STUDENT SUSTAINABILITY COMMITTEE

Funding Application – Student-Led Projects (Under $10K)

Funding Criteria

A. General Rules

1. Students, faculty, and staff are encouraged to submit requests for funding. Student-led projects require a faculty or staff sponsor in order to have funds awarded.
2. Funding can only go to university-affiliated projects from students, faculty, staff, and departments.
3. All SSC projects must make a substantial impact on students. This may be a direct impact or an impact through education and engagement. All SSC funding is 100% from student green fees, so the projects funded by the students must benefit them.
4. SSC encourages innovation and new technologies – creative projects are encouraged to apply.
5. Unless a type of expense is specifically listed below as having restrictions, SSC can generally fund it. The items referenced below should not be taken as comprehensive list.

B. Things SSC Can Fund, On A Case-By-Case Basis

1. SSC can fund feasibility studies and design work; however, it must work toward ultimately addressing a sustainability need on campus.
2. SSC can fund staff positions that are related to improving campus sustainability. Strong preference will be given to proposals receiving matching funding from departments and/or plans for maintaining continuity of the position after the end of the initial grant.
3. SSC can fund outreach events with a central theme of sustainability, provided their primary audience is the general campus community.
4. SSC discourages funding requests for food and prizes but will consider proposals on a case by case basis that prove significant reasoning.
5. SSC can fund repairs and improvements to existing building systems as long as it works toward the goal of improving campus sustainability; however, a preference is shown to projects utilizing new or innovative ideas.
6. SSC can provide departments with loans for projects with a distinct payback on a case by case base. Loans will require a separate memorandum of understanding between SSC and departmental leadership pledging to repay the award in full and detailing the payback plan.

C. Things SSC Will Not Fund:

1. SSC will not fund projects with a primary end goal of generating revenue for non-University entities.
2. SSC will not fund personal lodging, food, beverage, and other travel expenses.
3. SSC will not fund any travel expenses.
4. SSC will not fund tuition or other forms of personal financial assistance for students beyond standard student employee wages.

Your funding application should include this application and any letters of support.

Please submit this completed application and any relevant supporting documentation by the deadline listed on the SSC website to Sustainability-Committee@Illinois.edu. The Working Group Chairs will be in contact with you regarding any questions about the application. If you have any questions about the application process, please contact the Student Sustainability Committee at Sustainability-Committee@illinois.edu.

General & Contact Information

Project Name: Campus Air Quality Monitoring Station and Web Dashboard.
Total Amount Requested from SSC: 9,752.50

Project Topic Areas: ☐ Land & Water ☒ Education ☐ Energy
☐ Transportation ☐ Food & Waste

Applicant Name: Moazam Iqbal Hakim
Campus Affiliation (Unit/Department or RSO/Organization): Smart Energy Design Assistance Center(SEDAC)
Email Address: mihakim2@illinois.edu

Check one:
☒ This project is solely my own ***OR***
☐ This project is proposed on behalf of (name of student org., campus dept., etc.):

Project Team Members

Name	Department	Email
Moazam Iqbal Hakim	Informatics, School of Information Sciences	mihakim2@illinois.edu
Name	Department/Organization	Email Address
Name	Department/Organization	Email Address
Name	Department/Organization	Email Address

Student-Led Projects (Mandatory):
Name of Faculty or Staff Project Advisor: Brian Deal
Advisor's Email Address: deal@illinois.edu

Financial Contact *(Must be a full-time University of Illinois staff member)*
Contact Name: Margaret Grace Kiener
Unit/Department: TBH Business Services Center
Email Address: kiener2@illinois.edu

Project Information

Please review the proposal materials and online content carefully. It is highly recommended you visit a working group meeting sometime during the proposal submission process.

Please provide a brief background of the project, its goals, and the desired outcomes:

We want to know: What is your project? What does it concretely produce, accomplish, or solve? Why is this project needed on campus?

This project proposes using funds for setting up one monitoring station for Air Quality for streaming live data through an open access web dashboard accessbile to all campus community members.

