accuracy required. A comparison with measurements from WP2 and (limited) sensitivity studies[18] should support the assumptions made.

The developed CFD model is subsequently used for a parameter study (e.g. position heat/contaminant sources), revealing optimal positions for microbiological sampling. These positions, for the investigated rooms, will be at a resolution of ~0.5-1.0m. A visual example of a (coarser) measurement location as function of the flow field/source location is presented in Figure 6.[19]

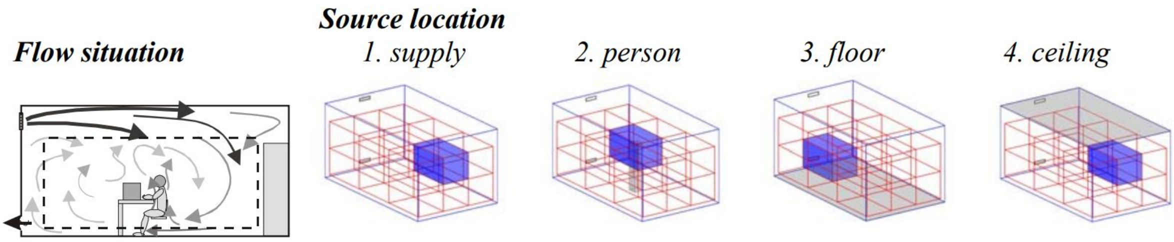

Figure 6. Example of measurement location area as function of flow field and source location (office room).[19]

WP5: Air sampling

WP leader: UU (Smit/Heederik)
Participants: TNO, TU/e

Deliverables:

- Data set of pathogen concentrations measured in air samples (M24)
- Reporting on comparisons of control/intervention conditions (M30)

Milestones:

- Selection of assays to analyse pathogens in air samples (M9)
- Air sampling under control/intervention conditions conducted (M17)
- Laboratory analysis of pathogens in air samples (M23)

Aims: WP5 aims to assess effectiveness of intervention scenarios by deploying optimized bioaerosol sampling strategies to collect and quantify airborne (infectious) SARS-CoV-2 virus.

In WP5, air sampling will be conducted during control and intervention situations delineated in WP1 and applied in WP2-3 (e.g. in a period before, during, and after an air cleaning device is switched on), and following optimization of sampling and detection strategies developed in WP4. To increase the likelihood of detecting microbial aerosols, and thereby widening the scope of the CLAIRE project, a variety of bacterial, viral, and fungal pathogens will be included.[20]
WP5 builds on the vast experience of (co-)applicants in the field of bioaerosol sampling and analysis over the last decades, and on COVID-19 research.[7,21-24] Using different air sampling techniques, SARS-CoV-2 was measured in air and on surfaces in Dutch nursing home residencies as well as in rooms of SARS-CoV-2 infected nursing home residents in isolation.[7] Active air sampling (CDC-NIOSH sampler,>4µm size fraction) in the room of a nursing home patient diagnosed with COVID-19 led to successful detection of infectious virus *in vitro*.[7] An important element of microbial sampling is also the development of science-based sampling strategies. Air levels of microbial agents vary considerably and this raises questions regarding the frequency and duration of bio-aerosol measurements for viruses and other pathogens in order to obtain a good insight in environmental levels. This type of information is also vital for other WPs in this project like WP6.

Approach
Time series of repeated measurements will be collected at several locations in class rooms and elderly care facilities to determine information on dynamics of air contamination and its effect on viral spread and impact of interventions. Further optimization of current sampling and measurement devices will be studied through parallel sampling. Size fractioned measurements will be conducted through application of the NIOSH BC251 bio-aerosol sampler.
Nucleic acids will be extracted from tubes containing aerosols of different size fraction (>4µm, 1-4µm) and filter (<1µm), and analysed using RT-qPCR and qPCR assays for SARS-CoV-2 and a range of microbial markers and potential pathogens
Samples tested positive by RT-qPCR with RdRp Ct≤35 will be tested for infectious SARS-CoV-2.

WP6: QMRA

WP leader: UU (Schijven/de Roda Husman)
Participants: TNO, TU/e, UU

Main deliverable: Model for assessment of illness risk resulting from exposure to airborne SARS-CoV-2 and other respiratory pathogens under different ventilation and air cleaning scenarios as compared with current guidance (M30)

Supporting deliverables:

- Data extraction sheet (M12)
- List of assumptions and possibly literature study (M18)
- Model description in freeware (M24)
- Publication of the model (M30)

Milestones:

- Conceptual model description based on experimental set-up established (M12)
- Data extraction sheet filled with data (M24)

Aims: Validate risk assessment model to evaluate illness risks from airborne SARS-CoV-2 and other respiratory pathogens under different ventilation and air cleaning scenarios as compared with current guidance.

WP6 applies a QMRA[25,26] framework to assess the airborne risk of contracting infectious diseases under different ventilation and air cleaning scenarios by modelling. Input data for the model concern ventilation system properties (WP2) and air cleaning properties (WP3), spatial and temporal distribution of aerosol and pathogen concentrations (WP5 and literature), and dose-response data for Coronavirus 229E.[27]
A conceptual model will be built specifically for the different systems and the experimental set-up. Scenarios will be developed and selected. Experience with such an approach was previously rendered for e.g. Legionella bacteria,[28,29] *Campylobacter*, *Cryptosporidium*, norovirus[30]. With respect to SARS-CoV-2, the AirCoV2 risk assessment model for exposure to virus particles in aerosol droplets was previously developed by Schijven et al.[8] Infectious virus measurements in aerosols under different ventilation and air cleaning scenarios are needed for further development of the model to be able to compare efficiencies of different technologies. The existing AirCoV2 interactive computational tool will be adapted for this specific use.

WP7: Acceptability and feasibility

WP leader: LU (Evers)
Participants: TNO, TU/e, Medical Delta

Deliverables:
- Insight in the acceptability of ventilation and air cleaning interventions in schools and long-term care
- Insight in the feasibility of ventilation and air cleaning interventions in schools and long-term care
- Effect on comfort and wellbeing of occupant for instance ozon, ionized particles, noise, draft & thermal comfort
- Effect on the energy use

Aims: WP7 aims to assess the acceptabilty and feasilbilty of ventilation and air cleaning interventions in elementary school classrooms and in long-term care.

To make sure that interventions are actually put into practice, they should be based on acceptability and feasibility of the environment. Additionally, the intervention should be in line with user preferences. To monitor the aspects that will influence the actual implementation of the interventions, a broad network of stakeholders will be involved in this WP. In WP7 the acceptability and feasibility of ventilation and air cleaning interventions will be monitored in elementary school classrooms and in facilities for aged care. The first aim will focus on acceptability, it will be investigated wether schools and facilities for aged care are willing to accept and comply with the regulations as such. Also, it will be assessed if they will continue to comply in the longer term.
The second aim focuses on feasibilty, to investigate whether it is possible for schools and facilities for aged care to comply with regulations. For example, there will be a difference in the degree of movement and the sensitivity for temperature in schools compared to facilities for aged care. These type of social, behavioral and environmental factors will be taken into account. The data wil be collected through questionnaires, semi structured interviews, focus groups and participative user research.

WP8: Dissemination

WP leader: TNO

Participants: All

Aims: Communication based on the results in the different sectors by the knowledge parties and branch organisations

WP8 is crucial for the project outcomes and follow-up. As such it is part of the overall dissemination strategy, as described under 15f in this proposal. The objectives, main deliverables, success criteria and approach for the dissemination work package are explicated under that heading.

11. Please provide a concise list of references

List all authors when there are six or less; when there are seven or more, list the first three, then 'et al'. Avoid using the words 'in press' in references if possible.

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TKI-LSH (Match) PPP Allowance application form 2022

12. Importance of the project

a. Please describe how does the project fits within the Knowledge and Innovation Agenda 2020-2023 and the general policy theme that is depicted in it (max. 300 words).

The Central Mission of the Knowledge and Innovation Agenda 2020-2023 is “a longer healthy life”. The Agenda has the subtitle: ”Vital functioning citizens in a healthy economy”. The CLAIRE project focuses on ventilation and air cleaning in general and on elementary school classrooms and facilities for aged care. CLAIRE intends to contribute to the health and well-being of our children and vulnerable older citizens. These groups in society deserve not only our respect but also our best fundamental and applied scientific research. The outcomes of the project will also benefit the safety, wellbeing and job satisfaction of frontline staff in primary education and aged care. These professionals have been particularly affected both in terms of physical health and emotional wellbeing by the risks they have been exposed to and the limitations on normal professional practice that have had to be imposed during the past two years. Research that improves these workers’ ability to work safely and well during future outbreaks or new pandemics is imperative both to support workforce health and to allow provision of services vital to the health and life expectancy of vulnerable groups in society.
Taking action is an ethical imperative. The past two years of the pandemic have seen dramatic situations of emotional and physical suffering in aged care centers, a situation that we should never allow to happen again, in the future. The Omikron-wave has particularly struck hard in the schools. Schools and elderly care centers are both environments where people stay for a very long time during the day, with many persons in the same rooms, often in buildings with no existing mechanical ventilation systems or at best ventilation systems that have been primarily guided by the Building Code, which is a good document, but which has never been developed with respiratory pandemics in mind.

b. Please describe below how the project contributes to the Central Mission of the Top Sector LSH (max. 150 words)
   - Central Mission:
     By 2040, all Dutch citizens will live at least five years longer in good health, while the health inequalities between the lowest and highest socio-economic groups will have decreased by 30%.

