With Advanced Solid Polymer Electrochemical Gas Sensing Technology

Safety | Environment | Health

EcoSense AQM
Air Quality Monitor

Indoor Environmental Air Quality

EcoSense AQM – Air Quality Monitor

A mobile rechargeable indoor air quality monitor with smiley face and traffic light LED system.

Applications: Ideal for classrooms, schools, universities/colleges, offices, communal areas, homes, residential/care homes and light industrial applications.

Includes: Mobile AQM unit, docking station and USB charging cable.

Technology: Features our advanced solid state sensor technology to measure important air quality pollutant multi-gases and VOCs (Volatile Organic Compounds).

Colour Options: White with silver docking station
Black with silver docking station

Part #: 2112B8000-AQM

☹ **RED:** **BAD air quality = open windows or turn on ventilation !**

😐 **AMBER:** **POOR air quality = think about opening windows or turn on ventilation or air purification !**

☺ **GREEN:** **GOOD air quality = all OK !**

What is IAQ?

IAQ is the abbreviation of Indoor Air Quality, that is, "indoor air quality". The indoor environment is mainly divided into three areas: 1) home indoor environment; 2) commercial public space environment (including places of public entertainment, medical, public transportation, schools/colleges/universities/campus, catering, food and drinking establishments, shopping, etc.); 3) an enclosed vehicle environment;

The definition of indoor air quality is mainly from the following two aspects:

1. Physical somatosensory comfort: including temperature, humidity and odour; where odour generally refers to factors that are irritating or allergic to the senses of the mouth, eyes, nose and skin.

2. Chemical pollution health hazards: mainly from chemical harmful gas pollution. National and international indoor air quality standards generally specify minimum allowable concentration limits of main pollutants in the indoor environment, including: SO_2 Sulfur Dioxide, NO_2 Nitrogen Dioxide, CO Carbon Monoxide, NH3 Ammonia, O_3 Ozone, HCHO Formaldehyde, TVOC Total Volatile Organic Compounds, C_6H_6 Benzene, C_8H_{10} Xylene, C_7H_8 Toluene, CO_2 Carbon Dioxide, particulate matter PM10 and visible harmful gases. These are all classified within indoor environmental air pollution.

Sources of indoor air pollution

Indoor harmful gas pollution is very complicated. Due to poor air mobility and low gas diffusion effect, indoor space pollution far exceeds outdoor environmental pollution by several times, and it is extremely harmful to human health. The main sources of pollution are as follows:

1. Volatile pollution of harmful chemical substances in construction, decorating materials and furniture: Various adhesives, glues, paints, and paints used in decorating materials, furniture, and building decorating processes contain large amounts of volatile harmful gases, mainly TVOC gases, including formaldehyde, benzene, toluene and xylene, which have carcinogenic or genetic effects, which seriously endanger human health.

2. Outdoor polluted air input: NO_2 Nitrogen Dioxide, SO_2 Sulfur Dioxide, TVOC Total Volatile Organic waste gas, NH_3 Ammonia gas, CO Carbon Monoxide gas, etc., which are mainly produced by automobile and transport emission pollution, rubbish, sewage and pollution emissions from surrounding factories.

Sources of indoor air pollution

3. Pollution gas produced by indoor activities at home:

Harmful exhaust gas from kitchen oil smoke, natural gas combustion, toilets, kitchen waste and human body exhaled gas, mainly produce hydrocarbons, aldehydes, ketones VOC gas, SO_2 Sulfur Dioxide, NO_2 Nitrogen Dioxide, CO Carbon Monoxide gas, H_2S Hydrogen Sulfide gas, NH_3 Ammonia, dimethylamine, methyl mercaptan, methyl sulfide and other hazardous gases.




4. Pollution gas produced by commercial public indoor activities:

Commercial wastes are mainly: NH_3 Ammonia, sulfide and amines, medical wastes carrying viral germs, exhaled gas in crowded places, in addition to CO_2 Carbon Dioxide, there are Ammonia, Hydrogen Sulfide, dimethylamine, diethyl Amine, diethanol, methanol, butane, butene, dibutene, acetic acid, acetone, nitrogen oxides, CO, phenol, benzene, toluene and CS_2 carbon disulfide gases. Among them, most are metabolites in the body, and the other part are pollutants that are still exhaled in the original form after inhalation, whilst 80% or more belong to VOC gases.

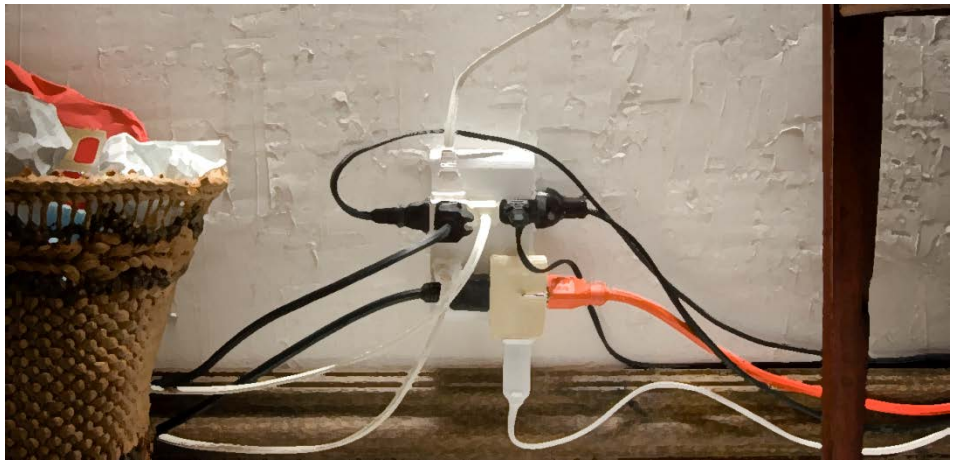
Sources of indoor air pollution

5. Pollution gas generated during the use of household appliances and commercial equipment:

It is mainly from electrical equipment, generating CO Carbon Monoxide, SO_2 Sulfur Dioxide and TVOC gas. Some electrical appliances will produce O_3 Ozone, such as disinfection machines, disinfection cabinets, etc.