The monitoring system would offer a robust and easy to-use air quality monitoring system that can deliver localised real-time readings, improving the accuracy and scope of gathering air quality data to support initiatives to reduce air pollution and its risk to human health. For this project a portable sensor station which includes multiple small-sensor air quality monitors for air quality is proposed. This measuring standard offers near real-time localized air quality information and data analysis.

The poject aims to measure key pollutants in ambient air using the small sensor technology combined with data processing derived from extensive global comparisons with reference data. Some of the parameters to be measured and reported include-

- Gases including NO, NO2, NOx, O3, CO, SO2, CO2 and H2S using the latest generation of electrochemical sensors
- Particulates PM1, PM2.5, PM10 and TPC with a light-scattering optical particle counter
- Relative humidity, pod temperature, atmospheric pressure and noise

Where will the project be located? Are special permissions required for this project site?

If special permission is required for this location, please explain and submit any relevant letters of support with the application. SSC cannot fund projects without prior location approval.

Since the project requires physical installation of a pod (monitoring station) that reports data directly, it requires a spot for installation like an existing light pole or a rooftop - just like a dish antenna. This would be installed at a location deemed feasible by campus F&S. The propsoed location would be the 1 St Mary's Dr, Champaign. (I will coordinate with the F&S team to get a formal approval for this before funds are disbursed by SSC.

Other than the project team, who will have a stake in the project? Please list other individuals, groups, or departments affiliated directly or indirectly by the project. This includes any entity providing funding (immediate, future, ongoing, matching, in-kind, etc.) and any entities that benefit from this project.

Please attach letters of commitment or support at the end of the application.

)In addition to the applicant, the Research team at Smart Energy Design Assistance Center headed by Prof Brian Deal would provide technical guidance for this project.The initial investment would include operations for one complete year, future cost include replacement of sensor bulbs which cost approximately $360 (as per the qoutation obtained from a renowned manufacturer) [Attached].

How will this project involve and/or benefit students?

This includes both direct and indirect impact.

This is an enagagement and educational project that aims to educate the campus and particularly students about the air quality, sound pollution levels within campus community. Although, there should be a

network of such monitors for an entity like a campus but to begin with I am applying for this grant to begin with a pilot project and explain its beneifits through the pilot involving only one monitoring station. Through the realtime dashboard, air quality data could be streamed live 24/7. Data from stations can also be made available to students through data files, API and maps for educational research.

What are your specific outreach goals? How will this project inspire change at UIUC?
As a Landscape Architecture and Urban Planning graduate I have researched about climate change throughout my graduate coursework.I am passionate about climate change and resilience. A realtime dashboard that reports live data would not only be enaggaing but also enlightening for the campus to actully goto there browser and check the quality of the air they breathe in. This potentially could lead to a change in behaviour in community members and encourage them to adopt the plethora of measures the iCap suggests.

How will the project improve environmental sustainability at the Urbana-Champaign campus?
With quality data and accurate metrics, environmental monitoring would become easy and accessible to everyone. Good metrics and easy visualizations are vital for explaining the need for sustainability. This is a small step towards establishing a mechanism of quantified information to augment other sustainability projects that are ongoing on campus. If we consider the the early days of Covid, the dashboard by John Hopkins University was go-to place for anyone needing information about the pandemic. The same dashboard has now become the major data source on Covid-19. This explains the significance of having continous and easy data monitoring and management systems.

If applicable, how does this project impact environmental injustice or social injustice?
When it comes to air quality, the same air is breathed in by everyone irrespective of skin color, gender or nationality. Every campus member deserves the right to know what they breathe in and how does the quality of air vary over the course of the year or during 24 hours of the day.

Scope, Schedule, and Budget verification

What is the plan for project implementation? Describe the key steps of the project including the start date, target completion date, target date for submitting a final report, and any significant tasks or milestones.
Please be as detailed as possible.
1) Procure the equipment (All relevent documents attached).
2) Code the web dashboard and implement by the applicant as an independent study with his PhD Advisor.
3) Develop a public access API for use by other campus entities to display on their websites, apps as widgets.
4) Document and publish a report on the project.

List all budget items for which funding is being requested. Include cost and total amount for each item requested.
Please be as detailed as possible.
Procurement of the monitoring station. Attched documents and a recent qoute with 25% discount. (100% of the amount requested).