The COVID-19 pandemic, like other high-impact infectious diseases, has had an adverse effect on (healthy) life expectancy both directly through excess mortality and indirectly through worsening health and socio-economic outlooks. The project focuses on major mitigation methods, and two major societal application domains, goes beyond avoidance of adverse effects and contributes to further advances in population health by maximizing indoor air quality and respiratory virus protection. This project adheres to the UN Sustainable Development Goals (*Figure 7*) by addressing at least goals nr. 3, 4, 10 and 11. As it is imperative that all schools and elderly care centers, regardless of their financial status, location and population, are served with the best indoor air quality and lowest degree of respiratory virus infection as possible.

Figure 7. UN Sustainable development goals.

c. Please describe below how the project contributes to one or more of the underlying missions of the Top Sector LSH (max. 300 words):
   - Mission I:
     By 2040, the burden of disease resulting from an unhealthy lifestyle and living environment will have decreased by 30%.
   - Mission II:
     By 2030, the extent of care provided to people within their own living environment (rather than in health-care institutions) will be 50% more than today or such care will be provided 50% more frequently than at present.
   - Mission III:
     By 2030, the proportion of people with a chronic disease or lifelong disability who can play an active role in society according to their wishes and capabilities will have increased by 25%.
   - Mission IV:
     By 2030, quality of life for people with dementia will have improved by 25%.

Mission I: Indoor environments are major determinants of people's health: about 90% of people's time is spent indoors. For vulnerable older citizens, time spent outside may be even more limited. Poor indoor air quality is a known contributor to ill health. Maximising indoor quality is therefore imperative not just in the context of respiratory virus pandemics, but in providing fit-for-purpose environments for healthy learning, work and care.

Mission III: The COVID-19 pandemic has struck people with chronic conditions especially hard. Not only have they disproportionately suffered adverse health effects, they have also seen the scope of daily life curtailed because of the need to shield. Especially for people with respiratory chronic conditions, poor indoor air quality is an activity inhibitor. Maximising indoor air quality, and improving prior assessibility of and trust in this quality will allow people with chronic conditions to participate in society more fully while staying safe.

13. Applicable categories

a. Please indicate below which roadmap(s) (see Appendix E) is/are most applicable to the project (max. 2 roadmaps).

LSH Roadmaps	**yes/no**
1. Molecular diagnostics	
2. Imaging & image-guided therapies	
3. Homecare & self-management	
4. Regenerative medicine	
5. Pharmacotherapy	
6. One health	X
7. Specialised nutrition, health & disease	
8. Health technology assessment, individual functioning & quality of life	
9. Enabling technologies & infrastructure	X
10. Global health, emerging diseases in emerging markets	

b. Indicate on which of the seven LSH-related Dutch National Research Agenda routes[2] the project applies to (max. 2 routes).

LSH-related Dutch National Research Agenda routes	yes/no
1. Healthcare research, sickness prevention and treatment	X
2. Personalised medicine: the individual at the centre	
3. Regenerative medicine: a game-changer moving to broad areas of application	
4. Creating value through responsible access to big data and its use	
5. NeuroLabNL: the ultimate living lab for brain, cognition and behavioural research	
6. Sport and exercise	
7. Quality of the environment: game-changer 'Exposome'	

c. Indicate on which of the Key Enabling Technologies[3] the project applies to.

Key Enabling Technologies	yes/no
1. Advanced materials	
2. Chemical technologies	
3. Digital technologies	
4. Engineering and fabrication technologies	X
5. Life science technologies	
6. Quantum technologies	
7. Nanotechnologies	
8. Photonics and light technologies	
9. Not applicable	

d. Name the applicable underlying subcategories[4] of the Key Enabling Technologies the project applies to.

Engineering and fabrication technologies

- Imaging
- Sensors and actuators

e. Describe why these Key Enabling Technologies are relevant for the project, and thus how the project helps in the application and/or development of these technologies.

Various sensoring and imaging techniques will be used in the project to measure and monitor ventilation system and air cleaning technology performance, sample air quality and visualize and follow air streams, particle concentrations and particle behaviour.
These KET's are used to pursue project outcomes, but their development / improvement is not a project goal in itself. Outcome level technologies (ventilation systems and air cleaning technologies) for the project can be described as Engineering and fabrication technologies but are not listed as specific subcategories in the documentation provided. It could be argued that, as enabling technologies contributing to the broad societal goal of maximising indoor air quality, they should be added to the list.

[2] https://2.wetenschapsagenda.nl/overzicht-routes/
[3] https://www.hollandhightech.nl/kia-sleuteltechnologieen
[4] https://www.nwo.nl/sleuteltechnologieen

f. Indicate which of the Key Enabling Methodologies[5] the project applies to.

Key Enabling Methodologies	yes/no
1. Vision and imagination	
2. Participation and co-creation	x
3. Behaviour and empowerment	
4. Experimental environments	x
5. Value creation and upscaling	x
6. Institutional change	
7. System change	x
8. Monitoring and effect measurement	x
9. Not applicable	

g. Describe why these Key Enabling Methodologies are relevant for the project by addressing:
- How they are embedded in the project's approach.
- How expertise on these methodologies is employed within the project (via which consortium partner or third party).

Experimental environments are at the heart of the project's approach and logic. Measuring, modelling and predicting ventilation and air cleaning performance, particle behaviour, exposure and transmission risk in real-life settings informs the whole WP2-WP5 workflow, and represents a major move beyond the current state of the art. Both TNO, TU/e and UU have extensive experience with research and experimentation in real-life settings, both generally and for SARS-CoV-2 specifically.
Monitoring and effect measurement is a central component in establishing the transition and coherence between the WP2-5 workflow and the transmission risk assessment in WP6, where specialist expertise on monitoring (embodied in the Aircov2-model used for the project) is available at UU. Monitoring and effect measurement of innovation take-up and scale-up is a key part of WP7, where specialist knowledge is brought to the table by the LUMC.
How the other three KEMs have been integrated into the project approach is discussed under item 15f.

h. Describe if the project aims at researching or developing methodologies, and describe the aims of this part of the project.

The KEM's as listed above are deployed to help achieve the project objectives. Research and/or further development of KEM's of the categories listed is not a project objective as such.

i. Describe possible collaborations with other public-private partnerships or which of these public-private partnerships are relevant for a future collaboration (see the overview on the Health~Holland website[6]).

The Netherlands Centre for One Health is a possible PPP with which the benefits of collaboration can be explored. Key players in this PPP are part of the current project consortium, so possible links can be explored organically.

[5] https://www.clicknl.nl/de-creatieve-industrie/key-enabling-methodologies/

[6] https://www.health-holland.com/public-private-partnerships

Prospects

14. Originality/innovativeness
Please describe the originality of innovativeness of the project. What is new and unique? What are the novel clinical applications?

To mitigate the spread of COVID19 infection, almost all possible measures have been implemented and tried, from social (physical) distancing, over face masks to repeated vaccination series and even large-scale lockdowns. Two measures have received relatively little attention: ventilation and air cleaning.

Regarding the assessment and prediction of ventilation system effectiveness, the project moves beyond the current state of the art by developing an assessment method that can be deployed quickly yet takes adequate account of operational circumstances and parameters affecting exposure level and system performance. Current methods are very laborious, and they often use simplifying assumptions on space utilization and particle behaviour. Moreover, they simplify or ignore the influence of environmental parameters such as ambient temperature, temperature gradients, and relative humidity. The method will offer stakeholders in primary education and aged care better support in management of exposure and transmission risks, as it is specifically geared to typologies of realistic deployment settings.

Mobile air cleaning systems have a number of clear advantages: they can be installed very quickly, can yield very large energy savings and can be even more efficient than ventilation systems. Indeed, installation of mobile devices can generally be done below one hour, sometimes even in 10 minutes. They can yield very large energy savings because, as opposed to mechanical ventilation systems working with fresh outdoor air, they do not require this outdoor air to be heated up in autumn, winter and spring. Note that heat exchangers can be used, but their efficiency never reaches 100%. In classrooms without mechanical ventilation, they avoid the need to constantly open doors and windows, which actually implies heating up the outdoor air. Although air cleaning can never fully replace ventilation as it does not remove several pollutant gases, earlier research also has shown that air cleaning can be much more effective than ventilation.[10]

Many high quality air cleaners exist, but unfortunately also inferior and even harmful products are available. Inferior refers to low efficiency. Harmful refers to products that emit harmful byproducts such as ozone, nitrogen oxides or free radicals. This is a worldwide hurdle for wide-scale implementation of air cleaning systems.

There is a lack of proper testing standards and certification. The AHAM standard[31] only requires testing air cleaners for dust, cigarette smoke and pollen in a very small test room of about 24 m^3, which is unrealistic for classrooms and elderly care centers, even for single-person rooms. In addition, research has shown that the effectiveness of air cleaners, the CADR (= clean air delivery rate) is strongly influenced by the size of the room.[32] Also, the effectiveness is only measured in a single point, while large concentration gradients can occur across the room.

To the best of our knowledge, this project will be the largest COVID-19 ventilation and air cleaning project in the world. With 250 classrooms or rooms in elderly care centers involved and 250 other (similar) rooms as control rooms, all 500 equipped with high-quality measurement devices, we want to generate results with a very large statistical significance. **We also want to showcase the Netherlands as a center point in the world for strong public-private partnerships with world-wide impact.**

Some examples of the schools that have agreed to participate include (but are not limited to): Kindcentrum De Kiezel (Best), Kindcentrum De Stroom (Helmond), Primair Onderwijs Amsterdam ZuidOost, De Haarlemse Montessorischool (Haarlem), KBS de

Nobelaer (Oude-Tonge), De Wereldwijzer (Eindhoven), Kairos Vrije School (Amsterdam), Accent Scholengroep (Aalten), Kindcentrum Beekrijk (Beek en Donk), Stichting Prisma (Panningen), Scholen met de Bijbel (Staphorst), St Dominicus (Utrecht), Het Tangram (Rotterdam).

