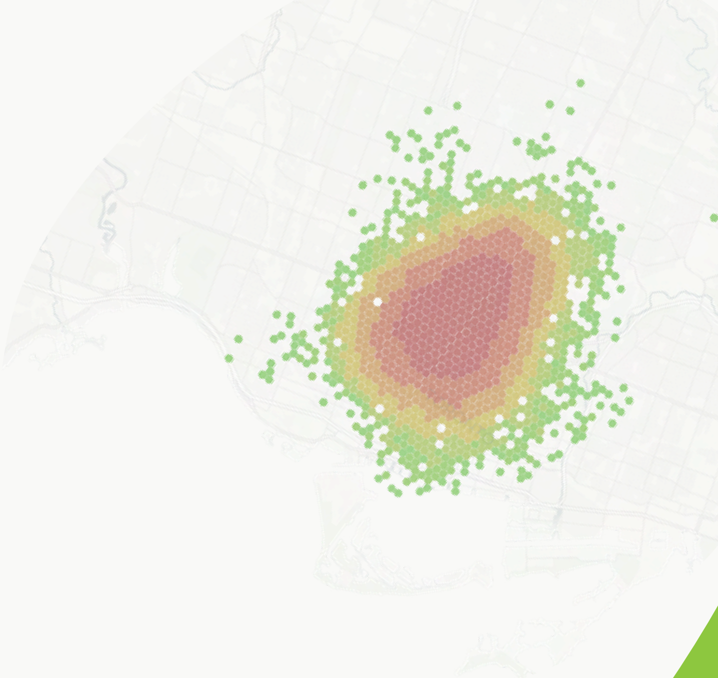

ENVIRONMENTAL INTELLIGENCE TECHNOLOGY CATALOG

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Disclaimer

The information contained in this document is provided for general informational and client engagement purposes only. Product specifications, capabilities, costs, maintenance requirements, operational assumptions, performance criteria, certifications, and service descriptions are subject to change and may vary based on project scope, site conditions, sensor configuration, deployment method, data requirements, and client objectives.

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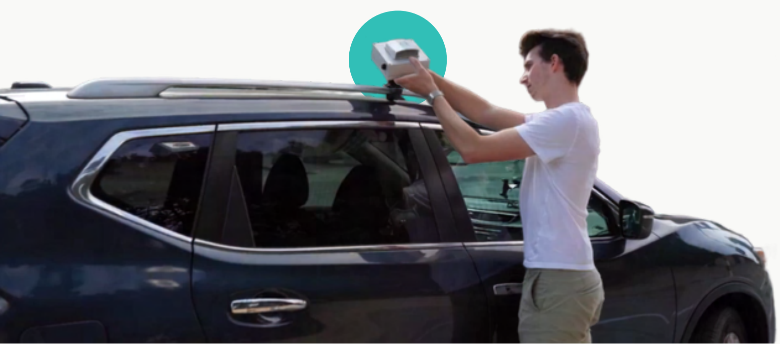
ESI may update, modify, or revise the information in this catalog at any time without notice. Final technical, commercial, operational, and performance details should be confirmed through project-specific discussions, proposals, agreements, and supporting technical documentation.



Real-time monitoring.
Actionable insights.
Defensible environmental decisions.

Environmental intelligence across air quality, GHGs, methane, source emissions, odour, dust, noise, vibration, meteorology, and custom indicators delivered through fixed, mobile, drone, indoor, fence-line, source, and project-based monitoring solutions.

Fixed, Mobile & Drone Monitoring

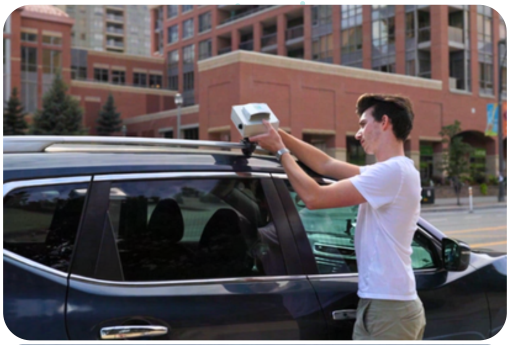
AI-Calibrated Data & Indicators

Project Planning to Execution

SaaS Dashboards, Alerts & Reporting

About ESI

ESI delivers integrated environmental monitoring and intelligence solutions that combine rugged field hardware, advanced sensors, wireless connectivity, cloud processing, and analytics dashboards to turn environmental data into actionable insights.



Platform Overview

Sensors → **Connectivity** → **SaaS Platform** → **Analytics** → **Alerts & Reporting**

Sensors
Gases • Particulates • GHGs • Meteorological • Odours • Noise • Vibration

Connectivity
Cellular/LTE • Wi-Fi • Satellite

SaaS Platform
Dashboards • Maps • Storage • Device Management • Data Export • API Integration

Analytics
AI Calibration • QA/QC • Trend Analysis • Hotspot Detection • Dispersion Modelling • Leak Detection • Source Attribution • Custom Indicators

Alerts & Reporting
Threshold Alerts • Event Detection • Notifications • Exceedance Logs • Automated Reports • Compliance & Decision Support

Tested, Certified & Field-Proven

U.S. EPA-Funded Project Experience
Community monitoring delivery, US EPA approved QAPP support, QA/QC, reporting, and public-facing insights.

AMEP Methane LDAQ
Methane leak detection, localization, quantification, emissions screening, and program support.

MCERTS-Certified PM Sensor
Certified particulate sensor module for PM monitoring applications across sectors

Protected IP
2 patents granted, additional patents pending.

Applications

Urban & Community Air Quality

- Neighbourhood air quality networks
- School and sensitive receptor monitoring
- Traffic corridor exposure studies
- Wildfire smoke and community exposure tracking
- Environmental justice and public reporting

Industry, Fence-Line & Odours

- Facility boundary monitoring
- H_2S, VOC, and odour event tracking
- Complaint correlation with wind and source data
- Industrial emissions and process visibility

Construction, Demolition & Dust

- PM and dust control monitoring
- Noise and vibration tracking
- Weather-based dust risk insights
- Remediation and post-fire cleanup monitoring
- Compliance-support reporting for active sites

Mining, Quarries & Heavy Industry

- Dust and emissions monitoring
- Worker exposure and operational safety insights
- Fixed, mobile, and underground monitoring
- Ventilation and equipment activity intelligence

Methane, GHG & Emissions Intelligence

- Methane LDAQ and leak detection
- Source localization and event analytics
- Emissions reduction and reporting support
- Monitoring, Reduction and Verification (MRV) support for carbon programs and credits

Transportation, Ports & Fleets

- Real-world fleet emissions testing
- Port, rail, roadway, and corridor monitoring
- Heavy-duty vehicle and auxiliary system testing
- Mobile monitoring and hotspot detection

Rugged Monitoring Hardware

ESI’s monitoring hardware is designed to collect high-frequency environmental data across a wide range of real-world deployment conditions. The device supports multi-sensor configurations, flexible power and communications options, onboard data storage, GPS, and remote management, enabling reliable monitoring for temporary campaigns, permanent networks, mobile surveys, and specialized source monitoring applications.

Rugged Enclosure
Polycarbonate enclosure, designed to withstand -35°C to +75°C

Status LEDs (not shown)
Display power, connectivity and sensor status

Mounting Plate
Designed for pole, fence-line, vehicle, drone, tripod, and custom installations.

Power Input (not shown)
Supports AC, DC, solar, battery, or vehicle power options.

Multiple Sensor Bays
The device holds multiple sensor bays to host a variety of pollutant, GHG and other sensors

Device Integration Ports
Supports physical connection and integration of external third-party devices

Communications Module
Cellular/LTE, Wi-Fi, satellite-ready configurations.

Onboard Storage
Local data backup and network buffer backup for communication interruptions.

Air Intake
Dynamic sampling for gases, odours, and environmental parameters.

Dust Sensor Enclosure
Dedicated particulate matter monitoring pathway.

Sensor Ports
In addition to multiple sensor bays inside the device, 2 separate modular gas ports are present

mCERTS
Certified Product for PM2.5 Particulate Monitors

Built for the real world: ESI monitoring solutions support industrial sites, indoor facilities, mobile platforms, and remote environmental applications.