All other work to be done as volunteer by the applicant.

If the project is implemented, will you require ongoing funding? What is the strategy for supporting the project in order to cover replacement, operation, or renewal costs?
SSC provides funding on a case by case basis and should not be considered as an ongoing source of funding
Yes, My plan is to reach out to RSO's and Other campus units for future funding. Since my goal is to expand the monitoring network in future, i will focus on reaching out to University for additional funding for installation of more stations. Since the operational cost for this project for one year is included, funds for year 2 onwards would be in range of $1500 to be obtained through croudfunding from different organizations on campus. The reason being - it is a project that belongs to community members of the campus and they should own it, operate it and run it!

Please include any other obtained sources of funding. Have you applied for funding elsewhere?
Please attach any relevant letters of support as needed in a separate document.
Not yet.

Have you applied for funding from SSC before? If so, for what project?
Yes, for the same project in Fall 2020 but that included installing multiple stations and was a large scale project. This time I have narrowed down to one station and I am willing to volunteer and operate it for free till I am a student (expected graduation May 2024).

How will you bring awareness and publicize the project on campus? In addition to SSC, where will information about this project be reported?
Through a dedicated dashboard that will the data would be reported, branding for SSC fund would be used at all locations. Additionally I plan to make accessible API's for other campus websites or apps so that they can directly import and stream the information on their websites, reception room screens,mobile apps. I also plan to reach out to MTD to stream the information on their campus bus stop tv screens.

ambilabs®

Quotation

Date	Estimate #
8/14/2020	M14138-R2

PO Box 311, Warren RI 02885
EIN: 45-2275301
Tel : 877-247-0403 , Fax : 401-537-9166
Email : info@ambilabs.com
Web : www.ambilabs.com

Purchaser

University of IL at Urbana-Champaign
1 St Mary's Rd | M/C 606
Champaign, IL 61820
ATTN: Moazam Hakim (217-979-3108

Item	Description	Qty	U/M	Per Unit	Total
	AQMesh Pod				
AQMesh Group					
AQM-PM6	Pod for measuring particulate (PM), NO, NO2, O3, CO, CO2, SO2, temperature, RH, and barometric pressure.	1		11,200.00	11,200.00
AQM-Heat	Heated inlet for PM pods to reduce humidity NOTE: Please only use DC power when incorporating a heated inlet for PM.	1		700.00	700.00
	Power Options:				
AQM-Mains-Inline	AC/DC waterproof power supply with mounting holes, 6' power cord, and water tight connectors.	1		130.00	130.00
AQM-PWRCON	Waterproof AC/DC power supply, with pole mount, tamper-proof enclosure, ability to power 2 AQMesh pods at once for co-location purposes, 6' power cord, and water tight connectors. Matches AQMesh pod design.	0		548.00	0.00
AQM-SOL	20W solar power pack; includes 20W solar panel and 12V battery with case. NOTE: Not for use with heated inlet for PM	0		1,820.00	0.00
	Data/Communication:				
AQM-DATA-API1YR	Standard On-demand data via API feed only. Price is per pod, per year. Data resolution minimum is 10 minutes.	1		420.00	420.00
AQM-Z1-Z2-SIM1YR	Cellular connection and monthly data transfer fee for Zones 1-2. Price is per pod, per year.	1		420.00	420.00
	Subtotal:				12,870.00
Equipmt Disc 25%	25% discount on above line item			-25.00%	-3,217.50
Shipping-Std	Packing, shipping, and insurance (UPS Ground to Champaign, IL).	1		100.00	100.00
T&C_Ambi_2015-12-31_...	Payment Terms: Net 30 days from date of invoice. Full terms and conditions : http://ambilabs.com/TnCV1.pdf				0.00T
				Total	USD 9,752.50

AQMesh

Small sensor air quality monitoring system

TOGETHER WE CREATE SOLUTIONS THAT SHAPE THE FUTURE

ambilabs®

> ***New 'hyperlocal' [AQMesh] sensor network will monitor London's air quality.***