In the short term, results of the CLAIRE project will increase the evidence-base on practical solutions to reduce the potential of aerogenic transmission of infectious virus. We will contribute to **solving knowledge gaps on the effect of practical interventions** by actually measuring infectious viruses, e.g. SARS-CoV-2, in airborne particles under different intervention scenarios, while characterizing air flows, ventilation system and air cleaning properties. In the longer term, this project will contribute to a broader understanding of respiratory virus transmission routes in the indoor environment in different contexts. The project will contribute to optimization of virus and microbial sampling and development of sampling strategies to optimally map transmission risk. The intervention study design that will be developed can be applied to other high-risk indoor settings or **other viruses with pandemic potential**.

Schijven et al.[8] developed an interactive computational tool, named AirCoV2, that can be used to conduct QMRA for airborne transmission of SARS-CoV-2 under the assumption that the SARS-CoV2 particles in aerosol are evenly distributed in a room, due to mixing of air, as well as movements of persons and possible positions of a contagious person.

Published data on droplets expelled by breathing, speaking, singing, coughing, and sneezing by an infected person were used as inputs. Scenarios encompassed virus concentration, exposure time, and ventilation. Newly collected data of virus RNA copies in mucus from patients were presented. Model outcomes were used to advise intervention measures. Comparing risk outcomes of AirCoV2 with those based on the measurements taken in the CLAIRE project provides an **excellent validation of AirCoV2**, i.e. the assumption of evenly-distributed aerosol, as well as under what conditions such an assumption holds or not. Based on those comparisons, AirCoV2 may be developed further to accommodate more complex situations.

The project will also uniquely contribute to the support of this type of measures (ventilation and mobile air cleaning systems) and therefore their **acceptability and feasibility**, particularly in subgroups of citizens, for example, teachers, schooklids and parents in the school environment as well as patients and health care professionals in the aging context. Moreover, the project can also contribute to **tailoring strategies to these specific subgroups**, depending on use profiles and needs of the participants.

15. Project outcome and follow-up

a. Describe the expected societal impact of the project.

The COVID-19 pandemic has forcefully brought home the crucial role that good quality, in-person primary education for all has to play in establishing the preconditions for a healthy population and a thriving economy. As the ancient Greek philosopher Pythagoras of Samos stated: "The basis of the state is the education of the youth." Remote learning and reduced curricula have adversely affected the mental and physical health and wellbeing of pupils and their parents/carers. While full analyses still need to be done, it is already clear that there may be lasting effects on future health and socio-economic potential, and that pupils from low-SES backgrounds are particularly at risk. Maximising indoor air quality helps to avoid these impacts in future and contributes extra to creating indoor environment conditions conducive to the creation of supportive, enabling teaching environments.
A socially responsible society strives to maximise health, wellbeing, quality of life and inclusion for its most vulnerable members. For vulnerable older people living in facilities for aged care this equates to a an end-of-life environment that not only (or most

importantly) provides good physical help and care, but also (crucially) supports and enables privacy, dignity, agency, variety, social interaction and sense of purpose. With the restrictions imposed during the COVID-19 pandemic, it was exactly these soft but important aspects of life that came under pressure. If exposure and transmission risks can be reduced through maximization of indoor air quality, and institutions' trust in and uptake of these mitigation can be increased, better quality of daily life can be maintained in future, even under conditions of heightened risks.
Frontline staff in both primary education and aged care are particularly at risk and so stand to benefit from improvements to the exposure and transmission safety of their working environment. Perhaps more importantly, maximizing indoor air quality may obviate the need for painful compromises and restrictions in performance of their tasks. In the longer run, this may boost the attractiveness of careers in these sectors, and reduce the number of staff dropping out. Given expected workforce shortages in both sectors but especially in aged care, this will help enable socially sustainable primary education and aged care. Given the possibility of future COVID-19 waves and even future – and more lethal – respiratory virus pandemics, the societal impact of this project is considered to be very large. Indeed a project of this type is urgently needed, not only scientifically because of the major knowledge gaps, but especially societally.
If and when the outcomes of the project can be generalized to other sectors, beneficial effects are to be expected on the potential for people with chronic conditions to participate fully in society, as well as on the reduction of health and wellbeing risks for people in low-paid employment.

b. Describe the expected economic (also for the companies) impact of the project. Please also include a cost-effectiveness analysis or a value-based reasoning to describe the economic impact. How does the project fit the strategic mission(s) of the parties involved?

<u>Value-based reasoning</u>:
In view of the potential next waves of the COVID-19 pandemic or even future pandemics, fundamental research on the effectiveness of ventilation and air cleaning on aerosol reduction and virus load reduction is necessary to create new circumstances in which elementary school classrooms and aged care centers can develop improved protocols and be made more COVID-19 proof. This should allow keeping schools and care centers open for children and visitors, respectively. This has a direct effect in avoidance of absentee costs for in-work parents/carers of young children. Reducing aerosol exposure and transmission risk should (under pandemic conditions) also drive down infection rates among pupils, residents, staff and visitors. This will avoid costs associated with sick leave and engagement of temporary and replacement staff. It will also bring down absentee costs accruing from follow-on infections occurring in other social circles.
The economical benefits of better educated children, teachers at work instead of at home, avoiding unnecessary suffering of elderly and their families evidently will incur positive effects on the whole society including the productivity of all families involved. The strain placed on families due to closed schools and especially closed care centers is something that should be avoided at all cost in the future.

For the involved companies:
The ventilation and air cleaning companies, to their own surprise, have seen that the past two years of the pandemic have not given them the attention they might had deserved. Participating in the current project has very large benefits for the companies involved and is expected to give a significant boost to the potential for deployment of their ventilation systems and/or air cleaners. First, they finally get strong scientific support based on fundamental and applied research that they have been missing for almost two years. Second, our research results based on these high-quality products and their involvement in this project might also persuade schools, teachers, parents, school

directors, care center directors, families to engage in purchasing and installing such air cleaning systems. In a February 2022 meeting with the company Signify, Minister Wiersma showed large interest in air cleaning technologies to combat the COVID-19 pandemic. Third, the companies included in this project will probably receive world-wide media attention because of the unique character and large scale of this project.
The Netherlands is home to many outstanding ventilation and air cleaning companies, some of them with European and even world-wide activities. In this PPP, we have engaged some – evidently not all – of the most ambitious of these companies to join forces in this unique project. As you will see in the budget overview, even several of the air cleaning SMEs have committed large amounts of in kind funding in providing very large amounts (50 up to 100) high-quality air cleaners for installation in the schools and elderly care centers.
Important note: the quality and safety of these air cleaner devices has been evaluated by Bert Blocken himself, already since December 2021, as part of the short-term project "Aircleaning in classrooms" that has provided the modest basis on which to build the current much larger and complete proposal. Many potential SMEs and others were declined from involvement, as any existing potential concern has been used to discriminate between allowed or non-allowed devices. Only the safe ones have been retained. Of those retained, a subset participates in this project. There do exist other safe devices on the market, but not all could be evaluated fully and completely for this project. Evidently, in this project we will only allow top quality and safe devices in the classrooms and aged care centers.

<u>How does the project fit the strategic mission(s) of the parties involved?</u>

Utrecht University
"We are working towards a better world. We do this by researching complex issues beyond the borders of disciplines. We put thinkers in contact with doers, so new insights can be applied. We give students the space to develop themselves. In so doing, we make substantial contributions to society, both now and in the future."

CLAIRE aligns with UU's strategic mission to bring fundamental and applied researchers together in a multidisciplinary context to investigate complex issues around a major societal problem.

TNO
"TNO connects people and knowledge to create innovations that boost the competitive strength of industry and the well-being of society in a sustainable way."

The current project, which tackles an urgent societal problem using methods that align long-term societal and industry interests, is completely in accord with TNO's central mission.

Eindhoven University of Technology
"Eindhoven University of Technology combines scientific curiosity with a hands-on mentality. Fundamental knowledge enables us to design solutions for the highly complex problems of today and tomorrow. We understand things by making them and we make things by understanding them."

The project aligns with this strategic mission to enable practical solutions for complex problems based on fundamental and applied research.

Signify / PlasmaMade / Euromate / Dolphin Air / Noa Air / Ultrasun Intl / Fellowes / AL-KO / Trox / WOLF
"*Creating a healthy indoor environment based on energy efficient air filtering*".

The project explores the use of high-quality air cleaners by these companies to reduce aerosol concentrations and/or the virus load in aerosols in elementary schools and elderly care centers.

c. Indicate what the effect on the Dutch economy will be and give an analysis of your position in your competitive environment.

Given the complexity in domains, actors, spatial scales and time scales involved in gauging the effects of the project's outcomes on the Dutch economy, a full analysis of economic impacts is far beyond the scope of the project. Such an analysis would represent a progression beyond the state-of-the-art in SCBA and HIA, would be methodologically very intricate and would probably constitute a fairly large-scale research project by itself. The current project outcomes and the methodologies employed will provide building blocks which economic impact analyses can utilize. At the tail-end of the current phase of the COVID-19 pandemic, the Dutch government has already instigated or at least announced various analyses to be conducted. It is envisaged that the RIVM will play a leading role.

<u>Position in the competitive environment:</u>

- All research organisations involved are large, internationally renowned institutions, with an extensive track record of excellence in research in the relevant R&I domains.
- The companies involved, as has been described under 15b above, have been carefully selected and represent the top-end of their respective fields.
- The representation in the consortium and/or advisory group of several trade organisations provides excellent communication channels to relevant market segments / stakeholder groups and provides valuable insights into market potential and preconditions for successful implementation.

d. Indicate the current and expected Technology Readiness Level (TRL; see Appendix F) of the project (level of development/readiness to go to the market), and why this is applicable for the project.