6. Gas pollution in vehicle space:

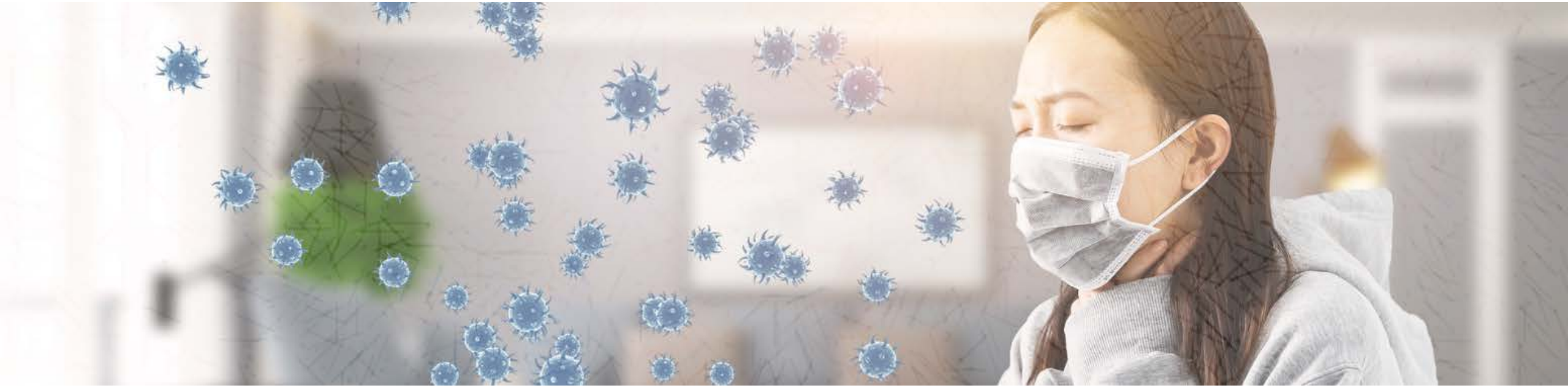
TVOC mainly comes from a volatile gas in interior decorating materials, which can cause cancer and sensitization. CO Carbon Monoxide gas produced by engine combustion is likely to cause poisoning under closed conditions.



Indoor gas pollution hazards

Most TVOC gases like amines, and sulfide gases have an irritating odour, which is unpleasant and reduce quality of life. Stench gas refers to any gas substance that stimulates the olfactory organs and causes unhappy or unwell feelings.

HC hydrocarbons, NOx nitrogen oxides, SOx sulfur oxides, and TVOC volatile organic gases have the characteristics of penetration, volatilization, and fat solubility, which can cause many discomforting symptoms, and are also toxic, irritating and teratogenic. Benzene, toluene, xylene and formaldehyde are the most harmful to health. Long-term exposure can cause anemia and leukemia. It can also cause diseases of the respiratory tract, kidneys, lungs, liver, nervous system, digestive system, and hematopoietic system. As the concentration increases, the body will experience nausea, headache, convulsions, coma and other symptoms.



Relationship between gas pollution and virus transmission

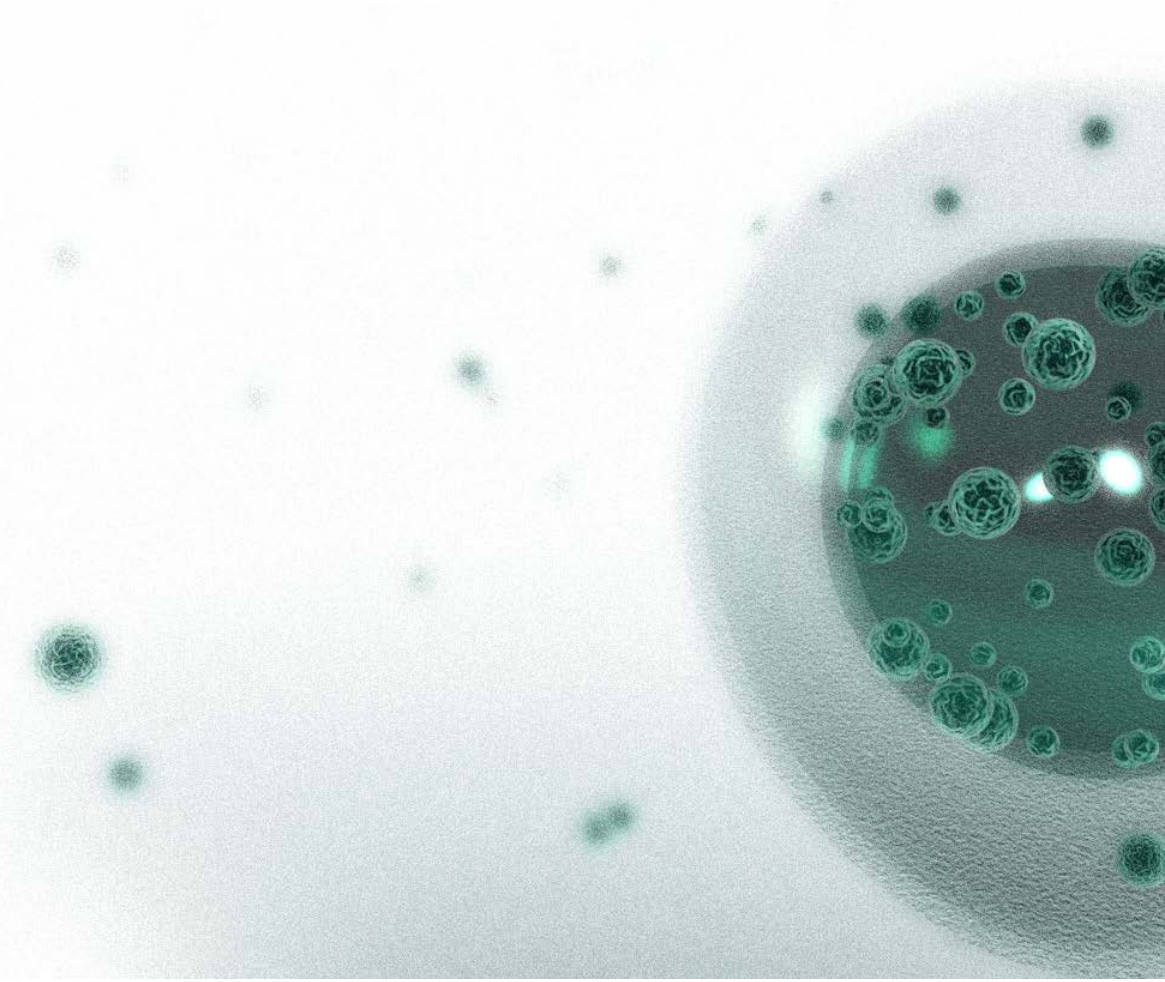
Virus transmission methods are mainly air transmission, contact transmission and food transmission, among which virus transmission is the most direct and rapid. The largest diffusion effect is indoor air pollution transmission. The exhaled gas exchange rate between people is high when there is poor air flow.