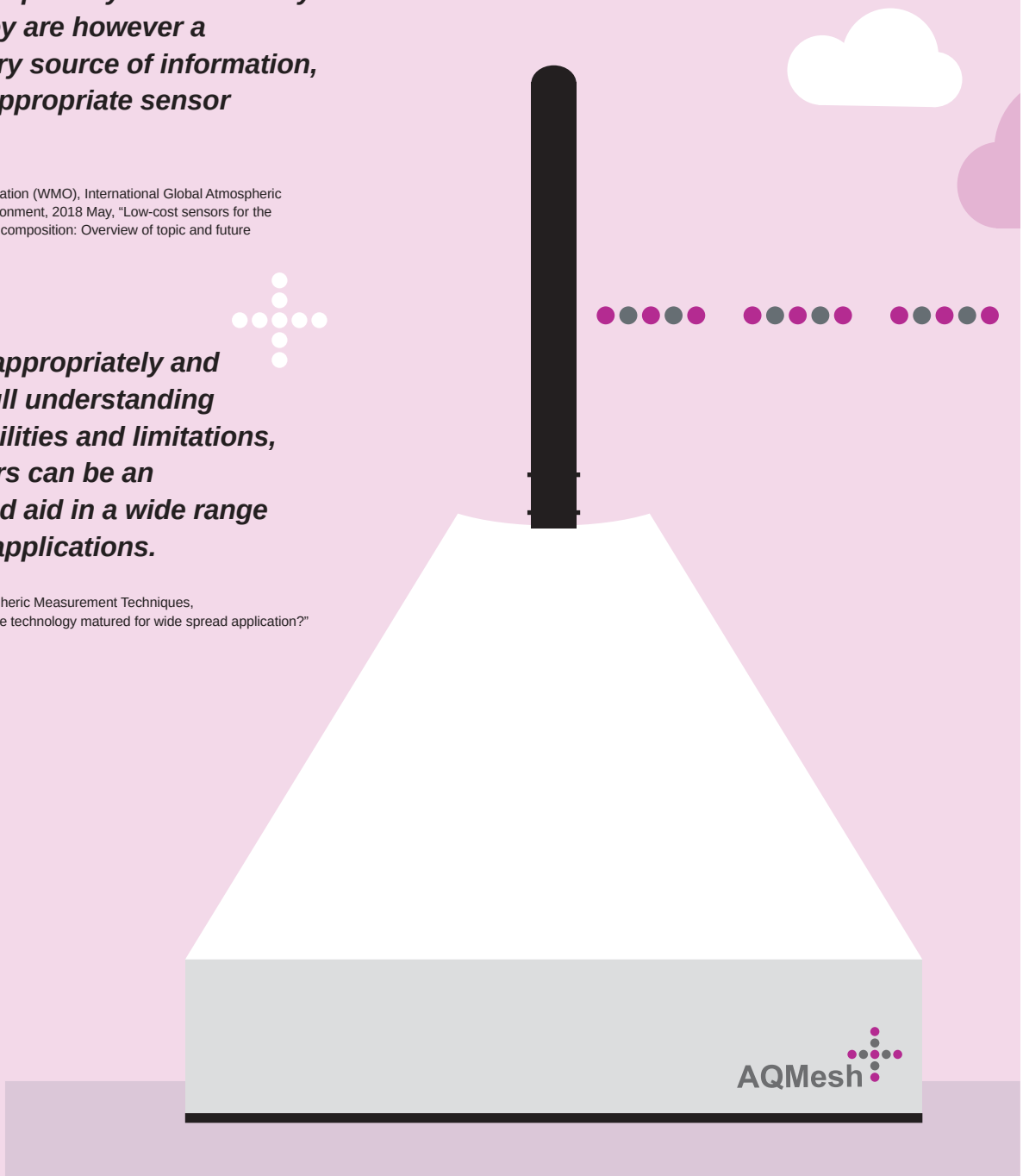
Intelligent Transport 2018, 22 Jun

> ***[Small] sensors are not currently a direct substitute for reference instruments, especially for mandatory purposes; they are however a complementary source of information, provided an appropriate sensor is used.***

World Meteorological Organization (WMO), International Global Atmospheric Chemistry (IGAC) & UN Environment, 2018 May, "Low-cost sensors for the measurement of atmospheric composition: Overview of topic and future applications"