Because there is very little information on engagement of ventilation and air cleaning against respiratory virus pandemics, associated reduced transmission risk and acceptability levels, the focus of this project is largely on the observation of basic principles, the formulation of technology concepts and experimental proof of concepts but also actual monitored application and implementation.
TRL is not a particularly apt measure to describe the current project, as the focus is not on the development of any specific technology, instrument or piece of equipment, but rather on the development of methods and methodologies to more accurately gauge and predict the performance of a range of ventilation systems and air cleaner devices. The TRL of the latter is generally quite high (many of these will already be on the market), but the developmental trajectory for these devices is not part of the project logic. Project outcomes may suggest developmental pathways to adjust / improve devices to increase effectiveness and widen potential deployment scope. This is part of item 15e below.

e. What and who will be needed to bring the innovation to the market/clinic (TRL 9)?

To bring the innovations to the market or into the classrooms and elderly care centers, parallel and/or follow-up activities need to be undertaken (mainly by the private partners) that can include (but are not limited to):

- Permanent installation of air cleaners in classrooms and care centers together with some APS (aerosol particle size) sensors for constant monitoring and connecting them

to building management systems.
- Development of a dashboard showing aerosols concentrations as a function of time and space in relation to weather conditions and number of infections.
- Implementation of digital twins for classrooms and elderly care centers.
- Increasing the installed power of ventilation systems and/or adding air cleaning units inside by default.

f. Describe the planned activities by each consortium partner in order to promote the dissemination and implementation (including potential exploitation) of the results. This should not be limited to scientific dissemination. Please also include a justification for the chosen approach for each partner.

This project aligns with the views expressed in the Key Enabling Methodology Agenda and the 6th Knowledge and Innovation Agenda (KIA) and communication and dissemination and implementation of the results will occur along the lines of this Agenda. First, the planned activities for dissemination and implementation that are common for all partners are described.

The Netherlands is well-known to be one of the most competitive and innovative countries worldwide and it is important to stay this way. Major societal challenges include – among others - climate, energy and health, where the latter has recently received a new dimension in the light of the SARS-CoV-2 pandemic. This represents a technological but especially also a societal challenge with massive economic ramifications. This societal challenge presents itself to the creative industry and can be used to stimulate innovations and develop new knowledge and methods, some of which – in education and care context – have been outlined in this proposal. The instruments, consisting of methods, models, strategies, processes and tools, used in this framework as referred to as key enabling methodologies (KEMs). This includes ways of working (together), tackling problems and creating interventions; tools that enable 'change professionals', such as designers, policy makers or administrators, to structure their work, provide direction and realise impact.

The fact that this project is well aligned with the Key Enabling Methodology Agenda and the 6th Knowledge and Innovation Agenda (KIA) is indicated by the presence of at least these five of the eight existing KEM categories. The following KEM categories are present:

Participation and co-creation
Experimental environments
Value creation and upscaling
System change
Monitoring and effect measurements

The planned activities link to these five KEM categories.

<u>Planned activities in order to promote the dissemination and implementation (including potential exploitation) of the results:</u>

1. To enhance participation and co-creation, the landscape of stakeholders has been assessed. Some specific stakeholders are directly involved in this project as consortium partners (some ventilation and air cleaning companies, 50 schools and elderly care centers). A stakeholder advisory group will guide the project based on their views and interests but they will also receive the project results first hand for implementation.

2. This project is strongly centered around the "experimental environment" of complex systems. Droplet and aerosol concentrations in space and time, impacts by ventilation

and air cleaning systems in classrooms and care centers. Field research and virtual environments (digital twins) are engaged to aid in understanding these systems. The project is therefore implemented partly by means of labotorary measurements, field measurements and numerical simulations, and partly by means of digital twins that allow exploration of the system behavior beyond the conditions in the measurements – allowing scenario analysis. The KEM category of "experimental environment" certainly in the form of digital twins is also considered a strong feature in terms of communication and dissemination as it allows to visualize physical phenomena that in reality are invisible, such as the exhalation of aerosols by classroom children or elderly persons and the build-up of aerosol concentrations or their removal by ventilation and/or air filtering.

3. Rapid value creation and upscaling is imperative in the SARS-CoV-2 crisis and in preparation towards future pandemics. Effective interventions are required in a short period of time and should be upscaled quickly as well. The ecosystem that has been developed in the past years, and sometimes decades, by the consortium partners and the surrounding ecosystem, should allow acceptation of the innovations and subsequent upscaling. The final objective (beyond the contents of this specific proposal) is evidently that all classrooms and elderly care centers in the Netherlands are offered a set of solutions (increase of ventilation flow rates, implementation of air cleaning systems, …), from which they can choose in order to make their indoor environments as corona-proof as possible.

4. The category "system change" is implemented by means of "gigamapping", which is a method that refers to pragmatically selecting a conceptual lense based on the properties of a complex problem. With a mixed-method approach including – in this project –views from microbiology, aerosol generation and distribution, ventilation and air cleaning, different perspectives and their contributions and mutual relationships are combined. For the digital twins, multicriteria mapping is performed, to combine different perspectives for various options in view of reducing virus transmission risk in sports venues by input from the different actors as well as the computer simulations with the digital twins.

5. In terms of "monitoring and effect measurement", the project includes the assessment of the effect of ventilation and air cleaning (both by field measurements and extrapolations with the numerical simulations). The KEM's in this category allow process monitoring and measuring the effects and contributions of the interventions on the system. They provide information that allows changing interventions, if needed, during the research project. This includes Reflexive Monitoring in Action (RMA) and the "Meten Weten Handelen" approach that was developed for the Delta Programme. Here, reflection moments in consortium meetings and Advisory Board meetings stimulate the "learning during intervention". It allows taking into account new developments and potential strategy changes based on these new developments and/or system changes.

<u>Differences among consortium partners</u>

Given the urgency and the potentially large societal impact of the project results, some common dissemination actions are defined. Most of these actions are scheduled as early as possible:
- At least two press conference: (i) at the start of the project, explaining the project set-up, methodology and timeline of results; (ii) at end of project.
- At least six peer-reviewed journal publications
- Two large workshops/conferences for all interested stakeholders (schools and elderly care centers).

In addition:
Communication actions by any partner are first agreed upon within the consortium. Each consortium partner will provide press releases on their website and subsequent social media posts (Linked In, FB, Twitter). Scientific dissemination by means of peer-reviewed journals will be done by the academic partners UU, TU/e, LU, and research partner TNO. The companies communicate mainly via their website and professional magazines where they often provide interviews.

Description dissemination work package (WP8)

In WP8, the project-wide, stakeholder-oriented communication of the project is coordinated. This not only concerns involving the right parties in research such as schools and healthcare institutions, but also towards the grassroots from the installation sector. In addition, the progress of the project will be communicated to the members of the branch organizations in understandable language. The sector organizations play a crucial role in this. They actually know how to communicate with their members and which channels are most suitable for this. WP8 will also disseminate and promote results published in (open access) scientific journals as part of the other WPs, e.g. by statements on social media and other expressions. The dissemination work package is led by TNO, with the active involvement of all consortium partners. The trade organisations represented in the consortium and/or its advisory board have an especially important part to play in communication project outcomes to a large and diverse group of stakeholder organisations.

Approach
The general dissemination strategy and communication events delineated by WP8 will be discussed in steering committee meetings (WP1). All parties involved within WP8 agree on what can be communicated in regular meetings. The message is formulated here and the branch organizations can set up communication towards the members on the basis of this. If there are parties that do not yet want to communicate about certain subjects and results to the constituency of the branch organizations, it can be decided to suspend communication about this. However, the knowledge parties (TU/e, UU, TNO, University of Leiden) are free to include the results in scientific articles according to consortium agreement.

Deliverables
- Mid-project and end-of-project working conference / promotion event (M18/M36)
- Six dissemination events, organized by/with the trade organisations that are in the consortium
- Six pitches / presentations at events organized by third parties.
- Project info website
- Community of Interest mobilized and contacted through the project website
- Digital newsletter (every 3 to 6 months)
- Webinars (every 6 months)
- Popular media publications
- Media appearances
- International press conference with major results near the end of the project

16. Data management
The data should comply with the FAIR principles (Findable, Accessible, Interoperable, and Reusable; https://www.dtls.nl/fair-data/fair-data/).

a. Could the research question(s) be answered with existing data and a therefore suitable research methodology? If not, or only partially, please explain the added value of the new data to existing datasets.

The research question cannot be answered with existing data. The study design and envisaged steps beyond the state of the art hinge on the systematic collection of data on and in actual, real-life implementation contexts (e.g. specific classrooms, sections of specific long-term care facilities). Data generated through CFD simulation uses this data on real-life implementation contexts to improve the reliability and generalizability of point-specific sampling. The combined outputs of implementation context analysis and CFD modelling determine the selection of pathogens, sampling techniques and interpretation of sampling data in WP5. Existing data sets on pathogen samples lack the systematic implementation context information generated in the CLAIRE project and are therefore unsuited as sources. The outcomes of the CLAIRE project may allow reinterpretation of existing data sets if relevant context information for those data sets can be retrieved.

b. Will data be collected or generated that are suitable for reuse? If yes, then answer questions c to e. If not, then explain why the project will not result in reusable data or in data that cannot be stored or data that for other reasons are not relevant for reuse.

Yes

c. Where will the data be stored during the project?

A central online data repository will be created by the project coordinator UU (https://www.uu.nl/en/research/yoda). Research organisation project partners will have full access; other partners will have tailored access according to their role in the project and their specific data access requirements (e.g. to own data, processed data showing peergroup reference information et cetera). Data access and data security plan will be devised by UU in accordance with its usual policies and guidelines for storage and handling of research data.
Nearly all data generated in the project are suitable for digital storage. Some short-term storage of samples collected for WP5 will be needed before analysis of said samples and generation of digitally storable read-outs. Short-term physical storage of samples will be done by UU using the storage facilities of IRAS.
A full Data Management Plan will be drawn up and agreed with all project partners before project start (WP1).

d. After the project has been completed, how will the data be stored for the long-term and made available for the use by third parties? To whom will the data be accessible?