Most of the polluted gases in an indoor environment, due to the interaction of gas molecules and photopolymerization, and under the action of temperature and humidity, will continue to polymerize to form tiny particles, and have the Brownian motion characteristics of gas molecules, floating in the air for a long term.

So what are the carriers for viruses in the air?

1. With droplets as carrier:

Droplets are mainly liquid particles, generated by the mouth and nose when the human body exhales, sneezes and coughs, and contains a large number of pathogens. In the air, it quickly loses moisture and forms droplet cores. The droplet nuclei exist for a long time. The diameter of the droplet nuclei is usually 1-5 μm, which will gradually settle to the surface or adsorb on the surface of objects, skin and clothing.



Relationship between gas pollution and virus transmission

2. Aerosol as carrier:

Aerosol is a gaseous dispersion system composed of solid or liquid fine particles suspended in a gas medium. The minimum diameter is 0.01 μm and has the Brownian motion characteristics of gas molecules. It floats in the air and exists for a long time, so the virus is in the aerosol carrier and spreads more widely.

Indoor air pollution provides a carrier for viruses. The more serious the gaseous pollution, the higher the spread rate of virus transmission. Providing real-time and accurate monitoring data for indoor air pollution can guide us to conduct air quality management more effectively, whether it is through simple window ventilation or through the operation of more sophisticated ventilation systems, air purification equipment, disinfection or sterilization treatment. This is of great significance to people's health, improving the quality of life and preventing disease and infection.

EcoSense AQM sensing technology

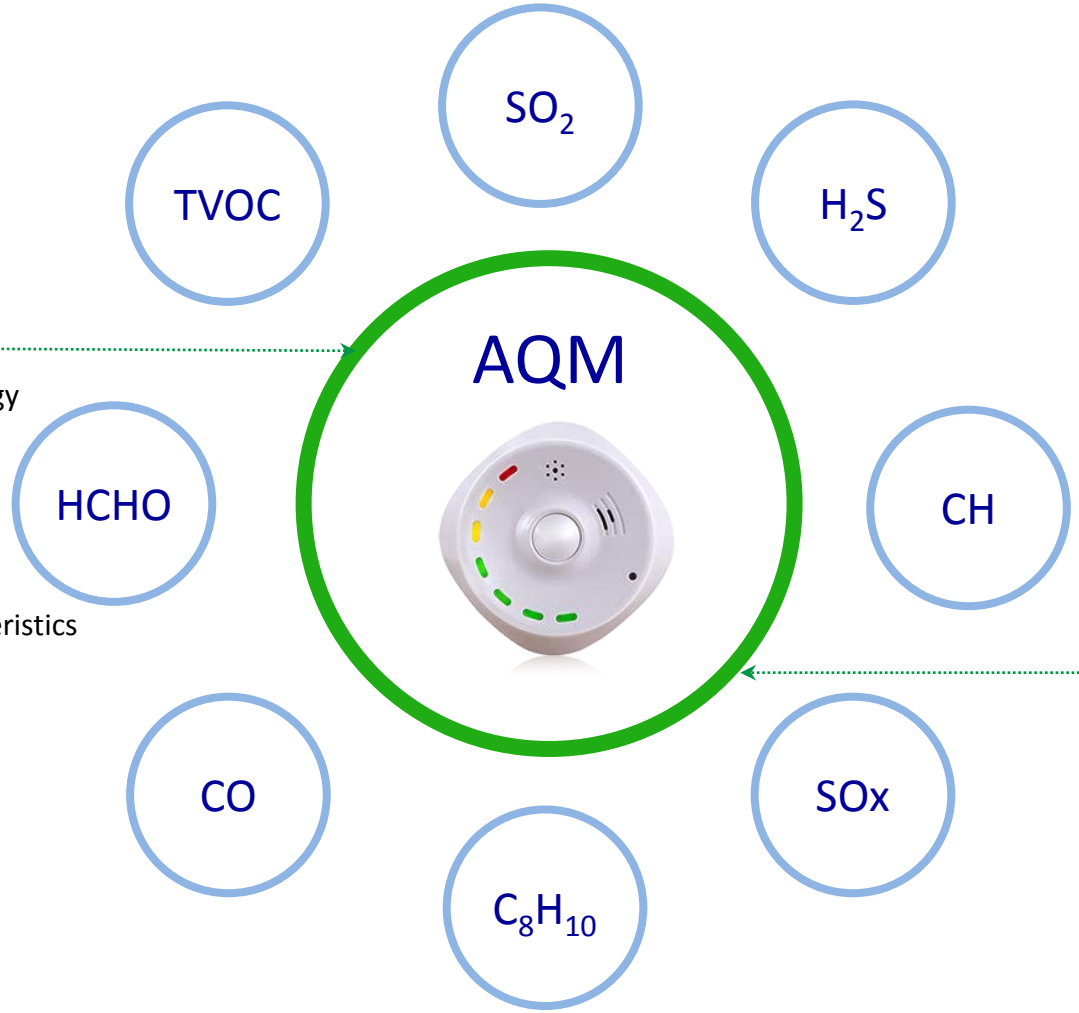
Advanced Solid Polymer Electrochemical Sensing Technology

How our technology works: By introducing an ionic liquid into the polymer, we have developed a solid polymer electrolyte electrochemical sensor. This sensor has the advantages of both ionic liquids and polymers. First, the electrolyte has the properties of a solid electrolyte, which eliminates the problem of difficult sealing of the ionic liquid. Secondly, the introduction of ions in the polymer improves the ion conductivity of the polymer. Solid polymer electrochemical sensing technology is a revolutionary technical innovation in the field of gas detection. This technology measures various volatile organic gases that can be chemically decomposed, based on the principle of electrochemical gas detection, and outputs a current signal or a digital signal corresponding to the gas concentration.

EcoSense AQM internal sensor technology characteristics: High linearity in full range (different resolutions, good selectivity in multiple ranges); no power consumption (suitable for low power consumption applications in the Internet of Things); ultra-small size (12mm*12mm*10mm); zero baseline stability; fast response in less than 3 seconds; low cost; high cost performance; no methane interference; chemical reaction to hundreds of organic gases; no humidity effect; no maintenance; long life (depending on working environment, indoor environment for more than 5 years); temperature range -20 ℃ ~ +55 ℃; different ranges can achieve high-precision measurement; power-on measurement without warm-up; no high concentration gas poisoning phenomenon.