> ***When tested appropriately and used with a full understanding of their capabilities and limitations, [small] sensors can be an unprecedented aid in a wide range of air quality applications.***

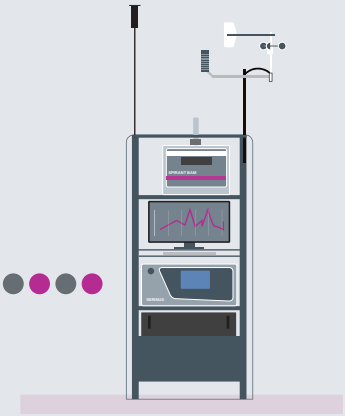
Jayaratne et al. 2018, Atmospheric Measurement Techniques,
"Low-cost $PM_{2.5}$ sensors: Is the technology matured for wide spread application?"



AQMesh + **Am**bilabs®

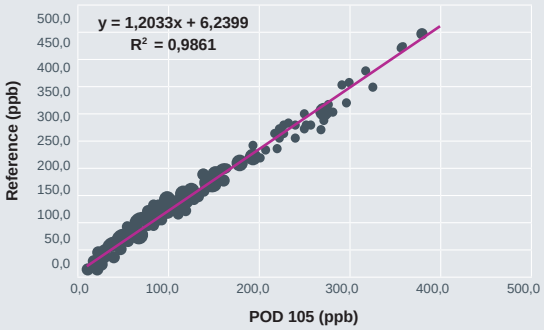
The world's finest reference quality gas analyzers has teamed up with the best of breed small sensor Air Quality monitoring system.

Combining AQMesh with Ambilabs®'s superior range of gas analyzers will transform the way smart cities and progressive thinking organizations use the power of collective environmental monitoring to measure, report and adhere to air quality standards and regulations.



> ***Co-location comparison trials against certified reference equipment continue to prove AQMesh performance and reliability for localised air quality monitoring.***

Environmental Technology 2018, "Latest AQMesh co-location studies show capability of small sensor systems", 14 Nov.



AQMESH

The tried and tested name in small sensor technology for commercial use:

- Hundreds of published scientific papers and research papers
- Thousands of hours of real-world trials and commercial placements in more than 30 countries
- No other commercially available small sensor system demonstrates better accuracy.*

AMBILABS®

Tier one trusted supplier of reference quality Air Quality Monitoring Systems (AQMS):

- Superior design, manufacture, installation and maintenance
- Air quality monitoring pioneer with 20 years' experience
- Serinus® gas analyzers for reference quality monitoring of O_3 , CO, NO, NO_2, NO_x,NH_3, SO_2, H_2S, TS and TRS
- Hundreds of AQMS sites around the world consisting of thousands of individual pieces of reference quality monitoring equipment.

AQMESH + AMBILABS® GAS ANALYZERS

Designed to work alone, together with Serinus® gas analyzers or in harmony with new or existing reference quality AQMS:

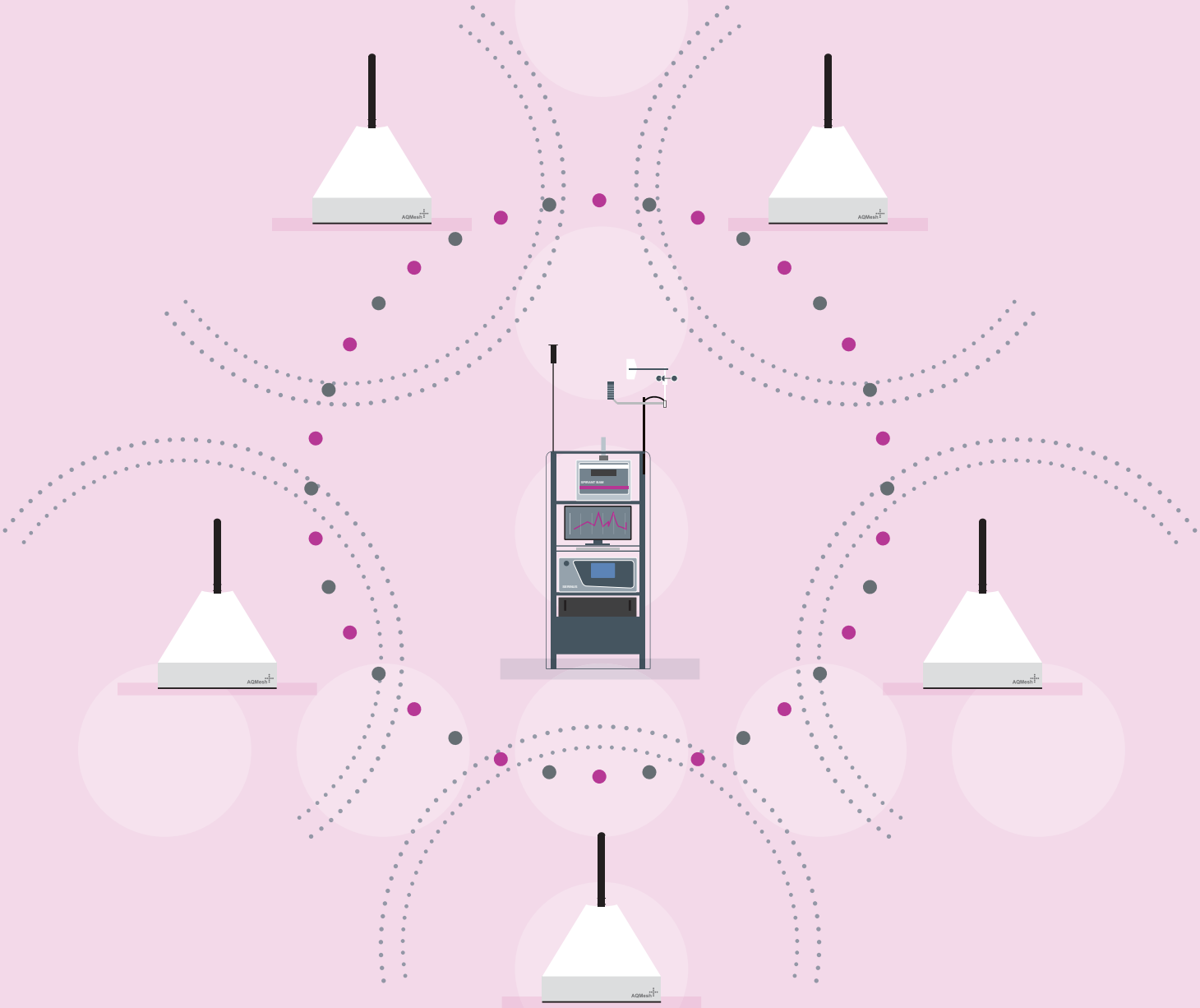
- Practical, cost-effective, commercial indoor and outdoor use
- Greatly increase the spatial resolution of air quality monitoring networks
- Provides hyperlocal measurement and trend analysis over time of human exposure to air pollution.

* Environmental Instruments Ltd 2016, "Looking for a 'low cost' air quality monitoring solution?" "10 reasons why you should choose AQMesh", 25 Jul

Scalability

When multiple AQMesh pods are added together they deliver localized real-time air quality data that supports initiatives to reduce air pollution and its risk to human health.

It's this ability to easily add, subtract, or relocate individual AQMesh pods where and when required that provides environmental professionals with a level of monitoring flexibility and scalability not possible with fixed-site reference quality AQMS alone.



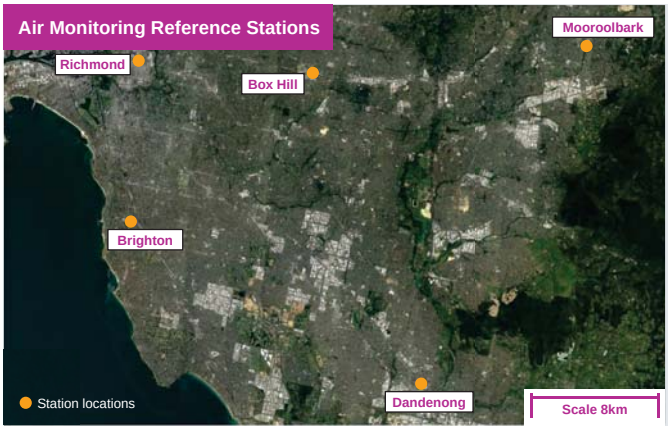
One to Many

Strategically placing a high number of AQMesh pods around and between a low number of reference quality AQMS stations delivers hyperlocal monitoring results.