The project will pursue an "as open as possible" data access policy for the project. No patient-specific data will be collected. All data for long-term storage will be digital in nature and will be stored by the project coordinator UU according to its usual practice for long-term research data storage. UU will arrange for project partners to have continued access to project data after project end.
Data will be made available to third parties upon request. All project data will be available for request, unless and to the extent that specific privacy, economic sensitivity and/or IP restrictions apply. The nature and extent of these restrictions will be assessed and agreed between project partners and formally recorded before project end.

e. Which facilities (ICT, (secure) archive, refrigerators or legal expertise) do you expect will be needed for the storage of data during the project and after the project? Are these available? ICT facilities for data storage are considered to be resources such as data storage capacity, bandwidth for data transport and calculating power for data processing.

The main research partners in the project are all large universities and/or applied research organisations who routinely handle and store large and complex data sets as part of their day-to-day operations. All ICT facilities are in place. There will be limited long-term storage of physical data such as samples. At UU, -80°C freezer capacity is available to store extracted air sample aliquots for re-use or analysis of additional biocontaminants. All main research partners can call on specialized in-house legal expertise to advise on data management and (restrictions on) data access. Other partners in the project either have comparable in-house resources or can call on assistance of trade organisations.

17. Patient/end user participation

Please describe if and how citizens in their role as patients, end users, clients, and/or loved ones are involved in the design, execution and dissemination/implementation of the project results. Please address the following points within your answer (max. 400 words):

- *What is the consortium's vision on participation of citizens in their role of patients in the organisation of the project, from project idea to the project's end result (output and outcome)?*
- *Are these groups actively involved as partner in the formation of the consortium?*
- *Are these groups structurally and (pro)actively involved in the execution of the project?*
- *How are the experiences and wishes of these groups included in the process?*
- *Are these groups financially facilitated/compensated for their active involvement?*

The project focuses on ventilation and air cleaning technologies as risk-reducing measures in public and semi-public buildings, specifically schools and long-term care facilities for aged care. Ownership of these buildings, responsibility for health and safety within these buildings, and decision-making responsibility on deployment of ventilation and air treatment technologies lie with professional organisations (health care institutions, school boards). The end-users of the project outcomes are therefore organisations rather than the individuals making use of these buildings. These organisational end-users are part of the project organisation through their trade organisations such as Actiz. A number of end-user organisations will be directly involved as test sites.

The individuals in question are not considered to be patients. Their distinguishing characteristic is not that they suffer from any specific condition, but rather that – either through behavioural interaction characteristics, through intrinsic vulnerability, or a combination of both – they are especially at risk from contracting COVID-19 and/or of experiencing severe health effects if they are infected. They therefore need adequate safety measures to be in place to be able to conduct their daily activities normally.

The prime responsibility of the organisational end-users directly targeted by the project's outcomes is to provide safe, fit-for-purpose indoor environments for residents, pupils, staff and other individual users. What constitutes "safe and fit-for-purpose" from the viewpoints of these individual users is therefore pertinent information to guide organisational end-user requirement specifications and assess the efficacy of risk-reducing measures. Information on these individual user perspectives will be generated in the project in the following ways.

- Through analysis of available research literature
- Through participation of platform organisations representing user groups in the project advisory group and in working sessions to establish the project's Study design in WP1.

of individual user needs in WP7, priorities and values as part of the analysis of implementation contexts in WP2 and WP3. This analysis will take place through literature study, questionnaires, interviews and group discussions.

18. Inclusion of the Key Principles for reducing health inequalities
Please describe to what extent the following Key Principles to reduce health inequalities are included in the project (max. 400 words):

- *Specific goals are set concerning the desired outcome in population groups with a low SES (socio-economic status).*
- *People with a low SES are engaged in the design and development process, and they are a partner within the consortium (co-creation, quadruple helix).*
- *There is proportional representation in the project, and inclusive research methodologies are used (no bias, valid data, representative4All, non-discriminating algorithms).*
- *The usability and accessibility of envisaged innovations are tested for people with a low SES.*
- *Innovations look beyond lifestyle and have specific attention for underlying factors as poverty, debts, loneliness, poor housing etc.*
- *Innovations are to be embedded in the local/regional context with active involvement of local stakeholders.*

The desired outcomes for the primary target groups (primary schools and long-term care facilities for aged care) are based on the one hand on the susceptibility and vulnerability of individuals in these settings to (the deleterious effects of) COVID-19 and on the other hand on the importance to health and wellbeing of continuation of normal daily activity under heightened risk conditions. These considerations apply across different SES status groups. However, specific consideration of how outcomes can benefit population groups with a low SES is given in the project through the following:

- One of the objects of the project is to identify pathways to generalize project outcomes beyond the primary application domains to a broader range of indoor environments where interactions between people take place. Successful generalization will especially benefit people in lower income jobs. These jobs tend to offer fewer opportunities to work from home and hence more often leave people exposed to infection risks. Also, awareness and uptake of preventative measures tend to be lower in low-income sections of the job market.
- Schools and long-term care facilities situated in low-SES areas more often face constraints on finances to invest in ventilation and/or air cleaning technologies. In addition, these schools and long-term care facilities tend to be housed in buildings of relatively low functional and technical quality. Financial attainability and effective functionality of technologies under unfavourable implementation conditions will feature prominently in the assessment frameworks to be developed in WP7.
- The innovations developed in the project are not lifestyle-oriented but aim to allow at-risk user groups to participate fully in activities conducive to their health and wellbeing under conditions of heightened transmission risk.

19. Inclusivity: Relevant differences within target groups concerned
Inclusivity entails paying attention to diversity and differentiation of the target groups concerned, including characteristics as sex, age, socio-economic status (SES), level of education, migration, cultural background, and sexual orientation, to the extent these are relevant for the theme of the project.

a. Please describe to what extent the (health) problem affects men, women and/or other relevant subgroups.

The two main application domains are primary schools and long-term care facilities for aged care. Within each domain we distinguish three main target groups.

- Pupils or residents
- Staff
- Visitors and other building users

  Residents in long-term care facilities for aged care full into age-groups that are known to be at heightened risk from (severe) COVID-19. For nearly all residents, health risks are exacerbated through poor general health and the presence of multiple (chronic) morbidities.
  Among teaching staff in primary education, workers aged 55+ are over-represented. From statistics collected over the course of the COVID-19 pandemic so far, people in this age group are more at risk from deleterious health effects related to COVID-19. Among teaching staff in primary education and care staff in long-term care, women are substantially overrepresented. In primary education, over 80% of teaching staff are women. Women are also substantially overrepresented in resident populations in long-term aged care.

b. Please describe and substantiate how the project takes into account relevant differences between people (e.g. according to sex and/or gender) in the design, execution, analyses conclusions and publication of your research. If there are no relevant differences, substantiate this.

Differences within the target groups for the project are relevant primarily for the transmission risk assessment in WP6. To the extent that differences in transmission risk and resultant morbidity risks are known from the literature and have been incorporated in the QMRA and AirCoV2 model that will be used as the departure point for the WP6-analysis, these differences will be factored in to allow balanced, differentiated risk assessments from implementation setting to implementation setting.

20. Risks of the project

Are there any risks regarding the execution of the project? List the risks for each WP, the risk mitigation strategy already incorporated in the strategy or the proposed strategy adaptations once risks are encountered.

WP	Risks	Risk mitigation strategy
WP1	One or more participants are not able to fulfil their responsibilities.	Partners possess recognised expertise and track record. The situation will be detected early via steering committee meetings and monitoring progress in WP1. If necessary, tasks will be redistributed. Participants are involved with more than one staff member, or they can delegate tasks within their organisation.
WP2	It is not possible to recruit testing environments where a new ventilation system can be deployed during the WP run time.	The research methodology envisaged for the WP can cope with this eventuality. Different settings and/or deployment configurations of the same systems can be used for the two rounds of measurements to create comparable 'before / after' comparator data.
WP3	The massive amount of work (instrumenting 500 rooms) is too large in a short time, and the associated data processing too time-consuming.	In this case other researchers from the team of Bert Blocken will be asked to join and contribute. The group is rather large (30 researchers) so that should not be a problem.

WP4	The parameter space in terms of room geometry, source positions, ventilation/air cleaning parameters is too large.	In such a scenario, this WP will have to use "Design of Experiments" to properly cope with this.
WP5	The viral load in the air is dependent on highly variable source strength, hampering interpretation of intervention scenarios.	Intervention scenarios will be examined in different implementation contexts over a prolonged period of time. Study design will include testing before, during, and after a certain intervention is applied. Due to the large spatial and temporal variability in settings and the repeated sampling strategy, the probability of chance findings will be reduced. The inclusion of a range of other airborne pathogens and microbial markers will further strengthen interpretation and relevance of the intervention scenarios, and extends the project beyond SARS-CoV-2 risk.
WP6	Risk outcomes depend on the availability of data. Dose response data are lacking.	The timeline has been optimally designed, making sure that data will be available in time in different stages, so that risk modelling steps can be finalized in time. Dose-response data from other viruses than SARS-CoV-2 will be used. Further, effects of for example environmental conditions in the various scenarios can be evaluated based on relative risks.
WP7	Subgroups of the relevant stakeholders (e.g. patients in elderly homes, healthcare workers, schoolkids and their patiens) are not reached and/or underrepresentated in the studies.	Analyses of relevant stakeholders and reach out strategies will be extensively discussed and are part of the study of acceptability and feasilibty.
WP8	Insufficient cohesion and control over project-related communications. Possible conflicts of interest between wide dissemination need and confidentiality / sensitivity of outcomes.	A detailed agreement on project communications and dissemination guidelines will be drawn up as part of the final Consortium Agreement, implementation and monitoring mechanisms will be agreed at the start of WP1 and monitoring will take place over the course of WP8.