EcoSense AQM sensing technology

- Using multi-gas mixing calibration technology
- Low-power design IOT applications
- No need to wait after power on
- Long life design> 5 years
- Algorithm of multiple gas response characteristics



- Can effectively detect polluted gas
- Formaldehyde gas responsive
- Smoke pollution monitoring
- Odour monitoring
- Detection of human exhaled gas pollution

Technical performance comparison

Performance parameters / sensor principle	Our Solid Polymer Electrochemistry Technology	Other Semiconductor / MEMS Technology
Detect gas preference	TVOC gas, formaldehyde, methanol, toluene, sulfur dioxide SO_2 Carbon monoxide CO, hydrogen sulfide H_2S, methyl mercaptan CH_4S, CH hydrocarbons, etc.	Alcohol, combustible gas, isobutane, formaldehyde
Standard sizes	Small size 11.5*11.5*10mm	Small size 17*10*10mm/2.45*2.45*0.9mm
Design standards	Industry standard	Civil
Data linearity	Full linearity is good	Non linear
Examination range	0.01-10ppm 0.1-200ppm	1-10ppm 1-30ppm
Minimum resolution	0.01ppm	> 1ppm
Accuracy	< ± 5% FS	> ± 20% FS
Response time	< 3s	< 3s□ alcohol□
Warm-up time	< 60s	> 30min
Power consumption	Sleep mode: no power consumption Detection mode□ 25mW	> 300mW
Zero drift	Full range < 0.5% 10ppm range□ < 50ppb	Large baseline drift > 1ppm

Technical performance comparison

Performance parameters / sensor principle	Our Solid Polymer Electrochemistry Technology	Other Semiconductor / MEMS Technology
Influence of environmental humidity	No effect	Greate impact
Influence of ambient temperature	Effective temperature compensation	Low temperature environment has a greater impact
Working humidity	15-95% (No condensation)	Greate impact
Operating temperature	-20℃~+55℃	100℃~300℃
Toxic gas detection	Can react to hundreds of toxic gases	A small amount of gas, sensitive to alcohol
Reliability / life	Home environment > 5 years	> 5 years
Reaction to chlorine dioxide disinfectant	No response	Response
Application range	Industrial environment, outdoor atmospheric monitoring, indoor environment, Internet of Things, etc.	Civil field
Safety	Intrinsic safety	Flameproof
Anti-poisoning performance	No poisoning when impacted by high concentration gas; Corrosive gases H_2S, Cl_2, HCl, SOx have no effect and damage; No smoke and silicon compound poisoning ;	Oil fume, silicon compound gas, corrosive gas have irreversible damage after long-term contact

Indoor chemical contaminants

1. Classification of indoor common harmful gas pollution:

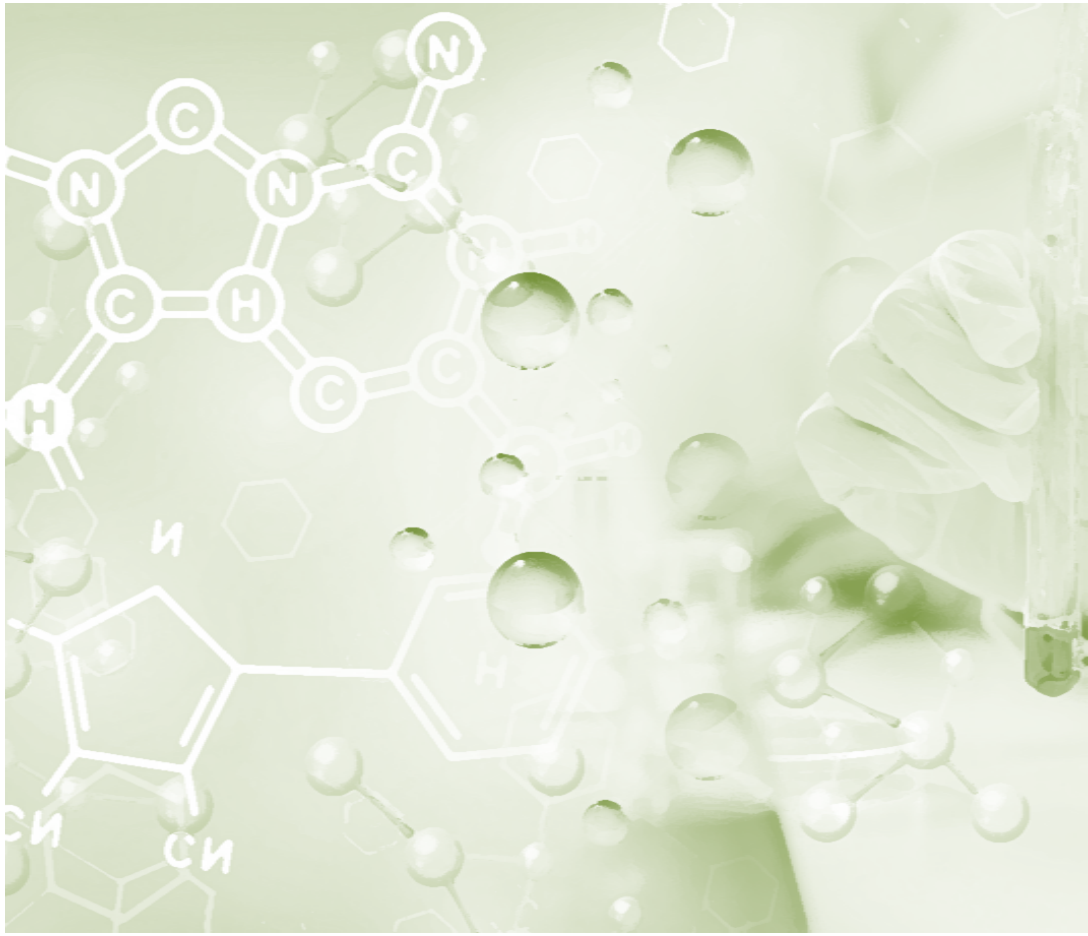
We conducted a test comparison of the main common polluting gases in indoor spaces and classified them for somatosensory comfort and as substances harmful to human health. We divided these into the following four types of gases:

1) TVOC volatile organic gas:

C_4H_8 Isobutylene gas: It is the standard gas of TVOC sensor in the industrial field. The response characteristic of this gas can better reflect the comprehensive concentration of TVOC, a volatile organic gas.