However, small sensor technology is not a direct substitute for reference quality instruments, especially for mandatory or regulatory purposes.

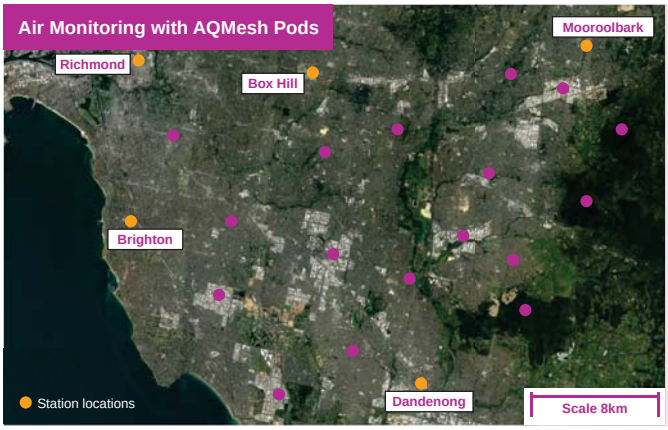
That is why when AQMesh is used as a complementary source of information to augment and enhance existing reference quality AQMS networks, environmental professionals are rewarded with increased spatial resolution of air quality data.

Increased spatial resolution of air quality data dramatically multiplies the opportunity for better understanding, insight and action.



MELBOURNE SOUTH EASTERN SUBURBS

- A city of 5 million
- 5 ECOTECH reference quality AQMS stations
- 10-20 km apart
- Mixed land use over changing topography: Suburban, residential, commercial, industrial, roads, parks



WHAT AN AUGMENTED AIR MONITORING NETWORK COULD LOOK LIKE

- Add 25 AQMesh pods
- Each pod 3-7 km apart
- 5 AQMS + 25 AQMesh = Significantly increase understanding of air quality at the neighbourhood level

AQMesh

The proven small sensor air quality monitoring system

AQMesh has been designed to offer a robust and easy-to-use air quality monitoring system that can deliver localised real-time readings, improving the accuracy and scope of gathering air quality data to support initiatives to reduce air pollution and its risk to human health.

Power

Sensor type	Expected life span	Notes
External DC	> 5 years	9 – 24V DC
Lithium metal battery pack [#9]	> 24 months	Dependent on measurement strategy & pod spec
External high capacity battery pack [#9]	> 60 months	Dependent on measurement strategy & pod spec
NiMH rechargeable battery pack [#9]	> 4 months	Dependent on measurement strategy & pod spec
Solar power pack	> 5 years	Change internal lead-acid battery every 24 months

Sensor life

Sensor type	Expected life span
Electrochemical	2 years [#7]
NDIR	5 years
Solid state	5 years
Omnidirectional microphone	5 years
Optical particle counter	1 year (minimum) [#7] [#8]

Physical

ENCLOSURE
ABS, protection IP65

ENVIRONMENTAL

Temperature range: -20°C to +40 °C

Humidity range: 15 to 95 % RH

MOUNTING

Pod supplied with mounting bracket for walls / posts

APPROX. SIZE & WEIGHT

Length: 170 mm

Width: 220 mm

Height (excl antenna): 250 mm

Height (incl antenna): 430 mm

Weight: 2 – 2.7 kg

Data & Communications

COMMUNICATIONS
Data sent to remote server via 2G or 3G SIM (data access contract is required)

MEASUREMENT PERIOD

Variable, from 1 min to 1 hr

TRANSMISSION FREQUENCY

Variable, from 5 mins to 12 hr intervals

SERVER SOFTWARE

Web browser based, processing of sensor output to give reading, database storage on secure server

DATA ACCESS

Tables, graphs, data download, multi-user access, password controlled, optional API data access