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Human subjects, laboratory animals, biological hazards

21. Will the project involve experiments with patient material?

	Answer
a. Use of healthy volunteers?	~~yes/~~no
b. Use of patients?	~~yes/~~no
c. Number of healthy volunteers	
d. Number of patients	
e. Is ethical approval from a commission needed regarding experimental subjects?	~~yes/no/~~NA
f. If 'd' is answered with 'yes': Do you already have ethical approval from a commission to perform the study?	~~yes/no/requested/~~NA

22. Will the project involve experiments with animals?

	Answer
a. Use of animals?	~~yes/~~no
b. What kind of animals are used?	
c. Number of animals needed for the total project	
d. Nature of intervention	
e. Is ethical approval from a commission needed regarding experimental subjects?	~~yes/no/~~NA
f. If 'e' is answered with 'yes': do you already have ethical approval from a commission to perform the study?	~~yes/no/requested/~~NA

23. Justification for the requirement of experimental animals

a. Indicate if alternative methods (besides experimental animals) have been considered? Have experts been consulted and has a systematic review been performed?

b. What are the reasons that this project cannot be performed without experimental animals (replacement)?

c. What are the reasons that this project cannot be performed with fewer animals (reduction) or with less distress and discomfort for the animals (refinement)?

d. What are the reasons that this project cannot be performed with a lower species of animals?

24. Will the project involve biological risks?

	Answer
a. Use of recombinant DNA?	~~yes/~~no
b. If 'a' is answered with 'yes': provide class of recombinant DNA	
c. Use of radiation (wave and/or particle)?	~~yes/~~no
d. Use of radioactive isotopes?	~~yes/~~no
e. Use of pathogenic micro-organisms?	yes/~~no~~
f. Are required grants, permits and facilities available?	yes/~~no/NA~~

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Budget

25. Budget

Please specify the project's budget in the TKI-LSH budget form. Use a separate line per consortium partner for their contribution. Do not forget to add the numbers in the 'total' column and rows.

Contribution		2022	2023	2024	2025	2026	Total
Research organisation	In cash						
	In kind	€ 116.000	€ 191.000	€ 97.000			€ 404.000
Company	In cash						
	In kind	€ 417.000	€ 443.500				€ 860.500
Other partners	In cash						
	In kind	€ 9.750	€ 19.500	€ 9.750			€ 39.000
PPP Allowance	In cash	€ 758.400	€ 1.400.600	€ 589.023			€ 2.748.023
Total funding (incl. PPP Allowance)	In cash	€758.400	€1.400.600	€589.023			€2.748.023
	In kind	€542.750	€654.000	€106.750			€1.303.500
	Total	€1.301.150	€2.054.600	€695.773			€4.051.523
Total project costs	**Total**	**€1.301.150**	**€2.054.600**	**€695.773**			**€4.051.523**

26. Deployment of PPP Allowance

Please indicate for each consortium partner 1) their total costs (incl. in kind contribution); 2) the amount of PPP Allowance that they will use; and 3) the activities that will be financed through the PPP Allowance.
Note: each consortium partner must incur payroll costs (in kind) as part of the collaboration.

Partner	Total Costs	PPP Allowance	Activities
UU	€ 693.490	€ 595.700	WP1 Coordination, study design and governance, WP4 Characterization of fluid dynamics in air sampling to optimize bioaerosol sampling
UU (RIVM)	€ 140.000	€ 131.000	WP6, Quantitative Microbial Risk Assessment (QMRA) based on different intervention scenarios
TuE	€ 954.320	€ 805.023	WP3 Characterization of mobile air cleaning properties, performance including efficiency, effectiveness and safety (e.g. exposure to harmful substances generated by the devices) under different combinations of implementation contexts and intervention scenarios based on proxies e.g. artificial aerosol particles, tracer gasses
TNO	€ 592.633	€ 530.000	WP2 Characterization of ventilation properties and performance under different combinations of implementation contexts and intervention scenarios based on proxies e.g. artificial aerosol particles, tracer gasses, WP8 Dissemination

LU	€ 485.840	€ 414.000	WP7 Acceptability and feasibility of different intervention scenarios
PlasmaMade	€ 222.400	€ 54.000	On site installation, maintenance, measurements and user/science support of their technology
Dolphin Global Trade Holding B.V.	€ 132.400	€ 34.000	On site installation, maintenance, measurements and user/science support of their technology
Euromate	€ 222.400	€ 57.000	On site installation, maintenance, measurements and user/science support of their technology
Noa Air	€ 284.400	€ 72.500	On site installation, maintenance, measurements and user/science support of their technology
Ultrasun International B.V.	€ 154.400	€ 40.000	On site installation, maintenance, measurements and user/science support of their technology
WOLF	€ 34.400	€ 3.000	On site installation, maintenance, measurements and user/science support of their technology
Jaga	€ 29.040		On site installation, maintenance, measurements and user/science support of their technology
AL-KO	€ 20.600	€ 5.600	On site installation, maintenance, measurements and user/science support of their technology
Fellowes	€ 21.200	€ 6.200	On site installation, maintenance, measurements and user/science support of their technology
Trox	€ 25.000		On site installation, maintenance, measurements and user/science support of their technology
ActiZ	€ 10.000		WP 8 dissemination and impact; support for their constituencies
Binnenklimaat NL	€ 20.000		WP 8 dissemination and impact; support for their constituencies
St Binnenklimaat techniek	€ 9.000		WP 8 dissemination and impact; support for their constituencies
Total sum*	**€ 4.051.523**	**€ 2.748.023**	

***Make sure that the total sum of costs and the total sum of PPP Allowance in this table is in accordance with the total budget and total requested PPP Allowance in the budget form.*

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27. Budget specification

Please provide a justification/specification of the budget per work package or deliverable. Only referring to the budget form is not sufficient.

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Total
Utrecht University	138.698	-	-	138.698	312.071	34.675	34.675	34.675	693.490
Utrecht University (RIVM)	14.000	-	-	7.000	7.000	105.000	-	7.000	140.000
TNO	59.263	385.212	-	29.632	-	59.263	29.632	29.632	592.633
Eindhoven University of Technology	28.630	47.716	620.308	171.778	-	28.630	28.630	28.630	954.320
Leiden University	24.292	-	-	-	-	-	412.964	48.584	485.840
Euromate	-	-	211.280	-	-	-	-	11.120	222.400
PlasmaMade	-	-	211.280	-	-	-	-	11.120	222.400
Dolphin Global Trade Holding B.V.	-	-	125.780	-	-	-	-	6.620	132.400
Ultrasun International B.V.	-	-	146.680	-	-	-	-	7.720	154.400
Noa Air	-	-	270.180	-	-	-	-	14.220	284.400
Fellowes	-	-	20.140	-	-	-	-	1.060	21.200
AL-KO	-	-	19.570	-	-	-	-	1.030	20.600
Trox	-	-	23.750	-	-	-	-	1.250	25.000
WOLF			32.680					1.720	34.400
Binnenklimaat NL	2.000	-	-	-	-	-	-	18.000	20.000
ActiZ	1.000	-	-	-	-	-	-	9.000	10.000
Jaga	-	27.588	-	-	-	-	-	1.452	29.040
Stichting Binnenklimaat Techniek	-	-	-	-	-	-	-	9.000	9.000
	267.883	**460.516**	**1.681.648**	**347.107**	**319.071**	**227.567**	**505.900**	**241.832**	**4.051.523**

28. Have the consortium partners requested/received any additional grants for this project? ~~Yes~~/No

If yes, please specify grant supplier(s), grant name(s), total amount requested/received per grant (in €) and status (applied/granted) in the TKI-LSH budget form.

Evaluation of health and care innovations

29. Innovation guidance

Before answering the questions below, please read section 3.2 of the Match Call 2022.

		Answer
a.	Do the consortium partners intend to apply for CE marking for the health innovation during the project period or within two years after the project period?	~~yes~~/no
b.	Did the consortium partners contact HI-NL no later than three weeks before the deadline for the Match Call?	~~yes/~~no/~~NA~~
c.	Does HI-NL believe that an innovation guide is valuable for this project? *If 'c' is answered with 'yes': The consortium can choose to enter an amount of 33,275 euros in the budget form under the heading 'costs due to third parties'.*	~~yes/~~no/~~NA~~
d.	What is your main question to be addressed by the HI-NL Round Table experts? (Multiple boxes can be checked)	☐ Integration of your innovation in the Dutch healthcare system ☐ Required (clinical) evidence for market entry ☐ Reimbursement of innovation ☐ Strategy for adoption by the market ☐ Path for CE-marking ☐ Scale-up of your innovation ☐ Other, namely:

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Statement by project coordinator

When submitting your application, please do not forget to upload the required budget form file (Excel), letter(s) of commitment, (concept) consortium agreement and other necessary documents such as a statement from the organisation's TKI contact person.

Please tick the boxes where applicable:

☒ By submitting this form, I declare that I have completed this form truthfully and I declare that I have informed the correct official(s) of my employing organisation of this submission.

☒ I hereby declare that the obligatory letter(s) of commitment of the other consortium partner(s) has/have been uploaded separately.

☒ I hereby declare that the application is checked according to **Appendix I**.

Name: Prof. dr. ir. Lidwien Smit

Place: Utrecht

Date: 9 March 2022

Please note: **Information provided in relation to this application will be treated confidentially by Health~Holland**. Health~Holland has to inform the Netherlands Enterprise Agency (RVO.nl) on the participants of the project and the in cash and in kind contribution of private partners, in order to claim the requested PPP Allowance. RVO.nl will also treat this information confidentially. Upon granting, the project coordinator will receive a request to provide a summary of the project and other basic project details (see Appendix I) that will be published on the Health~Holland website and for other communication purposes. Other content of the project will not be communicated beyond Health~Holland.