HCHO formaldehyde gas: As a common carcinogen in the room, it has a great impact on human health. The EcoSense AQM has a better sensitivity response to formaldehyde gas.

C_2H_6O ethanol gas: mainly volatilized by alcohol. Although it is of low toxicity, it can easily form a polymerization reaction with other TVOC gas in the air, forming a bad smell, poor body comfort and one of the polluted gas states.



Indoor chemical contaminants

2) Inorganic toxic gas:

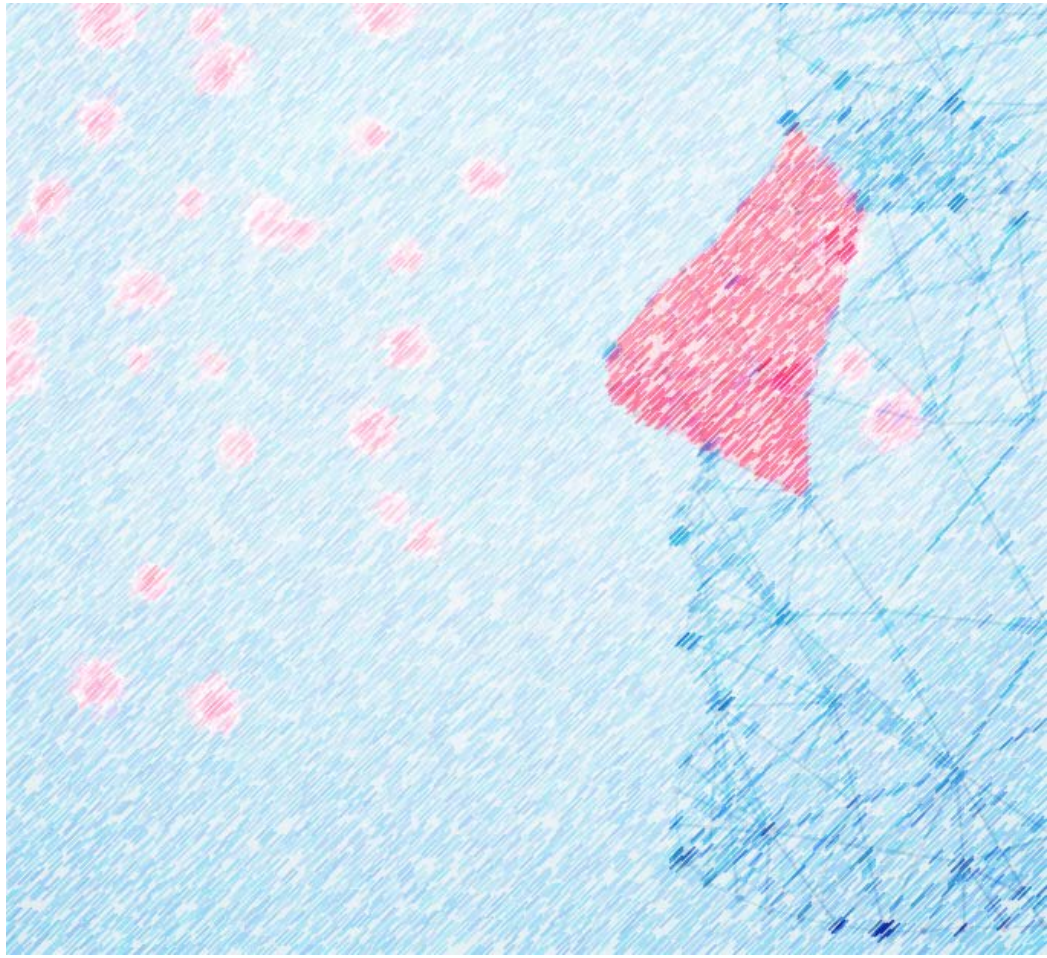
CO Carbon Monoxide, SO_2 Sulfur Dioxide: mainly produced in kitchen fumes, cigarettes, fire smoke; H_2S Hydrogen Sulfide gas: produced in domestic rubbish and toilet environments. Long-term existence has long-term impact on human health.

3) Poor-sense harmful gas (odour):

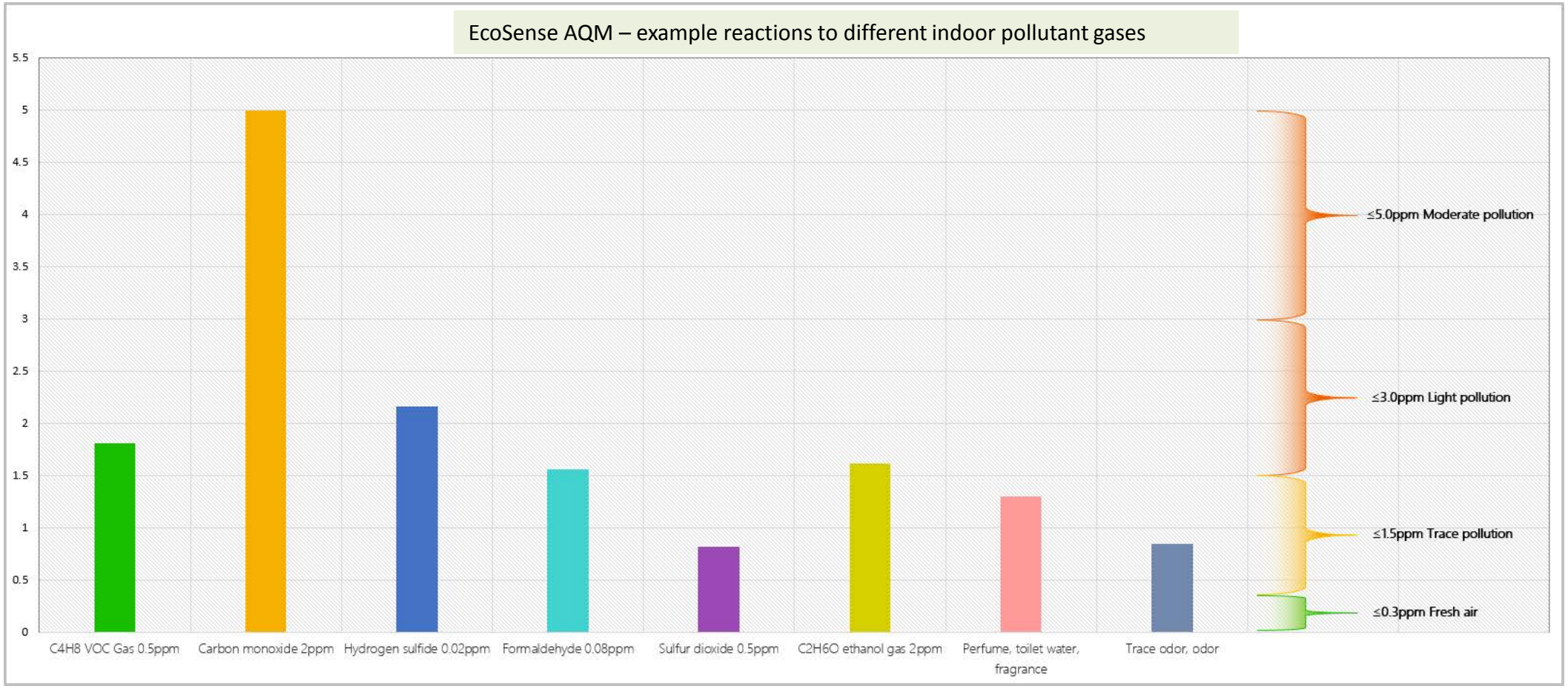
Contains mainly CH_4S Methyl Mercaptan, C_2H_6S methyl sulfide, C_2H_7N dimethylamine, C_3H_9N trimethylamine, H_2S Hydrogen Sulfide, C_8H_8 styrene, NH_3 Ammonia gas, etc. This kind of gas mainly comes from domestic rubbish, toilet environment, food waste and human body oral odours. They are all odorous substances causing poor reactions to the body.