Rugged Monitoring Hardware

US EPA Criteria Pollutants
- CO • NO_2 • SO_2 • O_3

Particulate Matter
- PM1 • PM2.5 • PM4 • PM10

Greenhouse Gases
- CO_2 • CH_4

Other Gas Sensors
- O_2 • NH_3 • EtOH • Cl_2 • C_2H_4 • NO • HCHO • H_2 • Flammable Gas* • IAQ • Benzene

Odour Sensors
- H_2S • Total VOCs • VOC Index • NOx Index

Meteorological Sensors
- Temperature • Relative Humidity • Barometric Pressure • Wind Speed • Wind Direction

Other Environmental Factors
- Noise • Vibration

Indicators
- IAQ Indicator • Black Carbon Indicator • Combustion Indicator • Combustion Readiness Indicator • Dryness / Dust Risk Indicator • Comfort Indicator

Dimensions
7″ × 7″ × 3.15″ / 4.5″ including front air vent

Weight
~1.6 kg / 3.5 lbs

Enclosure Material
Polycarbonate - IP Rating Certification Pending+

Operating Range
-35°C to +75°C hardware and basic electronics; sensor-specific limits may vary

Sampling
4–10 samples per minute per sensor

Sensor Capacity
Up to 16 sensors simultaneously

Storage
2 years of onboard storage + 18-hour backup buffer

Power Input
- 120–240 V AC single phase 50/60 Hz;
- Direct Power DC 6V / 9V / 12V / 24V;
- Optional Solar, battery or vehicle power.
- Can be powered by packs by 9V batteries

Power Consumption
- 2.0 W minimum / 6.5 W maximum.

Communications
- 3G • 4G • LTE • Wi-Fi • Cellular-over-Satellite

Operation Modes
- Stationary • Mobile vehicle mounting • Aerial drone / UAV mounting

Deployment Formats
- Fixed station • Mobile survey • Drone deployment • Fence-line • Indoor / facility • Source monitoring • Temporary campaign/Permanent network • Small scale stack monitoring • Leak Detection and Quantification • Custom deployment

Onboard Software Features
- Automated sampling • Local data logging • Communication buffering • Remote Device health monitoring • Remote Power status • Remote Sensor status • Onboard GPS location monitoring • OTA upgrades

Device Security
- Encryption • TLS • TrustedBoot • Anomaly Detection

*Flammable gas refers to LEL / combustible gas detection across gas families and mixtures. The sensor can detect gases such as methane, ethane, propane, butane, pentane, hexane, hydrogen, ethylene, propylene, isopropanol, toluene, and xylene. Methane has individually specified performance; other gases are detected through combustible gas/mixture response and gas classification.

+**Note:** IPXX certification is pending. The polycarbonate enclosure is designed for rugged outdoor deployment, with final ingress-protection rating to be confirmed upon certification completion.

Sensor Portfolio

ESI's monitoring platform supports a broad and growing portfolio of environmental sensors across air quality, greenhouse gases, odours, meteorology, noise, vibration, and project-specific indicators. The following pages provide sensor-level specifications for the main parameters available through ESI's hardware and analytics platform.

Because each sensor type serves a different monitoring purpose, performance should be understood in context. Criteria pollutants and particulate matter may be evaluated using more established air sensor benchmarking approaches, while specialty gases, odours, greenhouse gases, noise, vibration, and derived indicators may require fit-for-purpose validation based on project objectives, site conditions, calibration approach, and available reference data.

ESI selects and configures sensors based on the target pollutant, expected concentration range, deployment method, environmental conditions, data-use requirements, and client objectives.

Sensor Category	Parameters Included	Typical Use
Criteria Pollutants	CO, NO_2, SO_2, O_3	Ambient air quality, combustion influence, traffic, industrial monitoring, compliance-support
Particulate Matter	PM1, PM2.5, PM4, PM10	Dust, smoke, construction, mining, roadways, community exposure
Odour Sensors	H_2S, Total VOCs	Wastewater, landfill, industrial odours, complaint correlation, source investigation
Greenhouse Gases	CO_2, CH_4, N_2O	Climate monitoring, emissions screening, leak detection, process monitoring
Specialty Gas Sensors	NH_3, NO, HCHO, Cl_2, H_2, EtOH, C_2H_4, IAQ, RESP, Benzene, Oxygen	Industrial, facility, process, indoor air quality, safety, and application-specific monitoring
Meteorological Sensors	Temperature, RH, Pressure, Wind Speed, Wind Direction	Source attribution, dispersion, dust risk, odour tracking, QA/QC context
Noise & Vibration	Noise, Vibration	Construction, transportation, industrial activity, community impact monitoring

Sensor Portfolio - Criteria Pollutants

Criteria pollutants are among the most important pollutants for understanding ambient air quality because they are widespread, health-relevant, and commonly used in air quality management programs. ESI monitors gaseous criteria pollutants to support community monitoring, transportation studies, industrial fence-line monitoring, source investigations, exposure analysis, and compliance-support applications.

Because criteria pollutants have established air quality significance, ESI evaluates these measurements using a more structured performance approach than many project-specific or emerging sensor applications. This includes co-location, reference comparison, QA/QC, and EPA-style metrics such as R^2, RMSE/nRMSE, MAE, bias, precision, lower detection limit, and data completeness.

Sensor Type - Electrochemical

ESI's gaseous criteria pollutant sensors use electrochemical sensing technology. These sensors are compact, low-power, and sensitive to low-level gas concentrations, making them suitable for distributed air quality monitoring across fixed, mobile, drone, and project-based deployments. ESI evaluates these sensors using co-location, reference comparison, QA/QC, and EPA-style performance metrics where applicable.

Criteria Pollutants - Importance to Air Quality

CO — Carbon Monoxide	A combustion-related gas associated with vehicles, engines, equipment, and fuel-burning activities. It is important for identifying combustion influence and potential exposure concerns.
NO_2 — Nitrogen Dioxide	A key combustion and traffic-related pollutant. It is commonly used to understand roadway, diesel, industrial, and urban exposure patterns.
SO_2 — Sulphur Dioxide	Often linked to sulphur-containing fuel combustion and industrial processes. Useful for understanding industrial, port, rail, stack, and fuel-combustion impacts.
O_3 — Ozone	A secondary pollutant formed in the atmosphere through reactions involving precursor pollutants and sunlight. Important for regional air quality, smog, and public health studies.

Criteria Pollutants - ESI Sensor Specifications

Sensor	Range	Resolution	Accuracy (Normalized RMSE)	Lower Detection Limit
CO (Carbon Monoxide)	0 to 1000 ppm	0.1 ppb	± 3%	1 ppb
NO2 (Nitrogen Dioxide)	0 to 5 ppm	0.1 ppb	± 5%	0.1 ppb
O3 (Ozone)	0 to 10 ppm	0.1 ppb	± 4%	0.1 ppb
SO2 (Sulphur Dioxide)	0 to 20 ppm	0.1 ppb	± 3%	0.1 ppb

Note: Above metrics are based on ESI's co-location test results which were performed over 2-12 months in several locations and countries.

Calibration Precision Performance (R^2 Score): R^2 measures how well the model explains the variance in the data. ESI's self-calibration model's calibration precision, as indicated by an R^2 score of 0.XX, demonstrates that XX% of the variance in the reference data is captured by ESI's model.

Typical Error (MAE): MAE measures the average absolute error between predicted and actual (reference) values. It tells us how close the self-calibration model's outputs are to the true (reference) values on average.

Accuracy (nRMSE): quantifies prediction error as a percentage, showing how well the self-calibration model performs relative to the reference data range.

Sensor Portfolio - Dust/Particulate Matter (PM)

Particulate matter sensors measure airborne particles suspended in air, including fine and coarse particles associated with dust, combustion, road activity, construction, wildfire smoke, industrial operations, and other sources. Particulate monitoring supports community exposure analysis, dust control programs, construction and mining monitoring, transportation corridor studies, wildfire smoke response, industrial fence-line monitoring, and compliance-support applications.

Particulate matter is also a criteria pollutant, but ESI presents PM as a dedicated sensor category because dust and aerosol monitoring represent a major standalone monitoring need across many sectors. ESI evaluates particulate measurements using co-location, reference comparison, QA/QC review, and performance metrics such as R^2, RMSE/nRMSE, MAE, lower detection limit, and data completeness.

Sensor Type - Optical Particle Counter

ESI's particulate matter monitoring uses an optical particulate matter sensors. The sensor uses a laser-scattering measurement principle to detect particles in the air stream and convert the signal into particulate mass concentration outputs. The PM2.5 is an MCERTS-certified particulate matter sensor for PM monitoring applications.

Particulate Matter - Importance to Air Quality

PM1	Very fine particles often associated with combustion, smoke, and fine aerosols. Useful for identifying fine-particle trends and combustion-related conditions.
PM2.5	Fine particulate matter that can penetrate deep into the lungs and is important for community exposure, wildfire smoke, traffic influence, industrial activity, and public health studies.
PM4	Respirable particulate fraction used in occupational, industrial, and exposure-related monitoring contexts where respirable dust is a concern.
PM10	Coarse particulate matter commonly associated with road dust, construction, mining, aggregate handling, windblown dust, and industrial operations.