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Main applicants must submit this TKI-LSH PPP Allowance application form by e-mail to tki@health-holland.com. For any questions regarding submission, please send an e-mail to tki@health-holland.com or call +31 (0)70 205 14 00.

Attachments to be uploaded:

- TKI-LSH budget form.
- Letters of commitment of **all** parties involved, each stating the parties' in cash & in kind (separately) contribution to the project. Only the main applicant does not need to upload a letter of commitment. See Appendix H for a template of a letter of commitment.
- Signed copy of the consortium agreement and IP settlements agreed upon in this project. If a signed consortium agreement is not yet available, a concept agreement must be submitted. The signed consortium agreement may be handed in within 16 weeks after the submission deadline.
- If the applicants want to use (part of) their temporarily reserved PPP Allowance (generated from the 'grondslag' 2020/2021): a statement from the research organisation's/company's TKI contact person (or other authorized person) indicating that (part of) reserved PPP Allowance can be used for this project.

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Appendix A: Definition of enterprise

English

According to established case law from the European Court of Justice, an enterprise is any unit that carries out economic activity irrespective of its legal status and manner of funding.

In this regard, the following points are important:
- The legal status (e.g. a private company or a foundation) of the entity is not important;
- A for-profit status is not required, competition on the market is sufficient (economic activities). This means that the entity participates in economic dealings and that there is business funding. Business funding means that the funding cannot consist entirely of grants, gifts and endowments. A turnover needs to be made and there has to be income from economic activity;
- An entity that carries out both economic and non-economic activities will only be designated as an enterprise with respect to the economic activities;
- The European Court of Justice has further determined that entities that (legally or de facto) fall under the authority of the same main entity should be viewed as a single enterprise;
- Having a Dutch ANBI or charitable status (serving the common interest, no profit-making status, 90% rule) means that such an entity with ANBI status cannot also be an enterprise. That is because an entity with ANBI status enjoys fiscal advantages that a business does not enjoy.

With respect to economic activity, the following aspects are, amongst others, considered in line with the Dutch Tax and Customs Administration:
- Registration with the Dutch Chamber of Commerce (KvK);
- Having a Dutch VAT (BTW) number and/or corporate income tax (VPB) number;
- Goods and/or services are delivered;
- The remuneration received for these is more than symbolic;
- The entity participates in the economic arena and enjoys income from this.

Nederlands

Volgens vaste rechtspraak van het Europees Hof van Justitie is een onderneming elke eenheid die een economische activiteit uitvoert ongeacht haar rechtsvorm en wijze van financiering.

Hierbij zijn de navolgende punten van belang:
- De juridische status (b.v. BV of een stichting) van de eenheid is niet van belang;
- Er is géén winstoogmerk vereist, concurrentie op de markt is voldoende (economische activiteiten). Dit houdt in dat er wordt deelgenomen aan economisch verkeer en er ondernemingsfinanciering plaatsvindt. Ondernemingsfinanciering betekent dat de financiering niet volledig kan bestaan uit subsidies, giften en schenkingen. Er zal omzet en inkomsten uit economische activiteit moeten plaatsvinden;
- Een eenheid die zowel economische als niet economische activiteiten verricht, wordt alleen met betrekking tot de economische activiteiten aangemerkt als onderneming;
- Het EU Hof van Justitie heeft verder bepaald dat entiteiten die (juridisch of feitelijk) onder de zeggenschap staan van dezelfde entiteit, als één onderneming dienen te worden beschouwd.
- Het hebben van een ANBI-status (algemeen belang dienen, geen winstoogmerk, 90% regel) sluit uit dat een entiteit met ANBI-status ook een onderneming is. Een entiteit met ANBI-status geniet namelijk fiscale voordelen welke een onderneming niet heeft.

Bij economische activiteit wordt, in lijn met de Belastingdienst, onder andere gekeken naar:
- Inschrijving KVK;
- het hebben van een BTW-nummer en/of VPB-nummer;
- er worden goederen en/of diensten geleverd;
- hier staat een meer dan symbolische vergoeding tegenover;
- men neemt deel aan het economisch verkeer en daar komen inkomsten uit.

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Appendix B: European Commission Recommendation 2003/361/EC regarding SME definition

Micro-enterprises are defined as enterprises that employ fewer than 10 persons and whose annual turnover or annual balance sheet total does not exceed EUR 2 million.

Small enterprises are defined as enterprises that employ fewer than 50 persons and whose annual turnover or annual balance sheet total does not exceed EUR 10 million.

Medium-sized enterprises are defined as enterprises that employ fewer than 250 persons and either have an annual turnover that does not exceed EUR 50 million, or an annual balance sheet not exceeding EUR 43 million.

For more details 'The revised User Guide to the SME definition' can be downloaded here.

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Appendix C: Conflict of Interest

This Appendix is also available in Dutch and can be requested by sending an email to tki@health-holland.com

According to Articles 28.d and 29.c of the Framework, applicable to the PPP Allowance regulation, research organisations are to receive a remuneration equivalent to the market price for the intellectual property rights arising from their activities during the course of a project. The absence or inadequacy of agreements pertaining to a remuneration based on the market price, leads to the indirect granting of state aid to the participating private parties.

'A remuneration equivalent to the market price' creates a best-effort obligation between the parties involved. It means that the research organization and the participating private parties must make an effort to negotiate this remuneration on so-called 'arm's length' terms. Arm's length conditions mean that the terms of the remuneration do not deviate from those which would be agreed upon in a private setting, between independent parties. Any transaction resulting from an open, transparent and non-discriminatory procedure will be deemed to comply with the arm's length procedure.

Every project has the potential for a conflict of interest between the research organization and one or more private companies. A conflict of interest can exist on a personal level or on an organizational level. The presence of a conflict of interest means that the arm's length conditions are potentially not met. Promptly upon identification of an objective conflict of interest, the consortium and Health~Holland should be notified. A pertinent example is when the director of a participating company, also has an employment relationship with the participating research organization.

Health~Holland will not subjectively assess the conflict of interest. Health~Holland will assess whether the performance of the consortium will be hindered or compromised by the existence of such potential conflict of interest. Health~Holland will therefore require full transparency if and when an objective conflict of interest arises or is likely to arise. 'Objective' means that potentially, a conflict of interest can occur, regardless of whether a party or person can derive any benefit or disadvantage from it.

It is up to the parties concerned – and in particular the directors of the participating companies – to recognize, interpret and report such an objective conflict of interest. This obligation to report may already exist at the time of the Match Call application being made. And thus a notification should be made upon submission of the Match Call application.

Such a notification must be accompanied by the response to the following questions:

- What are the motivations to indicate the presence of a conflict of interest?
- Has the director concerned weighed up the interests?
- Has the potential conflict of interest been adequately addressed?
- Is there a transparent procedure in place to ensure that the director can abstain from involvement in certain decisions (which may involve a conflict of interest)?
- How are the arm's length conditions adequately met?
- Has the director provided for the involvement of other researchers who can make these decisions without bias?
- Can the director involve his or her fellow director(s) in the decision-making process and is it possible in the management relationship for the director concerned to abstain from taking management decisions (four eyes principle)?

The duty to provide adequate answers to the above questions rests exclusively with the consortium parties involved. This means that the consortium parties involved have the duty to assess whether and to what extent the potential conflicting of interest has been adequately addressed and whether they are satisfied with the precautionary measures that the director(s) concerned have taken.

If, as a result of a conflict of interest, situations occur that violate the arm's length conditions, the (consortium) parties involved are liable for the resulting damage. Such damage may include the consequences of establishing that indirect state aid has been granted to one or more participating undertakings.

For the sake of completeness, Health~Holland recommends involving legal support from the consortium partners, preferably from the research organization, in order to adequately address a potential conflict of interest.

Appendix D: Definitions of the three types of research[7]

Fundamental research means experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any direct commercial application or use in view.

Industrial research means the planned research or critical investigation aimed at the acquisition of new knowledge and skills for developing new products,processes or services or for bringing about a significant improvement in existing products, processes or services. It comprises the creation of components parts of complex systems, and may include the construction of prototypes in a laboratory environment or in an environment with simulated interfaces to existing systems as well as of pilot lines, when necessary for the industrial research and notably for generic technology validation.

Experimental development means acquiring, combining, shaping and using existing scientific, technological, business and other relevant knowledge and skills with the aim of developing new or improved products, processes or services. This may also include, for example, activities aiming at the conceptual definition, planning and documentation of new products, processes or services. Experimental development may comprise prototyping, demonstrating, piloting, testing and validation of new or improved products, processes or services in environments representative of real life operating conditions where the primary objective is to make further technical improvements on products, processes or services that are not substantially set. This may include the development of a commercially usable prototype or pilot which is necessarily the final commercial product and which is too expensive to produce for it to be used only for demonstration and validation purposes. Experimental development does not include routine or periodic changes made to existing products, production lines, manufacturing processes, services and other operations in progress, even if those changes may represent improvements.

[7] In case of drug development, pre-clinical research in animals falls within the research category 'industrial research'. In principle, the clinical phases 1 and 2 fall within the research category 'experimental development'. Phase 3 clinical trials (and beyond) are seen as competitive development and fall outside the scope of the PPP Allowance Regulation.

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Appendix E: Definitions of the ten roadmaps

The roadmaps are designed to address priorities in health outcomes (age-related, chronic, acute, infectious, orphan and neglected diseases) and along the healthcare chain (from prevention through diagnosis to cure and care). The roadmaps represent the areas in which public and private parties are committed to co-innovate and ask the government to co-invest. Companies, research institutes, practitioners, patient organizations, health foundations, health insurers, regulators, and many others have contributed and endorsed these roadmaps. Seven roadmaps (1 through 7) are product oriented. They are supported by two that deliver health technology assessment (8) and enabling technologies & infrastructure (9). The latter also links to other Top Sectors with a strong life sciences component, such as Agro-food, Horticulture and Chemistry. A final roadmap (10) is centred around diseases that cause a high burden mainly in the developing world, but for which the developed world can make strides in solving.