4) Somatosensory and harmful gas:

Perfume, aftershaves, fragrance, etc.: most of the unqualified products in this category come from chemically synthesized fragrances. The main components are ethanol, aromatic hydrocarbons, benzenes, phthalates, vanillin, butadione, etc. All of them are toxic substances. Some of them are highly toxic and contain high carcinogenic substances.

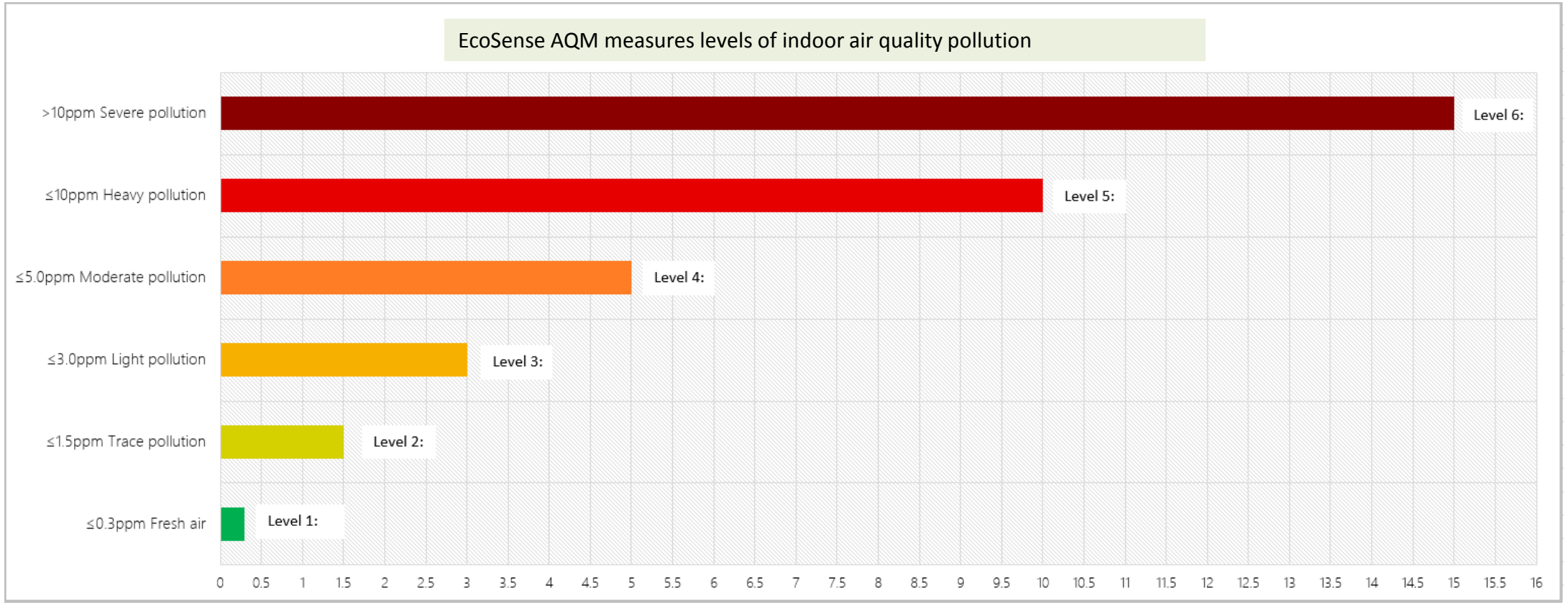


Using the EcoSense AQM to measure indoor pollution levels



Using the EcoSense AQM to measure indoor pollution levels

Air quality grades using the EcoSense AQM



Using the EcoSense AQM to measure indoor pollution levels

EcoSense AQM pollution levels – LED explanation and actions recommended

First level: ≤ 0.3ppm, Good fresh air: this level of fresh air is healthy, like an early morning park or countryside environment.

Second Level: ≤ 1.5ppm, Trace pollution: indoor formaldehyde, TVOC and other harmful gases are nearing point of indoor air standard minimum limit.

Third level: ≤ 3.0ppm, Mild pollution: allergies or discomfort to people with sensitive physiques. At the same time, check whether someone smokes or drinks alcohol or disinfects with alcohol in the area. It is recommended to open the window to ventilate or turn on fresh air purification.

Forth level: ≤ 5.0 ppm, Moderate pollution: this can affect health over the long-term in this environment. People with symptoms or allergies have difficulties in this area. Open the window as soon as possible, use ventilation or a fresh air purification treatment.

Fifth level: > 10 ppm, Heavy pollution: the indoor environment should be checked for hidden fire hazards; if cooker hoods are not turned on during cooking; gas leaks; smoking and drinking; alcohol disinfection or perfumes have been used. Windows must be opened as soon as possible, ventilation switched on or use fresh air purification treatment.