Particulate Matter - ESI Sensor Specifications

Sensor	Range (Extendable)	Resolution	Accuracy (Normalized RMSE)	Precision Performance (R^2 Score)	Typical Error (MAE)	Lower Detection Limit
PM 2.5	0 to 1000 µg/m3	0.1 µg/m3	± 3%	0.95	± 0.7 µg/m3	0.5 µg/m3
PM 10	0 to 1000 µg/m3	0.1 µg/m3	± 5%	0.84	± 6.5 µg/m3	0.7 µg/m3

Note: PM2.5 and PM10 are the primary particulate fractions used in most air quality and dust monitoring applications; therefore, ESI's baseline co-location and benchmarking metrics are reported for PM2.5 and PM10. **PM1 and PM4 are supported outputs from the same particulate sensor platform and are expected to show comparable trend behaviour, with project-specific validation applied where required.**

Note: Above metrics are based on ESI's co-location test results which were performed over 2-12 months in several locations and countries.

Calibration Precision Performance (R^2 Score): R^2 measures how well the model explains the variance in the data. ESI's self-calibration model's calibration precision, as indicated by an R^2 score of 0.XX, demonstrates that XX% of the variance in the reference data is captured by ESI's model.

Typical Error (MAE): MAE measures the average absolute error between predicted and actual (reference) values. It tells us how close the self-calibration model's outputs are to the true (reference) values on average.

Accuracy (nRMSE): quantifies prediction error as a percentage, showing how well the self-calibration model performs relative to the reference data range.

Sensor Portfolio - Odours

H_2S • Total VOCs (Volatile Organic Compounds)

Odour sensors support monitoring of compounds and signal patterns commonly associated with nuisance odours, industrial emissions, wastewater treatment, landfills, organic decomposition, chemical processes, and community odour complaints.

Odour monitoring is treated as a dedicated sensor category because odour events are often site-specific, intermittent, wind-driven, and perception-based. A single concentration value may not fully explain an odour issue. ESI evaluates odour conditions using sensor measurements, meteorology, wind direction, time patterns, complaint records, field observations, and project-specific thresholds where available.

Sensor Type - Electrochemical & Metal Oxide

ESI's odour monitoring may use a combination of electrochemical sensors and metal oxide sensors, depending on the target compound and project objective.

H_2S is measured using electrochemical sensing technology, which is suitable for detecting low-level hydrogen sulphide concentrations commonly associated with wastewater, landfill, industrial, and organic decomposition odours. Total VOCs are used to support broader odour and air quality interpretation. These outputs can help identify changes in ambient chemical conditions, odour-relevant events, and patterns that may require further investigation.

Odours - Importance to Air Quality

H_2S — Hydrogen Sulphide	A key odour compound commonly associated with wastewater, landfills, organic decomposition, sewer systems, and industrial processes. Useful for identifying sulphur-based odour events and community complaint patterns.
Total VOCs — Based on Isobutylene	Measures total volatile organic compound response as an isobutylene-equivalent signal. Useful for detecting changes in VOC conditions, odour-related events, chemical vapours, and industrial or facility influence.

Odours- ESI Sensor Specifications

Sensor	Technology	Range	Resolution	Accuracy	Lower Detection Limit
H_2S — Hydrogen Sulphide	Electrochemical	0 to 50 ppm	0.1 ppb	±1%	1 ppb
Total VOCs — Based on Isobutylene	Metal Oxide Sensor	0 to 1000 ppb	0.1 ppb	—	1 ppb

Note: H_2S can be co-located and benchmarked where suitable reference or comparison data is available. However, there are no equivalent EPA-style air sensor performance benchmarks for H_2S as there are for criteria pollutants. ESI therefore evaluates H_2S using a fit-for-purpose approach that may include calibration checks, co-location, QA/QC, event detection, wind alignment, and correlation with odour complaints or field observations.

Odour interpretation: Odour monitoring is often event-based and context-dependent. ESI may evaluate odour events using H_2S, VOCs, wind direction, weather conditions, time-of-day patterns, source context, complaint logs, and field observations where available.

Total VOCs: Total VOC readings are generally interpreted as a broad VOC response rather than compound-specific identification. Values may be reported as an isobutylene-equivalent signal depending on configuration.

Sensor Portfolio – Meteorological Sensors

Temperature • Relative Humidity • Atmospheric Pressure

Meteorological sensors provide critical context for interpreting environmental monitoring data. Weather conditions influence how pollutants move, dilute, accumulate, disperse, or appear as localized events. For ESI deployments, meteorological data is used not only as a measured condition, but also as an input into source attribution, odour analysis, methane event interpretation, dust risk, dispersion modelling, and data QA/QC.

Sensor Type – Solid State

ESI's meteorological monitoring uses solid-state sensors for temperature, relative humidity, and atmospheric pressure.

Solid-state sensors provide compact and reliable measurement of site conditions for fixed, mobile, industrial, community, and source-based applications.

Meteorological – Importance to Air Quality

Temperature	Supports environmental correction, sensor interpretation, heat/dryness analysis, combustion readiness, and general site condition tracking.
Relative Humidity	Important for dust behaviour, PM interpretation, sensor response, odour conditions, and dryness / dust risk indicators.
Atmospheric Pressure	Provides site condition context and supports meteorological interpretation, data correction, and environmental trend analysis.

Meteorological – ESI Sensor Specifications

Sensor	Technology	Range	Resolution	Accuracy	Lower Detection Limit
Temperature	Solid State	-40 to 85°C	0.01°C	Full accuracy from 0 to 65°C	-40°C
Relative Humidity	Solid State	0 to 100% RH	0.008% RH	±3%	0% RH
Atmospheric Pressure	Solid State	300 to 1100 hPa	0.18 hPa	<1.7 hPa	300 hPa

Meteorological context: Weather data is essential for interpreting pollutant patterns. Wind speed and wind direction are especially important for source attribution, odour events, methane detection, dispersion modelling, and fence-line monitoring.

Solid-state sensors: Temperature, humidity, and pressure sensors support continuous monitoring of site conditions and help contextualize sensor readings across changing environmental conditions.

Performance basis: Meteorological sensor performance is typically evaluated using sensor specifications, installation checks, field reasonableness checks, and comparison with nearby weather or reference data where available.

Sensor Portfolio – Wind Sensor

Wind Speed • Wind Direction

Meteorological sensors provide critical context for interpreting environmental monitoring data. Weather conditions influence how pollutants move, dilute, accumulate, disperse, or appear as localized events. For ESI deployments, meteorological data is used not only as a measured condition, but also as an input into source attribution, odour analysis, methane event interpretation, dust risk, dispersion modelling, and data QA/QC.

Sensor Type – Ultrasonic Anemometer

ESI uses an ultrasonic anemometer for wind speed and wind direction. Ultrasonic wind sensing avoids moving parts and supports continuous wind monitoring for fixed, mobile, industrial, community, and source-based applications.

Wind- Importance to Air Quality

Wind Speed	Helps determine pollutant movement, dilution, plume behaviour, dust transport, odour movement, and downwind impact potential.
Wind Direction	Critical for source attribution, fence-line interpretation, odour event analysis, methane plume tracking, and identifying likely upwind sources.

Meteorological – ESI Sensor Specifications

Sensor	Technology	Range	Resolution	Accuracy	Lower Detection Limit
Wind Speed	Ultrasonic Anemometer	0 to 40 m/s	0.01 m/s	±0.5 + 2% FS	No limit
Wind Direction	Ultrasonic Anemometer	0 to 360°	1°	±3°	No limit

Ultrasonic wind sensing: Ultrasonic anemometers measure wind without moving parts, supporting reliable field operation and reduced mechanical wear compared with traditional cup-and-vane systems.

Performance basis: Wind sensor performance is typically evaluated using sensor specifications, installation checks, field reasonableness checks, and comparison with nearby weather or reference data where available.

External Sensor Note: This sensor is externally attached to the ESI device.

Sensor Portfolio - Carbon Dioxide (CO_2)

Carbon dioxide sensors measure CO_2 concentrations in air and are used to understand greenhouse gas trends, ventilation conditions, combustion influence, occupancy patterns, process emissions, and site-specific environmental conditions.

ESI treats CO_2 as a dedicated greenhouse gas monitoring parameter because it supports both climate-related monitoring and operational environmental intelligence. CO_2 data can help identify changes from background conditions, track indoor or facility air quality, support source and process investigations, and provide context for broader emissions and environmental monitoring programs.

Sensor Type - Photoacoustic NDIR

ESI's CO_2 monitoring uses Photoacoustic NDIR sensing technology. NDIR-based CO_2 sensors measure how carbon dioxide absorbs infrared light at specific wavelengths. Photoacoustic NDIR sensors use this absorption response to estimate CO_2 concentration with stable, low-power performance suitable for fixed, mobile, indoor, and project-based monitoring applications.

This technology is well suited for CO_2 monitoring because it is selective to carbon dioxide, supports broad concentration ranges, and can provide reliable measurements across environmental and facility monitoring applications.

Carbon Dioxide - Importance to Air Quality

CO_2 - Carbon Dioxide	A major greenhouse gas and useful indicator of ventilation, combustion influence, occupancy, process emissions, and background environmental conditions. CO_2 monitoring supports climate-related projects, indoor/facility monitoring, source investigations, and environmental intelligence applications.