1. **Molecular diagnostics**: Development of candidate biomarkers into validated molecular diagnostics for clinical use
2. **Imaging & image-guided therapies**: Development of imaging applications for more accurate and less invasive diagnosis and treatment
3. **Homecare & self-management**: Development, assessment and implementation of technologies, infrastructure and services that promote clients' abilities to live independently and manage their own care, adequately supported by healthcare professionals
4. **Regenerative medicine**: Development of curative therapies for diseases caused by tissue damage and ensuing organ dysfunction, through repair or renewed growth of the original tissue or replacement by a synthetic or natural substitute
5. **Pharmacotherapy**: Discovery, development and stratified use of new, safe and (cost-)effective medicines in order to cure or prevent progression along the healthcare chain
6. **One health**: Development of solutions like vaccines, optimized antimicrobial use and early warning systems that improve health status of humans and animals by coupling the know-how and infrastructure available in the human and veterinary/agricultural domains
7. **Specialized nutrition, health & disease**: Researching specialized nutrition for nutritional intervention as part of integrated health solutions in terms of prevention, cure and care of chronic, acute and rare diseases
8. **Health technology assessment, individual functioning & quality of life**: Development of methods and knowledge for health technology assessments in which the impact of health innovations on quality of life, cost-containment and productivity is assessed
9. **Enabling technologies & infrastructure**: Development and offering of expertise and infrastructure in cutting-edge molecular life science technologies (e.g. next generation sequencing, proteomics and bioinformatics), in biobanks and in ultramodern research facilities, all readily accessible to industry and academia, and with existing, strong links to other Top Sectors (Agro-food, Horticulture, Chemistry, Biobased Economy and High Tech Systems and Materials)
10. **Global health, emerging diseases in emerging markets**: Development and delivery of solutions to diseases associated with poverty, which affect more than 2 billion people in the developing world

Appendix F: Technology Readiness Levels

TRL	Definition	Indication type of research*
TRL 1	Basic principles observed	Fundamental research
TRL 2	Technology concept formulated	Fundamental research
TRL 3	Experimental proof of concept	Fundamental research
TRL 4	Technology validated in lab	Fundamental/industrial research
TRL 5	Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)	Industrial research
TRL 6	Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)	Industrial research
TRL 7	System prototype demonstration in operational environment	Industrial research/experimental development
TRL 8	System complete and qualified	Beyond the scope of the PPP Allowance Regulation
TRL 9	Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)	Beyond the scope of the PPP Allowance Regulation

*The TRL is an indication of the type of research but the definition of type of research (Appendix D) prevails.

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Appendix G: Project page content for Health~Holland website

Health~Holland Project Page

An overview of all public private projects and partnerships supported by the Top Sector Life Sciences & Health

The Top Sector Life Sciences & Health (LHS) wants to illustrate all its currently accepted and ongoing public private projects and partnerships to our international audience throughout the world. Therefore, the Health~Holland website will be complemented by the new Health~Holland project page. This page will provide an overview of all the projects and partnerships hosted in the Top Sector LSH from the start of the top sector approach. To successfully launch our new project and partnership webpage, we ask you to provide us with a correct, clear, and legible content on your public private partnership's project (all in British English).

Project page content

Health~Holland wants to collect content on your public private partnership's project. Can you provide us with the following aspects on your partnership/project:

1. LSH project number
   LSHM ....
2. Clear popular title
   This title (max. 10 words) appears above the project. No use of abbreviations.
3. Clear scientific title
   No use of abbreviations and the title must be understandable for the lay public. In addition, the project acronym can be mentioned.
4. One liner
   The one liner (max. 15 words) includes a short summary of your project, acts as a trigger to read more or describes the relevance of the project.
5. Short summary of the project
   A short summary of two sentences (max. 50 words) that includes a brief explanation of the project. This summary will be visible on the project page and helps the reader to decide whether to continue reading about the project. The text has to be both informative and excitatory to continue reading. Please do not use jargon or abbreviations that the lay public may not understand.
6. Public summary
   The public summary consists of 250 to max. 300 words. The summary is intended for a broad audience with a secondary education language level. In short, the public summary describes the who, what, where, when, why and how of the project. Focus on the core message of the project instead of elaborating on explanations and background information.

   Health~Holland would like you to follow these guidelines:
   - First paragraph: short summary of the whole project (see point 4) with a highlight on the (newly) established public private partnership.
   - Second paragraph: introduction on the societal/economic impact and relevance of the health/disease/vital functioning/etc. and why innovation is necessary. Make use of numbers, statistics, or rankings to illustrate the relevance of the project to the lay public.
   - Third paragraph: explanation of the project's approach and conceptualisation, and how this innovative solution will contribute to the previously described societal challenge(s).
   - Fourth paragraph: description of deliverables and, if the project is finished, an illustration of the (end)results.

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7. Keywords
   Define a maximum of five clear keywords.
8. Consortium partners

Indicate all partners that contribute and send us the original logos of their organisation/company.

9. Start date of the project
10. End date (intended) of the project
11. Project duration
12. Image (free of copyright)
    The image will be used to illustrate the project, this can include a picture of the laboratory, consortium partners, target audience, product, innovation, building, university, or ambience of the project. It is important that the image is free of copyright so Health~Holland is able to use it in their communication channels.
13. Link
    If possible a link to a webpage with more information.

Project page filters

Health~Holland makes use of several filters to facilitate the search of projects. Can you select filters that address your public private partnership's project:

1. **Objective:** prevention, cure or care *(select one)*
2. **Kind of research:** fundamental, industrial or experimental
3. **Major TKI-LSH roadmap of project:** *(select one)*
   1) molecular diagnostics
   2) imaging & image-guided therapies
   3) homecare & self-management
   4) regenerative medicine
   5) pharmacotherapy
   6) one health
   7) specialized nutrition, health & disease
   8) health technology assessment, individual functioning & quality of life
   9) enabling technologies & infrastructure
   10) global health, emerging diseases in emerging markets
4. **Minor TKI-LSH roadmap of project:** *(select one)*
   1) molecular diagnostics
   2) imaging & image-guided therapies
   3) homecare & self-management
   4) regenerative medicine
   5) pharmacotherapy
   6) one health
   7) specialized nutrition, health & disease
   8) health technology assessment, individual functioning & quality of life
   9) enabling technologies & infrastructure
   10) global health, emerging diseases in emerging markets
5. **Operating in:** bio(pharma), medical technology or healthcare *(select one)*
6. **Technology readiness level (TRL) of project:** select the current and predicted TRL (see attachment A)

Current TRL:	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-
Predicted TRL:	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-

Comments

If you have any comments or questions, please note here.

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Editorial rights

Health~Holland will perform a check on the submitted text prior to publication. If we have any questions regarding the provided content, we will contact you before we publish the content of the project. For more information, please contact Elise de Gier (gier@health-holland.com).

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Appendix H: Letter of commitment template

[Use headed paper of party]

[Name and address of the main applicants' duly authorised representative ("bestuurlijk verantwoordelijke")]

[Date]

LETTER OF COMMITMENT
for the
[name of] PROJECT

Dear [main applicants' duly authorised representative],

I, [first name and family name], in my capacity of [position in the organisation (has to be a duly authorised person)] at [name legal entity] hereby confirm that [legal entity] is committed to contribute to the [project name] project, on the condition that Stichting LSH-TKI grants the PPP Allowance as applied for by the main applicant, [first name and family name], [position] at [name organisation].

[Name legal entity] will contribute € [•] in cash towards the project costs in accordance with the budget in the project proposal and budget form.

[Name legal entity] will provide an in kind contribution of [description of the contribution], representing a monetary value of € [•] and further detailed in the project proposal and budget form.

Yours sincerely,

____

Name:
Position:
Date:

NL Health~Holland
SHARED CHALLENGES, SMART SOLUTIONS

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Appendix I: Checklist application form

☒ The consortium must consist of at least one research organisation and one for-profit enterprise
☒ The main applicant is located in the Netherlands
☒ The project has a duration of a maximum of 48 months
☒ The starting date is after the deadline of the Match Call and within six months after the awarding letter will be received
☒ The chamber of commerce number or equivalent is listed for all consortium partners
☒ Effective collaboration takes place. This means, for example, that the project is realised at joint cost and risk
☒ All consortium partners should make an *in kind* contribution. This means, for example, that all consortium partners should at least incur payroll costs
☒ Dutch SMEs may finance a maximum of 50% of their *in kind* costs (e.g. man hours, consumables and the use of equipment) with PPP-Allowance in the case of fundamental/industrial research and a maximum of 25% of their *in kind* costs in the case of experimental development.
☒ Depending on the type of research, a for profit enterprise must contribute at least 15%, 30% or 45% of the total project costs
☒ At least 2/3rd of the required minimum contribution of a large enterprise must consist of a cash contribution
☒ The research organisation must contribute at least 10% of the total project costs
☒ All parties, with the exception of the main applicant, must submit a letter of commitment; a letter of intent is not sufficient
☒ If a claim is made to the temporarily reserved PPP Allowance (generated from the *grondslag*) of a research organisation/enterprise, then a statement should also be sent. In this statement the PPP Allowance contact person or another authorised person states from which *grondslagjaar* and the amount of reserved PPP Allowance may be used for this specific project
☒ The consortium must submit a draft consortium agreement; a blank format is not sufficient
☒ The budgeted costs are directly related to the R&D activities, and do not include for example: bench fee costs, travel within the Netherlands, supporting/project management tasks that are not directly related to the project's R&D activities