Sixth level: > 10 ppm, Heavy pollution: the indoor environment should be checked for hidden fire hazards; if cooker hoods are not turned on during cooking; gas leaks; smoking and drinking; alcohol disinfection or perfumes have been used. Windows must be opened urgently, ventilation switched on or use fresh air purification treatment.

EcoSense AQM - Applications for public health

The EcoSense AQM air quality monitor is valuable for a wide range of applications in indoor public health environments. The AQM monitor's high-precision design for measuring a multitude of important indoor pollutant gases efficiently and effectively reflects the current indoor environment. With its simple LED traffic lights and happy face display, it can constantly remind the user to provide quick and easy window ventilation or integrate other air purification and ventilation measures. This is valuable for indoor air pollution monitoring and treatment in working and living environments. At the same time, the monitor can provide medical and public health systems valuable data reference for management decision-making, improvement and construction. Here are some of the applications for the EcoSense AQM:

EcoSense AQM - Applications for public health

1. Monitoring of indoor gas pollution in schools, colleges, universities and campus environments

Indoor air pollution in educational environments mainly comes from school equipment, decorating materials, tables and chairs, furniture, etc. TVOC harmful gases are then volatilized. An educational environment is relatively densely populated and exhaled gas exchange rate between people is high. The polluted gas formed by poor air mobility is the most serious, and at the same time, provides favourable conditions for the spread of viruses. Through monitoring the air pollution index, we can understand the pollution situation in a classroom in real time, accurately and effectively adopt air pollution control, and therefore create a healthy and comfortable teaching environment.

Applications for public health

2. Monitoring of indoor gas pollution in public medical and health environments

Various medical supplies, medical equipment, medical waste, toilet odours and human exhaled breath carry a large number of germs and viruses, leading to serious indoor air pollution in a hospital or care environment.

Generally, the human body has limited ability to perceive the polluted air, which carries virus-contaminated gases that are colourless and odorless, and so are invisible to the human. Instead we require effective real-time monitoring methods for harmful polluting gases in the medical environment. Through long-term monitoring and data analysis, we can clearly understand the pollution distribution and traceability of pollution sources in different medical areas. This provides a basis for decision-making, whether it be to increase the fresh air volume or to carry out sterilization and disinfection, as examples.



EcoSense AQM - Applications for public health

3. Monitoring of gas pollution in public transportation environments

Airports, rail, transport hubs and stations are places where people gather in smaller spaces and travel long distances, especially in aircraft cabins, rail, underground/subway and long distance transport. The environmental space is relatively tight and narrow. Air pollution is greater and can be more serious. The main sources of pollution come from the vehicles, human activity (eating, eating, rubbish, toilet odour, etc.), TVOC gas volatile from decoration facility materials, and human exhaled gas pollution.

Applications for public health

4. Occupational health, safety and health monitoring

Infrastructure, engineering, materials and chemicals, resource mining, heavy industry and light industry manufacturing all cause environmental pollution and occupational health diseases. Many manufacturing companies across the globe are still labour-intensive, where the production environment is poor, and often there is not the attention paid to the safety and health of employees.

According to data statistics, more than 80% of occupational safety and health hazards are caused by chemical substance pollution. Amongst them, chemical substances that enter the human body through gaseous pollution through the respiratory system are the main factors leading to health diseases.

The EcoSense AQM can monitor various toxic and hazardous substances, comprehensively judging on-site pollution and give the corresponding pollution level. This provides reference guidelines for personal safety and health, and also important data for national occupational health, safety and health supervision.

- Multi-gas mixing
- Internal Calibration
- Low-power design of IOT applications
- No need to wait after power on
- Long life design> 5 years
- Multi-gas response characteristic algorithm

EcoSense AQM - Applications for public health

5. Monitoring gas pollution in entertainment environments

Restaurant, cafes, pubs and bars are important places in people's daily life. The pollutants in the ambient air mainly come from the pollution of decorative materials and cooking smoke. Decoration materials might include sandwich boards, glues, paints, adhesive and gypsum, etc., which all contain pollutants such as formaldehyde, benzene, ammonia, radon, TVOC, etc. The gaseous pollution caused by kitchen fumes is mainly total hydrocarbons, CO Carbon Monoxide, SO2 Sulfur Dioxide and other harmful gases. With the continuous improvement of social living standards, restaurants and bars have gradually become an important environment for people to enjoy food and socialising. In the future, a healthy dining environment, breathing fresh air, will become people's primary choice. The EcoSense AQM can provide catering with visual air quality data, provide a safe dining environment, and improve restaurant competitiveness and user satisfaction.

EcoSense AQM - Applications for public health

6. Household indoor air pollution detection

The indoor home environment is at the heart of daily life. Any polluted gas directly affects our health. The actual gas pollution in the indoor environment of our homes is surprisingly often much higher than that of the outdoor environment.

The main source of pollution:

House decoration materials, spray paints and their solvents, wood preservatives, plywood, etc. can release a variety of volatile organic substances such as benzene, toluene, formaldehyde, phenols, xylene at room temperature.