Carbon Dioxide - ESI Sensor Specifications

Sensor	Range	Resolution	Accuracy	Lower Detection Limit
CO_2	0 to 40,000 ppm	1 ppm	±(50 ppm + 2.5% of reading) @ 400–1,000 ppm ±(50 ppm + 3% of reading) @ 1,001–2,000 ppm ±(40 ppm + 5% of reading) @ 2,001–5,000 ppm	1 ppm

Note: For CO_2 applications, the monitoring objective may include absolute concentration tracking, background comparison, ventilation analysis, source influence, or trend detection. CO_2 performance is primarily supported by Photoacoustic NDIR sensor specifications, factory calibration, functional checks, and project-specific QA/QC. Because CO_2 is abundant and has well-understood background behaviour, routine long-term co-location is not typically required for every deployment; however, co-location or reference comparison can be applied where project objectives require additional validation.

Accuracy: CO_2 accuracy varies by concentration range. The sensor accuracy is expressed as a fixed ppm value plus a percentage of the measured reading.

Lower Detection Limit: The lower detection limit represents the lowest concentration change the sensor can meaningfully resolve under defined operating conditions.

Application Note: CO_2 is not only a greenhouse gas parameter. It can also support indoor air quality screening, occupancy and ventilation analysis, combustion-related interpretation, process monitoring, and emissions intelligence when combined with other gases, particulate matter, meteorology, and site context.

Sensor Portfolio - Flammable Gas & Methane

This flammable gas sensor category is different from standard gas concentration monitoring because many combustible gas applications are focused on LEL detection, meaning the sensor reports the presence of flammable gas as a percentage of the Lower Explosive Limit rather than identifying and measuring every gas as a separate compound-specific channel. The sensor can support detection across a broad range of combustible gases and mixtures, including:

Methane • Ethane • Propane • Butane • Pentane • Hexane • Hydrogen • Ethylene • Propylene • Isopropanol • Toluene • Xylene

Important: this does not mean every gas is always reported as a separate individual concentration channel. For most combustible gases, the output is interpreted as %LEL / combustible gas response and gas-family classification. Hydrogen and Natural Gas/Methane are however, individually specified.

ESI treats methane as a key gas within this category because methane is both a flammable gas and a major greenhouse gas. Methane monitoring can support leak screening, emissions investigations, landfill monitoring, wastewater monitoring, oil and gas applications, industrial monitoring, and methane LDAQ programs.

Sensor Type - Molecular Property Spectrometer

For flammable gas monitoring, ESI uses a Molecular Property Spectrometry MPS™ Flammable Gas Sensor, depending on configuration and project requirements. The MPS sensor is designed for worker safety and leak detection applications and uses built-in environmental compensation to detect and quantify combustible gases and gas mixtures. The sensor has a 0–100% LEL detection range.

Methane and Flammable Gases- Importance to Air Quality

Methane / CH_4	Methane is a combustible gas and a high-impact greenhouse gas. It is monitored for leak detection, emissions screening, landfill, wastewater, oil and gas, industrial, and source investigation applications.
LEL / Flammable Gas	Reports combustible gas presence as a percentage of the lower explosive limit. Useful for safety screening, leak detection, and identifying potential combustible gas risk.
Combustible Gas Mixtures	Many real-world flammable gas events involve mixtures rather than a single gas. The sensor evaluates the bulk combustible gas response and classifies gas types into broader groups.

Methane and Flammable Gases - ESI Sensor Specifications

Sensor / Output	Range	Resolution	Accuracy / Performance	Notes
Methane / CH_4	0–100% LEL	0.1% LEL	±3% LEL at 50% LEL	-
Other combustible gases / Gas Mixtures	0–100% LEL	Gas-dependent	Typically ±5% to ±15% LEL depending on gas type	Reported as combustible gas / gas mixture response and classification, not always individual gas concentration.

Methane Note: Methane is treated separately because it is both a combustible gas and a greenhouse gas. ESI can use methane data for leak detection, event screening, source investigation, emissions intelligence, and methane LDAQ style monitoring workflows.

Performance Basis: Flammable gas and methane performance may be evaluated using sensor specifications, calibration checks, response time, environmental compensation, event detection, field comparison, and project-specific QA/QC. For methane projects, background correction, wind alignment, GPS-linked patterns, and repeatability of detected events may be as important as absolute concentration accuracy.

Sensor Portfolio - Nitrous Oxide (N_2O)

Nitrous oxide sensors support monitoring of N_2O in environmental, industrial, agricultural, biological, medical, gas pipeline, chemical, petroleum, and process-related applications. ESI treats N_2O as a specialty greenhouse gas and process gas parameter because monitoring needs may vary significantly by site, concentration range, and application.

N_2O is relevant for climate-related monitoring because it is a potent greenhouse gas. It may also be important in agriculture, biological systems, industrial processes, gas handling, and controlled environments where nitrous oxide generation, use, or release may occur.

Sensor Type - NDIR

ESI's nitrous oxide monitoring uses NDIR — Non-Dispersive Infrared sensing technology. NDIR sensors measure gas concentration by detecting the absorption of infrared light at gas-specific wavelengths.

For N_2O, NDIR technology is useful because it supports stable measurement, long operating life, no oxygen dependency, and suitability for industrial and environmental monitoring conditions.

Nitrous Oxide - Importance to Air Quality

N_2O — Nitrous Oxide	An indirect greenhouse gas associated with agriculture, biological processes, industrial activity, chemical operations, and gas handling applications. N_2O monitoring supports environmental monitoring, emissions screening, process monitoring, agricultural applications, and industrial safety / operations programs.

Nitrous Oxide - ESI Sensor Specifications

Sensor	Detection Range	Resolution	Accuracy	Response / Operating Notes
N_2O - Option1	0 to 1000 ppm	Configuration dependent	±(20 ppm + 3% of reading)	T90 <30 seconds
N_2O - Option2	0 to 5000 ppm	Configuration dependent	±(100 ppm + 3% of reading)	T90 <30 seconds
N_2O - Option3	0 to 2% VOL	Configuration dependent	±(0.02 VOL + 3% of reading)	T90 <30 seconds

N_2O performance basis: N_2O performance is evaluated using sensor specifications, calibration checks, drift review, response time, field QA/QC, and project-specific validation where required.

Application note: N_2O monitoring can support greenhouse gas screening, agricultural applications, industrial process monitoring, biological systems, gas handling, and environmental intelligence programs.

Variant selection: N_2O sensor range should be selected based on the expected concentration environment, whether the project is focused on low-level environmental monitoring, elevated industrial conditions, or percent-volume gas monitoring.

Certification / Protection Note: The N_2O sensor specification includes explosion-protection certification by CNEX under GB3836.1-2010 and GB3836.4-2010, with explosion-proof markings Ex ia I Ma and Ex ia IIC T4 Ga.

Sensor Portfolio – Benzene (C_6H_6)

Benzene sensors support monitoring of benzene-related vapours in air, particularly in industrial, petrochemical, refinery, oil and gas, transportation, fence-line, and community exposure screening applications. Benzene is treated separately from general VOC monitoring because it is a high-priority hazardous air pollutant and often requires a more targeted monitoring approach.

ESI uses benzene monitoring as part of project-specific environmental screening, source investigation, fence-line monitoring, and exposure assessment programs. Because benzene monitoring can be influenced by other VOCs and site conditions, ESI evaluates performance using sensor specifications, calibration, QA/QC review, field comparison, and project-specific validation where required.

Sensor Type – Photoionization Detector

ESI's benzene monitoring uses Photoionization Detector, or PID, sensing technology. PID sensors detect gases and vapours by ionizing molecules with ultraviolet light and measuring the resulting electrical signal. This makes PID technology useful for detecting VOCs and benzene-responsive compounds at low concentrations.

Because PID response can vary depending on the gas mixture present, benzene monitoring should be interpreted based on calibration approach, site context, expected interferences, and project objectives. Where benzene is a critical target parameter, ESI can apply project-specific validation, calibration checks, or comparison against reference methods where available.

Benzene – Importance to Air Quality

C_6H_6 – Benzene	A high-priority hazardous air pollutant associated with petrochemical operations, fuel handling, refineries, oil and gas activity, industrial sources, combustion, and traffic-related emissions. Benzene monitoring supports fence-line screening, community exposure studies, source investigations, and industrial environmental programs.

Benzene – ESI Sensor Specifications

Sensor	Range	Resolution	Sensitivity	Lower Detection Limit
Benzene	0 to 10 ppm	1 ppb	>100 mV/ppm	1 ppm

Note: Benzene monitoring performance may vary based on sensor configuration, calibration gas, VOC mixture, humidity, temperature, cross-sensitivities, and site conditions.

Performance Basis: Benzene performance is evaluated using sensor specifications, calibration checks, field QA/QC, response behaviour, and project-specific validation where required.

Application Note: For projects where benzene is a primary decision parameter, ESI can support additional validation through co-location, reference comparison, grab sampling, lab confirmation, or client-defined QA/QC protocols.