AQMESH PLUS SPECIFICATIONS*

Measurement

Sensor	Sensor Type	Units	Range
NO	Electrochemical	ppb or µg/m³	0 to 4,000 ppb
NO_2	Electrochemical	ppb or µg/m³	0 to 4,000 ppb
NO_x	Electrochemical	ppb or µg/m³	0 to 8,000 ppb
O_3	Electrochemical	ppb or µg/m³	0 to 1,800 ppb
CO	Electrochemical	ppb or µg/m³	0 to 6,000 ppb
SO^2	Electrochemical	ppb or µg/m³	0 to 10,000 ppb
H_2S	Electrochemical	ppb or µg/m³	0 to 100,000 ppb
CO_2	NDIR	ppm or mg/m³	0 to 5,000 ppm
Pod temperature	Solid state	°C or °F	-20 °C to 100 °C
Pressure	Solid state	mb	500 to 1500 mb
Humidity	Solid state	%	0 to 100 %
Noise	Omnidirectional mic	dB	35 to 100 dB SPL
Particle count	Optical particle counter	Particles/cm³	0.30 to 30 µm
PM_1 [#1]	Optical particle counter	µg/m³	0 to 200 µg/m³
$PM_{2.5}$ [#1]	Optical particle counter	µg/m³	0 to 500 µg/m³
PM_{10} [#1]	Optical particle counter	µg/m³	0 to 1,000 µg/m³
Lat, long, alt	GPS	decimal	N/A

Performance

Sensor	Limit of confidence [#3]	Typical precision to ref [#4]	Typical mean prescaled accuracy [#5]
NO	< 5 ppb >	0.9 R2	+/- 5 ppb
NO_2	< 10 ppb >	0.85 R2	+/- 10 ppb
NO_x	< 10 ppb >	0.9 R2	+/- 10 ppb
O3	< 5 ppb >	0.9 R2	+/- 10 ppb
CO	< 50 ppb >	0.8 R2	+/- 0.3 ppm
SO_2	< 10 ppb >	0.7 R2	+/- 10 ppb
H_2S	< 5 ppb >	0.7 R2	+/- 5 ppb
CO2	< 1 ppm >	0.9 R2	+/- 30 ppm

Sensor	Limit of detection	Typical precision to ref [#4]	Typical mean prescaled accuracy [#5]
Pod temperature	0.1 °C >	0.9 R2	+/- 2 °C
Pressure	1 mb >	0.9 R2	+/- 5 mb
Humidity	1 % RH >	0.9 R2	+/- 5 % RH
Average noise [#6]	20 Hz to 20 kHz	> 0.8 R2	+/- 1 dB
Peak noise [#6]	20 Hz to 20 kHz	N/A	+/- 3 dB
Particle count	0 particles >	0.9 R2 variable	N/A
PM_1 (v2.0)	0 µg/m³	> 0.9 R2 variable	+/- 15 µg/m³ variable
$PM_{2.5}$ (v2.0)	0 µg/m³	> 0.85 R2 variable	+/- 20 µg/m³ variable
PM_{10} (v2.0)	0 µg/m³	> 0.7 R2	+/- 30 µg/m³ variable
GPS	0.5 m	N/A	+/- 3 m radius

Product designs and specifications are subject to change without prior notice.

The user is responsible for determining the suitability of the product.

#1 Mass estimation based on standardisation of particle shape and density.

#2 From sensor manufacturer's specification. This data was derived from independent lab tests. Standard test conditions are 20 °C and 80 % RH and in the absence of interfering gases. Tested range is -30 °C to +30 °C.

#3 Readings provided below this level, however, due to interferences the level of uncertainty is greater than at higher levels of the target pollutant.

#4 Results based on field testing around the world versus certified reference or equivalence methods at hourly intervals, in extreme and varied conditions.

#5 Average variance to reference equivalence methods at hourly intervals from field testing around the world, in extreme and varied conditions.

#6 Peak noise is the highest recorded value over the gas reporting interval while average noise is calculated using all noise samples over the same period.

#7 Electrochemical sensors and particle sensors carry a 12-month warranty.

#8 Detail of maintenance required is listed in the standard operating procedure.

#9 Subject to carrier restrictions on dangerous goods.

*Gas algorithm V4.2.3, PM algorithm V2.0

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