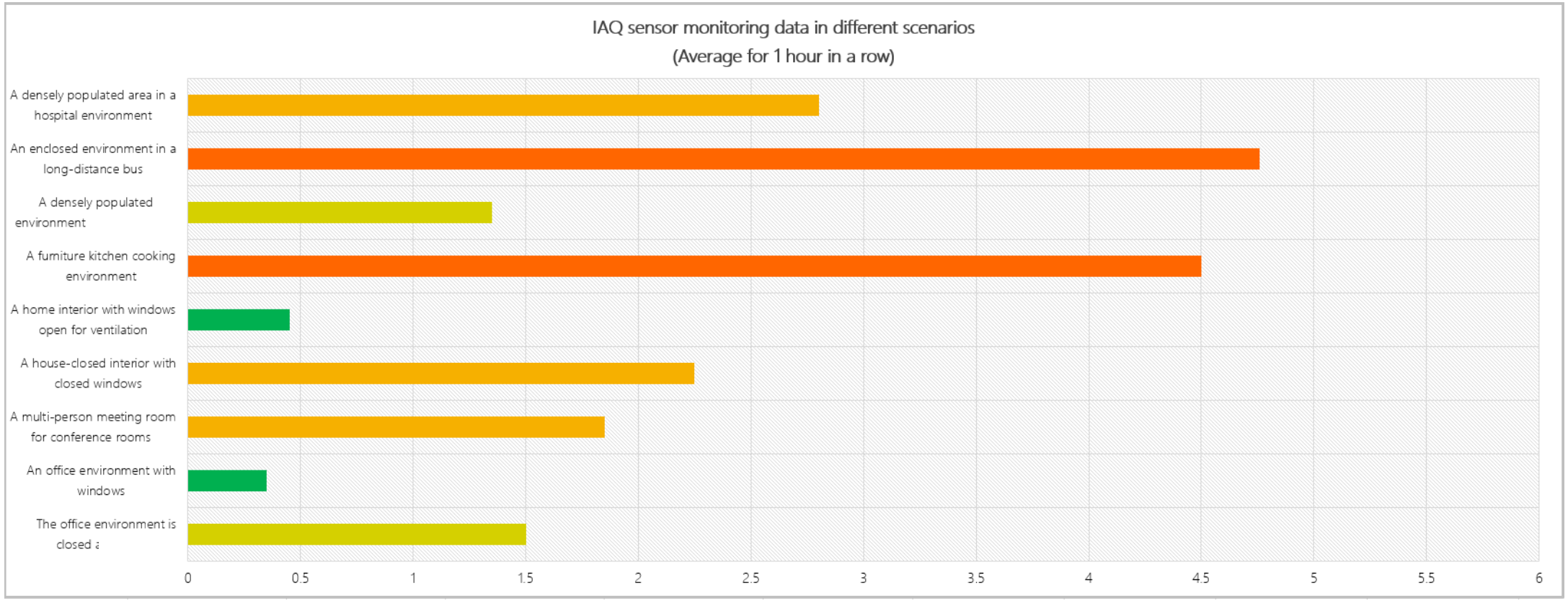
Other sources of pollution:

Pollution caused by household activities, kitchens and toilets mainly produce hydrocarbons, aldehydes, ketones VOC gas, SO2 Sulfur Dioxide, NO2 Nitrogen Dioxide, CO Carbon Monoxide gas, H2S Hydrogen Sulfide gas, NH3 Ammonia gas, dimethylamine, methyl alcohol Thiol, methyl sulfide and other hazardous gases.

The EcoSense AQM provides effective and reliable detection data, which can provide us with environmental health guidance to be aware of pollution levels, and alert us to open windows or use air purification methods.

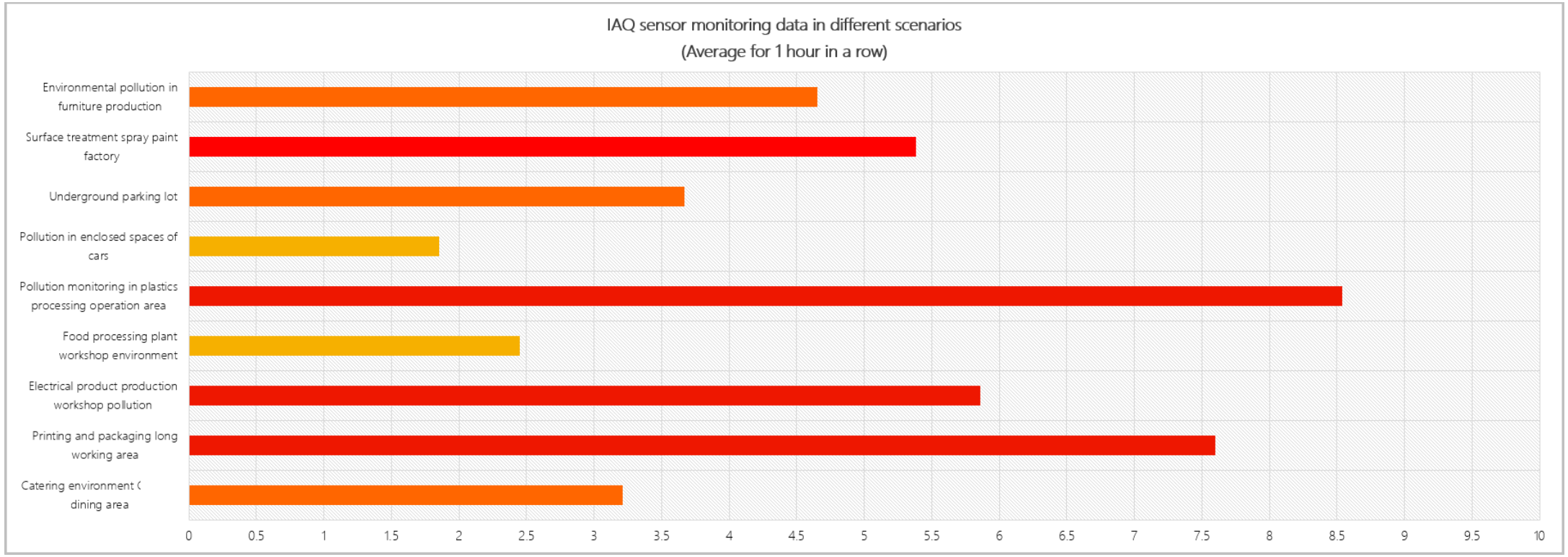
EcoSense AQM - Environmental testing

Testing of home, office and public environments using EcoSense AQM



EcoSense AQM - Environmental testing

Testing of factory environments using EcoSense AQM



EcoSense AQM – for our health and safety

The EcoSense AQM has been tested across a large range of applications and scenarios: manufacturing environments, communal traffic, personnel-intensive environments, office and home environments. Test data compares when windows are open and good, fresh air can be obtained, compared to other environments, where air pollution is serious. Some public spaces show light pollution of level 3 (1.6-3ppm), others higher, whereas some manufacturing environments show grades of 4 to 5 degrees of severe pollution (3.1 - 10ppm).

Whether it is in a home environment, public indoor space or working environment, air pollution is a widespread phenomenon and affects people’s health for a long time. Indoor air pollution provides a carrier for viruses. The more serious the gaseous pollution, the higher the spread rate of virus transmission. Providing real-time and accurate monitoring data for indoor air pollution can guide us to conduct air quality management more effectively, whether it is through simply opening windows or through the operation of more sophisticated ventilation systems, air purification equipment, disinfection or sterilization treatment. This is of great significance to people's health, improving the quality of life and preventing disease and infection. Effective indoor air pollution monitoring is crucial to improve environmental hygiene and our quality of life.