Sensor Portfolio - Ammonia (NH_3)

Ammonia sensors support monitoring of ammonia-related emissions and events in wastewater, agriculture, composting, refrigeration, chemical processing, industrial operations, indoor/facility environments, and odour-adjacent applications.

ESI treats ammonia as a specialty electrochemical gas sensor because monitoring needs can vary widely by site. Some projects require low-range sensitivity for ambient or community monitoring, while others require higher-range detection for industrial, process, or safety-related applications. For this reason, ESI offers multiple NH_3 sensor options to match the expected concentration range and monitoring objective.

Sensor Type - Electrochemical

ESI's ammonia monitoring uses electrochemical sensing technology. Electrochemical NH_3 sensors are compact, low-power, and suitable for continuous field monitoring. They are selected based on the expected ammonia concentration range, required resolution, deployment environment, and project-specific data needs.

Unlike criteria pollutants, ammonia does not have the same widely used EPA-style air sensor benchmark framework for metrics such as R^2, RMSE/nRMSE, MAE, bias, and precision. ESI therefore evaluates NH_3 using a fit-for-purpose approach that may include sensor specifications, calibration checks, lab review, field comparison, co-location where available, QA/QC, event detection, and project-specific thresholds.

Ammonia - Importance to Air Quality

NH_3 — Ammonia	A reactive gas associated with wastewater, agriculture, composting, fertilizer use, refrigeration, industrial processes, chemical handling, and odour-adjacent conditions. NH_3 monitoring supports emissions screening, site investigations, facility monitoring, community impact assessment, and operational decision-making.

Ammonia - ESI Sensor Specifications

Sensor	Range	Resolution	Sensitivity	Lower Detection Limit	Best suited for
NH_3 — Option1	0 to 20 ppm	0.1 ppm	0.150 ± 0.035 μA/ppm	0.08 ppm	Lower-range monitoring where sensitivity to smaller NH_3 changes is important.
NH_3 — Option2	0 to 100 ppm	0.2 ppm	0.135 ± 0.035 μA/ppm	0.08 ppm	General-purpose ammonia monitoring across moderate concentration ranges.
NH_3 — Option3	0 to 200 ppm	1 ppm	0.090 ± 0.018 μA/ppm	0.08 ppm	Higher concentration environments where wider range is more important than fine resolution.
NH_3 — Option4	0 to 500 ppm	0.5 ppm	0.035 ± 0.015 μA/ppm	0.08 ppm	Industrial or process-related applications where elevated ammonia concentrations may occur.

Option selection: NH_3 sensor option should be selected based on expected concentration range, resolution needs, deployment environment, potential interferences, and project objectives.

Performance basis: NH_3 performance is evaluated using sensor specifications, sensitivity, detection limit, calibration checks, field QA/QC, and project-specific validation where required. For projects where NH_3 is a primary decision parameter, ESI can support additional validation through co-location, reference comparison, grab sampling, laboratory confirmation, or client-defined QA/QC protocols.

Benchmarking note: Ammonia does not have the same EPA-style air sensor performance benchmark framework as criteria pollutants. Where needed, ESI may apply internal high-performance targets using metrics such as R^2, RMSE/nRMSE, MAE, bias, repeatability, response time, detection limit, and event correlation.

Sensor Portfolio - Oxygen (O_2)

Oxygen sensors support monitoring of oxygen concentration in industrial, combustion, process, indoor, safety-related, and general gas detection applications. ESI treats O_2 as a specialty gas parameter because it is often used to understand oxygen availability, combustion conditions, enclosed-space conditions, and process environments rather than ambient air quality alone.

O_2 monitoring can support applications such as industrial monitoring, combustion control, medical or laboratory environments, food industry applications, and general gas detection. The uploaded SGX Sensortech datasheet identifies the oxygen sensor as suitable for medical, industrial, combustion control, food industry, and general gas detection applications.

Sensor Type - Electrochemical / Solid Polymer Electrolyte

ESI's oxygen monitoring uses an electrochemical oxygen sensor based on solid polymer electrolyte technology. The sensor measures oxygen through a catalytic reaction that generates a small current proportional to the oxygen concentration.

This technology is suitable for compact, low-power oxygen monitoring and offers high sensitivity with very low cross-sensitivity from other gases.

Oxygen - Importance to Air Quality

O_2 — Oxygen	Supports monitoring of oxygen concentration in industrial, combustion, process, indoor, enclosed-space, and safety-related environments. O_2 data can help interpret combustion conditions, air availability, process performance, and general gas detection context.

O_2 — ESI Sensor Specifications

Sensor	Range	Resolution	Sensitivity	Lower Detection Limit
O_2 — Oxygen	0 to 25% vol	0.01% vol	0.2 ± 0.03 nA/ppm	≤0.5% vol

Application note: O_2 is not typically used as a general ambient air quality pollutant measurement. It is most useful in industrial, combustion, process, enclosed-space, and safety-related monitoring contexts where oxygen concentration provides operational or environmental context.

Sensor Portfolio – Other Pollutants/Gases

NO • C_2H_4 • HCHO • IAQ • Cl_2 • EtOH • H_2 • RESP

Other electrochemical gas sensors support specialized monitoring applications where the target gas is tied to industrial activity, combustion, process emissions, indoor air quality, chemical handling, safety screening, or project-specific environmental investigations.

These sensors are grouped separately from criteria pollutants because they are typically used for application-specific monitoring, rather than broad ambient air quality benchmarking. Performance expectations may vary depending on the target concentration range, site conditions, gas interferences, calibration approach, and monitoring objective.

Sensor Type – Electrochemical

ESI's other gas sensors use electrochemical sensing technology. Electrochemical sensors are compact, low-power, and responsive to specific gas families, making them suitable for distributed monitoring across industrial, facility, community, mobile, and project-based deployments.

For these specialty gases, ESI evaluates performance using a fit-for-purpose approach that may include sensor specifications, calibration checks, QA/QC review, co-location where available, reference comparison, response behaviour, event detection, and project-specific thresholds.

Pollutants – Importance to Air Quality

Sensor	Description
NO — Nitric Oxide	A combustion-related gas associated with vehicles, engines, industrial combustion, and process emissions. Useful for source investigations, roadway studies, and combustion-
C_2H_4 — Ethylene	Relevant for industrial, agricultural, storage, process, and combustion-related monitoring applications.
HCHO — Formaldehyde	Important for indoor air quality, material emissions, industrial activity, and facility monitoring.
IAQ — Indoor Air Quality	Supports general indoor and facility air quality screening where multiple gas signals may be relevant.
Cl_2 — Chlorine	Used for chlorine-related risk screening in water treatment, chemical handling, industrial, and facility environments.
EtOH — Alcohol / Ethanol	Supports process monitoring, indoor/facility screening, vapour detection, and project-specific applications.
H_2 — Hydrogen	Used in energy, battery, industrial, safety, and process-related monitoring contexts.
RESP — Respiratory Irritants	Supports screening of irritant gas conditions relevant to exposure, facility conditions, and environmental health investigations.

Performance & Benchmarking Note

Unlike criteria pollutants, many specialty electrochemical gases do not have a single widely adopted EPA-style benchmark framework for air sensor performance. ESI therefore evaluates these sensors using a fit-for-purpose benchmarking approach based on the application, site conditions, target gas, and available reference data.

Where applicable, ESI may apply internal high-performance targets using metrics such as R^2, RMSE / nRMSE, MAE, bias, repeatability, response time, detection limit, cross-sensitivity review, and field comparison.

Sensor Portfolio - Other Pollutants/Gases

NO • C_2H_4 • HCHO • IAQ • Cl_2 • EtOH • H_2 • RESP

Pollutants - ESI Sensor Specifications

Sensor	Range	Resolution	Accuracy	Lower Detection Limit
NO — Nitric Oxide, Option1	0 to 20 ppm	0.1 ppb	±1%	0.02 ppm
NO — Nitric Oxide, Option2	0 to 200 ppm	0.01 ppm	—	0.01 ppm
C_2H_4 — Ethylene	0 to 100 ppm	0.1 ppb	±1%	0.02 ppm
HCHO — Formaldehyde	0 to 20 ppm	0.1 ppb	±1%	0.05 ppm
IAQ — Indoor Air Quality	0 to 100 ppm	0.1 ppb	±0.5%	0.2 ppm
Cl_2 — Chlorine	0 to 20 ppm	0.1 ppb	±2%	0.02 ppm
EtOH — Alcohol / Ethanol	0 to 1000 ppm	0.1 ppb	±1%	1 ppm
H_2 — Hydrogen	0 to 250 ppm	0.1 ppb	±1%	1 ppm
RESP — Respiratory Irritants	0 to 20 ppm	0.1 ppb	±1%	0.02 ppm

Option selection: For gases with multiple options, such as NO, sensor selection should be based on expected concentration range, required resolution, and project objectives.

Cross-sensitivity: Electrochemical sensors may respond to interfering gases depending on site conditions. ESI can apply calibration, QA/QC, reference comparison, and interpretation methods to support defensible use of the data.

Application note: For projects where a specialty gas is a primary decision parameter, ESI may support additional validation through co-location, reference comparison, grab sampling, laboratory confirmation, or client-defined QA/QC protocols.

Sensor Portfolio - Noise Monitoring

Noise • Microphone Options • Certified Noise Configuration

Noise monitoring supports measurement of sound levels from transportation, construction, industrial activity, community environments, facilities, and temporary project sites. ESI treats noise as a separate environmental factor because it is a physical impact, not a chemical air pollutant.

Depending on the project objective, ESI can support either a standard onboard noise sensor configuration or a higher-specification dedicated noise monitoring configuration such as the Svantek SV 307A.

Sensor Type - ECM or Dedicated Noise Monitor

ESI's standard noise option uses an Electret Condenser Microphone (ECM) for continuous environmental sound level monitoring.

For projects requiring a certified environmental noise monitoring configuration, ESI may use the Svantek SV 307A. Svantek describes the SV 307A as a Class 1 noise monitoring station with PTB type approval and compliance with IEC 61672.

Svantek Noise Monitoring Station Class 1 SV 307A

Noise — Importance to Environmental Monitoring

Standard Noise Sensor	Supports continuous sound level monitoring for general environmental, facility, traffic, construction, and industrial applications.
Certified Noise Configuration	Supports higher-confidence environmental noise monitoring where Class 1 / certified sound measurement is required. Can support identification of noise events, time-of-day patterns, exceedances, and community impact periods.

Noise Sensor Specifications — Standard Configuration

Sensor	Technology	Measurement Range	Frequency Range	Measurement Error
Noise	Electret Condenser Microphone (ECM)	30 dBA to 130 dBA	20 Hz to 20 kHz	±1.5 dB

Sensor Portfolio – Noise Monitoring

Noise • Microphone Options • Certified Noise Configuration

Optional Certified Noise Configuration — Svantek SV 307A

Feature	Specification / Capability
Configuration	Class 1 environmental noise monitoring station
Standards	IEC 61672-1:2013 Class 1; IEC 61260-1:2014 Class 1
Type Approval	PTB Type Approval
Microphone	Patented MEMS microphone
Linear Operating Range	30 dBA Leq to 128 dBA Peak
Total Measurement Range	23 dBA Leq to 128 dBA Peak
Internal Noise	Less than 23 dBA Leq
Frequency Range	20 Hz to 20 kHz
Weighting Filters	A, B, C, Z, LF
Time Constants	Slow, Fast, Impulse

External Sensor Note: This sensor is externally attached to the ESI device or in a standalone configuration.

Standard vs. certified configuration: The standard ESI noise sensor is suitable for general environmental sound monitoring. Where regulatory, planning, or high-confidence environmental noise assessment is required, ESI can support a certified noise monitoring configuration such as the Svantek SV 307A.

Svantek Integration: Svantek is a strategic noise monitoring partner of ESI. Where required, ESI can supply and integrate Svantek noise instruments, including certified noise monitoring configurations, into ESI-supported environmental monitoring deployments.

Sensor Portfolio - Vibration

Vibration • Motion • Structural / Equipment Activity

Vibration sensors support monitoring of movement, impact, equipment activity, construction effects, blasting-related activity, transportation influence, and operational conditions. ESI treats vibration as a separate environmental factor because it measures physical motion rather than a gas or particulate concentration.

Vibration monitoring can support construction sites, demolition, mining, quarries, industrial operations, transportation corridors, equipment monitoring, and community impact investigations.

Sensor Type - MEMS Accelerometer

ESI's vibration monitoring uses MEMS accelerometer technology. MEMS sensors measure acceleration and movement across selectable measurement ranges, allowing the sensor configuration to be matched to the expected vibration environment.

The ESI sensor is an integrated motion-tracking sensor with a programmable accelerometer full-scale range of ±2g, ±4g, ±8g, and ±16g.

Vibration — Importance to Environmental Monitoring

Vibration	Supports monitoring of physical movement, impacts, equipment activity, construction activity, traffic influence, blasting-related activity, and industrial operations. Vibration data can help identify event patterns, operational impacts, and potential community or infrastructure concerns.

Vibration Sensor Specifications

Sensor	Technology	Measuring Range	Measurement Resolution	Best Suited For
Vibration	MEMS	±2g	0.000061 g/LSB in ±2g mode	Lower-level vibration monitoring where finer resolution is preferred.
Vibration	MEMS	±4g	0.000122 g/LSB in ±4g mode	General vibration monitoring for moderate movement or activity.
Vibration	MEMS	±8g	0.000244 g/LSB in ±8g mode	Higher-activity environments such as construction, equipment, or industrial operations.
Vibration	MEMS	±16g	0.000488 g/LSB in ±16g mode	High-impact or high-movement environments where wider range is required.

Selectable range: The vibration measurement range should be selected based on the expected vibration intensity, monitoring objective, installation method, and site conditions.

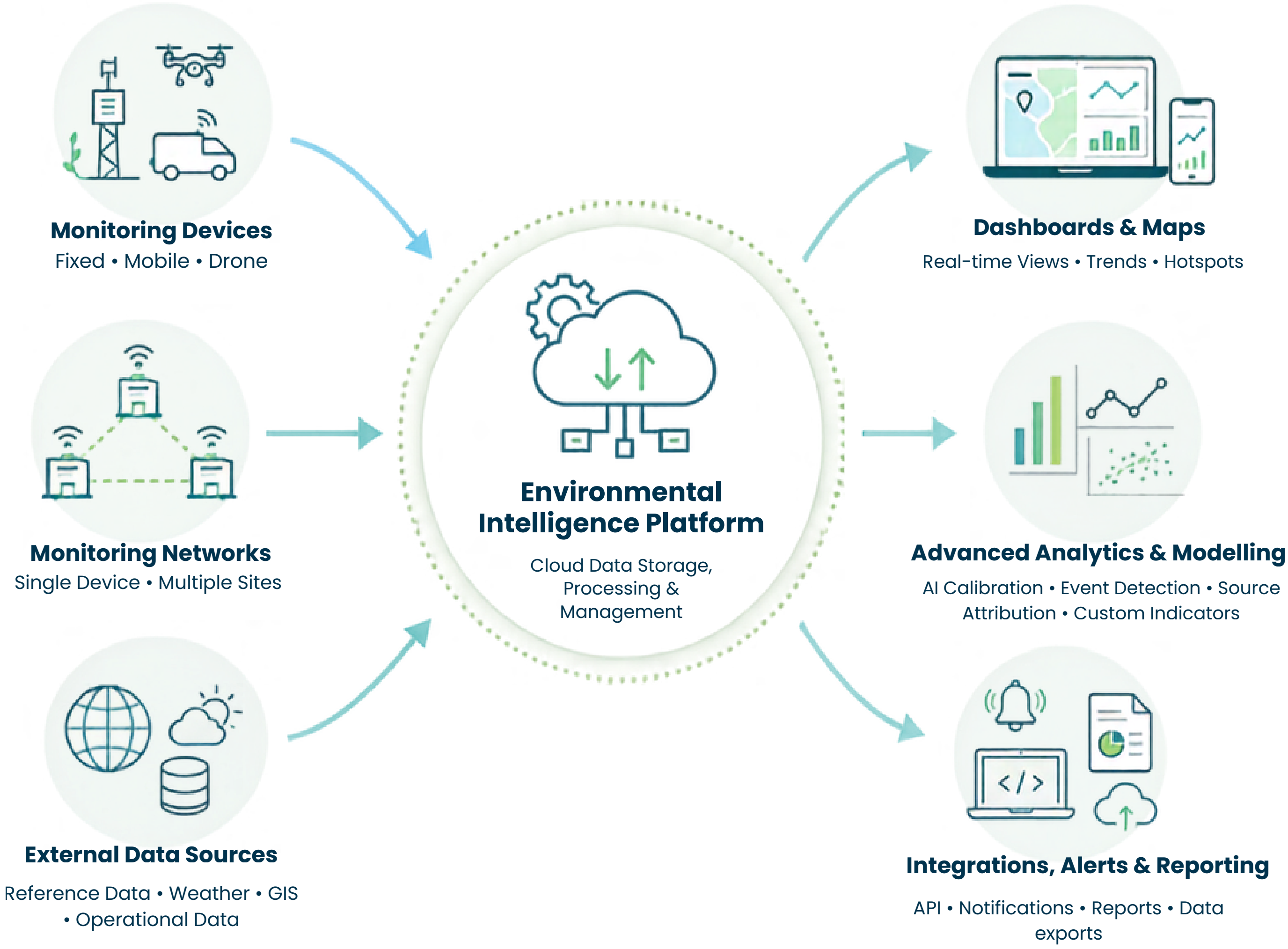
Performance basis: Vibration performance is evaluated using sensor specifications, installation checks, baseline comparison, event detection, threshold review, time-pattern analysis, and project-specific QA/QC.

Application note: Vibration data can be combined with noise, particulate matter, meteorology, GPS, equipment activity, and time-of-day patterns to support broader environmental impact analysis.

Data Pipeline - From Monitoring to Decision Support

ESI's data pipeline connects field measurements to actionable environmental intelligence. Data collected from ESI devices is transmitted securely into the Lumina platform, where it can be reviewed, quality-checked, visualized, analyzed, reported, and used to support operational or compliance-related decisions.

This pipeline is designed to help clients move from raw environmental measurements to trusted insights that support faster response, better planning, and clearer communication.



Real-Time Data Flow
Supports live monitoring from distributed devices and project sites.

Offline Data Protection
Data stored locally during communication interruptions and upload when connectivity returns.

Device Health Monitoring
Tracks connectivity, GPS location, sensor status, power status, and data transmission.

Quality Review
Applies QA/QC checks to support defensible interpretation and reporting.

Integrated Context
Combines pollutant data with meteorology, GPS, time patterns, source context, and project metadata.

Client Outputs
Supports dashboards, maps, alerts, exports, APIs, automated reports, and compliance-support summaries.

ESI does not stop at data collection.
The full pipeline is designed to capture, protect, review, analyze, and communicate environmental data so clients can understand site conditions and act with confidence.

Patented Technology - AI Powered Sensor Calibration

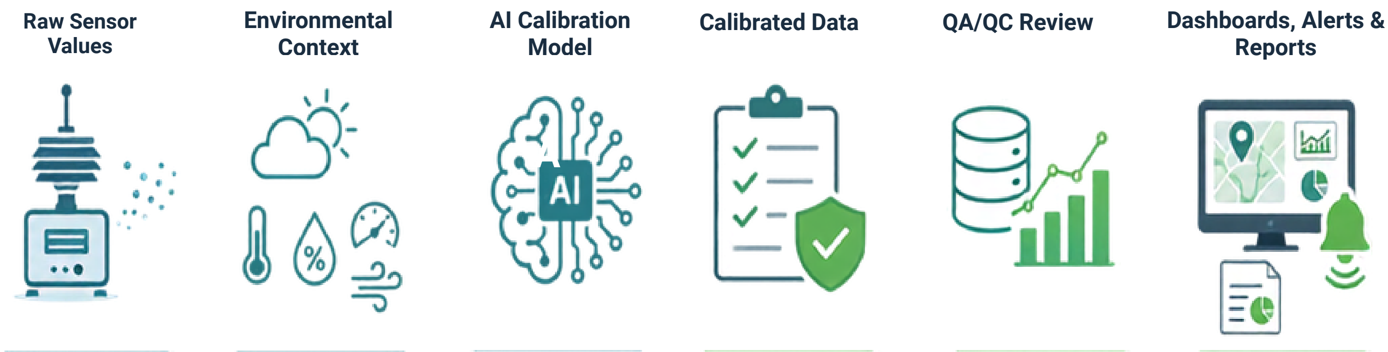
Improving raw sensor values for higher-confidence environmental intelligence

ESI's AI calibration capability helps improve sensor data quality by applying advanced calibration models to raw field measurements. Instead of relying only on factory sensor outputs, ESI uses data science, co-location results, environmental context, and sensor behaviour patterns to improve the accuracy, consistency, and usability of monitoring data.

This capability is especially important for distributed environmental monitoring, where sensors operate across changing temperatures, humidity, pollutant mixtures, seasons, locations, and field conditions.

AI-Powered Sensor Calibration

Capability	What It Supports
Raw Signal Correction	Improves raw sensor values using calibration models trained against reference or comparison data where available.
Environmental Adjustment	Accounts for factors such as temperature, humidity, pressure, and changing field conditions that may affect sensor response.
Cross-Sensitivity Management	Helps reduce the influence of interfering gases or environmental effects where model inputs allow.
Sensor Drift Review	Supports identification and correction of gradual sensor response changes over time.
Multi-Site Learning	Uses lessons from co-location studies and field deployments across different environments to strengthen calibration workflows.
Higher-Confidence Analytics	Provides cleaner inputs for dashboards, alerts, event detection, source attribution, reporting, and decision-support tools.



AI calibration helps turn raw sensor signals into more reliable environmental data
By combining sensor measurements, environmental context, field benchmarking, and machine learning, ESI improves the quality of data used for monitoring, alerts, analytics, and client decision-making.

Performance Benchmarking

ESI continuously evaluates sensor performance through co-location studies, controlled testing, and field deployments across different locations, climates, pollutant profiles, and monitoring applications. This ongoing benchmarking process helps ensure that ESI data remains reliable, defensible, and suitable for real-world environmental decision support.

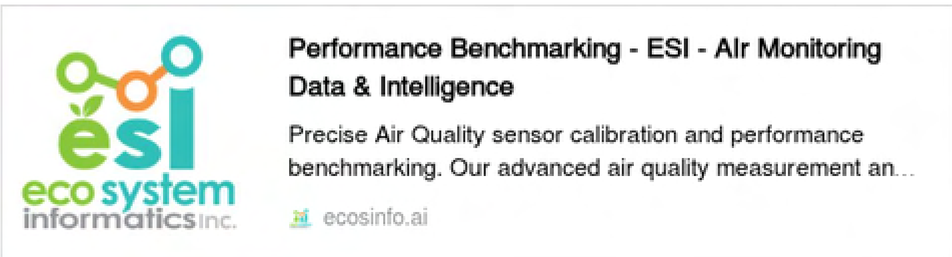
Co-location studies compare ESI sensor outputs against reference or near-reference monitoring equipment where available. These studies support performance review using metrics such as correlation, error, bias, precision, detection limits, data completeness, and response behaviour.

Performance Approach

Method	Purpose
Reference Co-location	Compare ESI sensors against reference-grade or near-reference instruments.
Multi-Site Testing	Evaluate performance across different geographies, climates, and pollutant conditions.
QA/QC Review	Identify anomalies, drift, missing data, sensor response issues, and environmental effects.
Performance Metrics	Review R^2, RMSE / nRMSE, MAE, bias, precision, lower detection limits, and data completeness where applicable.
Model Refinement	Improve calibration and analytics models using real-world comparison data.

Latest Co-Location Results

For additional and latest co-location study results, please visit:



Performance Benchmarking - ESI - Environment Monitoring Data & Intelligence

Compliance with US EPA Targets

EPA-style target values are used as a performance benchmarking reference for applicable air sensors. This does not imply U.S. EPA certification, endorsement, approval, or regulatory equivalency. Performance benchmarking is sensor-specific and depends on deployment conditions, reference availability, pollutant type, calibration approach, and project objectives.

ESI Compliance with US EPA Target Values for Co-Location Benchmarking

Environmental Intelligence Platform

ESI's Intelligence Platform turns environmental sensor data into real-time insight, operational awareness, alerts, maps, analytics, and reporting. The platform connects ESI's monitoring hardware, sensor portfolio, data pipeline, QA/QC workflows, and client dashboards into one integrated system.

The platform is designed to help clients move beyond raw measurements. It allows users to understand what is happening, where it is happening, when it is changing, and what action may be required.

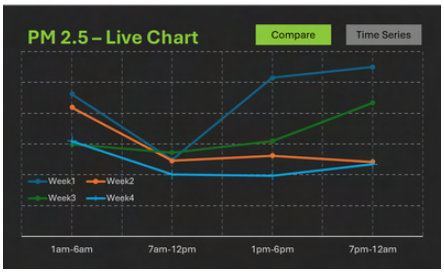
Platform Capability	What It Enables
Real-Time Monitoring	Live visibility into air quality, emissions, odours, meteorology, noise, vibration, and device status.
Interactive Mapping	Location-based views of fixed, mobile, drone, fence-line, and source-based monitoring data.
Dashboards & Trends	Time-series charts, pollutant trends, site comparisons, device views, and project-level summaries.
Alerts & Notifications	Threshold alerts, exceedance notifications, event detection, methane / odour / dust alerts, and device-health alerts.
QA/QC & Data Review	Data completeness checks, anomaly flagging, sensor status review, calibration support, and performance tracking.
Analytics & Indicators	Custom indicators such as dust risk, combustion readiness, odour events, methane events, source attribution, and device health.
Reporting & Export	Automated reports, CSV exports, API access, compliance-support summaries, and client-ready visual outputs.

The cloud platform connects monitoring, analytics, and action.
It gives clients a single platform to manage environmental data, understand site conditions, detect events, support reporting, and make faster, better-informed decisions.

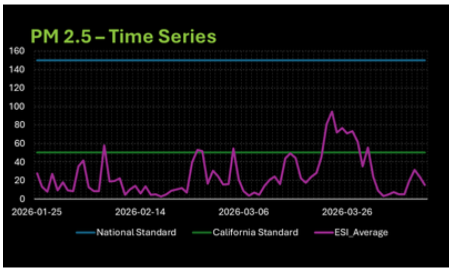
Maps, Alerts & Reports

The ESI cloud intelligence platform gives clients a clear way to view, interpret, and act on environmental monitoring data. Instead of reviewing raw sensor outputs across separate files or systems, users can access real-time dashboards, interactive maps, event alerts, trend views, and client-ready reports through one platform.

This page highlights the main tools clients use day to day to understand site conditions, identify issues, communicate results, and support operational or compliance-related decisions.

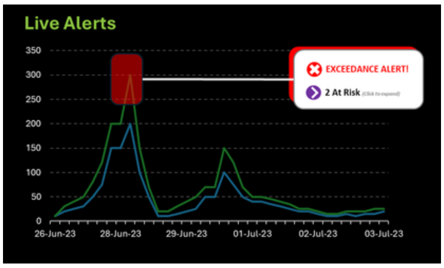


Live Dashboards

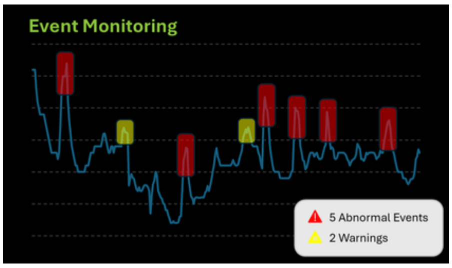


Time-Series Trends

Interactive Maps

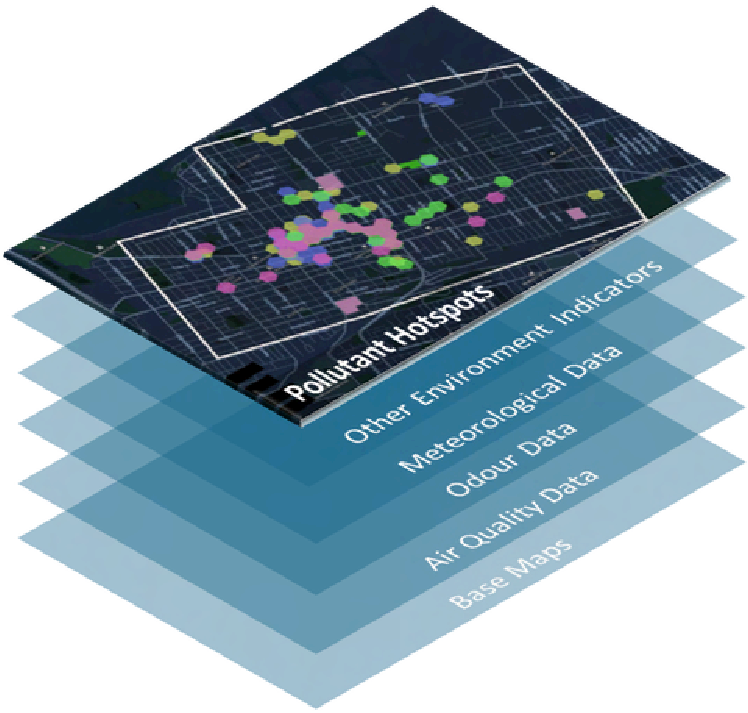


Threshold Alerts

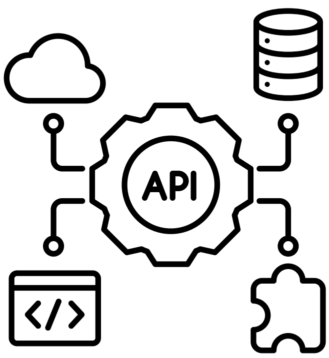


Event Detection

Custom Reports



Layered Insights



Data Export & API

Advanced Intelligence - Hotspot and Heat Island Analytics

Turning spatial monitoring data into clear maps of priority areas

ESI's hotspot analytics capability helps clients identify areas where pollutant levels, odours, dust, temperature, or other environmental conditions are consistently elevated. By converting monitoring data into intuitive maps and spatial outputs, ESI supports faster interpretation of complex datasets and helps clients focus attention on the locations that matter most.

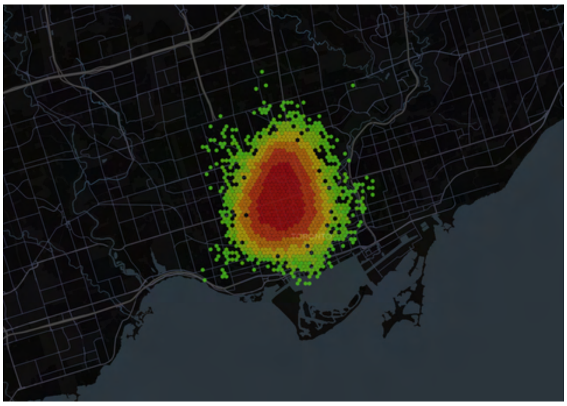
This capability is especially useful for urban air quality studies, heat island analysis, mobile monitoring, community exposure mapping, road corridors, industrial fence-lines, construction sites, mining areas, and complaint investigations.

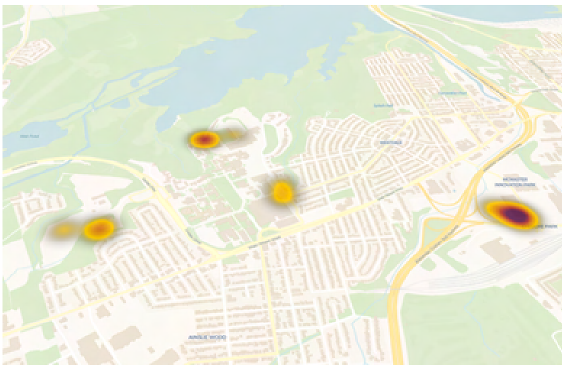
Methodologies Used

Capability	What It Supports
Local Moran's I	Identifies clusters of similar or dissimilar values, including high-high hotspots and low-low cold spots.
Z-Score Analysis	Highlights values that are significantly higher or lower than the average.
Percentile Thresholding	Identifies the highest or lowest percentage of values to focus on priority areas.
H3 / Spatial Grid Analysis	Organizes data into geographic grid cells to support clean spatial comparison and mapping.

What This Enables

Capability	Supports
Hotspot Detection	Identify areas with elevated pollutant, dust, odour, or temperature readings.
Heat Island Mapping	Locate areas with higher temperature patterns across urban or site-specific environments.
Spatial Pattern Analysis	Compare conditions across neighbourhoods, routes, facilities, receptors, or project zones.
Time-Based Mapping	Review hotspot patterns by date range, time interval, or selected hours.
Decision-Ready Visuals	Create maps that help clients understand where impacts are occurring.
Targeted Action Planning	Support inspections, mitigation, monitoring placement, community reporting, or operational response.





Advanced Intelligence - Methane LDAQ

Leak Detection, Quantification & Analytics

ESI's Methane LDAQ capability supports methane leak detection, emissions screening, source investigation, and operational response for oil and gas, landfill, wastewater, industrial, and other methane-relevant sites. Methane is a high-priority greenhouse gas and a key focus area for emissions reduction programs.

Performance Approach

Capability	What It Supports
Leak Detection	Identify methane events, elevated readings, and repeatable patterns that may indicate a leak or emission source.
Quantification Support	Estimate or support estimation of methane event magnitude using concentration data, wind, GPS, source context, and project methodology.
Source Localization	Use wind direction, device location, mobile routes, drone data, and site layout to identify likely source areas.
Event Analytics	Distinguish short-term spikes, recurring events, background changes, and operationally relevant methane patterns.
Alerts & Reporting	Generate methane event summaries, alerts, inspection triggers, and reporting outputs for operational or emissions programs.

Measure → **Contextualize** → **Detect Events** → **Localize Sources** → **Support Quantification** → **Report & Act**

- **Measure**: Collect methane / flammable gas data from fixed, mobile, drone, or site-based deployments.
- **Contextualize**: Combine methane data with wind speed, direction, GPS, time patterns, site layout, and operational context.
- **Detect Events**: Identify methane elevations, repeatable patterns, and potential leak-like signatures.
- **Localize Sources**: Use spatial and meteorological patterns to identify likely source direction or source area.
- **Support Quantification**: Apply project-specific methodology to support emissions estimation or prioritization.
- **Report & Act**: Provide alerts, event logs, maps, dashboards, and decision-support outputs.

ESI's methane capability has been demonstrated through the Alberta Methane Emissions Program (AMEP), with results available through the published **ESI AMEP Final Report**. This can be referenced as supporting evidence for ESI's methane monitoring, deployment, and performance evaluation experience.

Note: Methane LDAQ is project-specific. Detection, localization, and quantification confidence depend on sensor configuration, wind conditions, deployment method, source access, background methane levels, monitoring duration, and available validation data. ESI can configure methane programs for screening, event detection, source localization, operational response, or emissions-support workflows depending on client objectives.

Advanced Intelligence - Emissions Flux Mapping

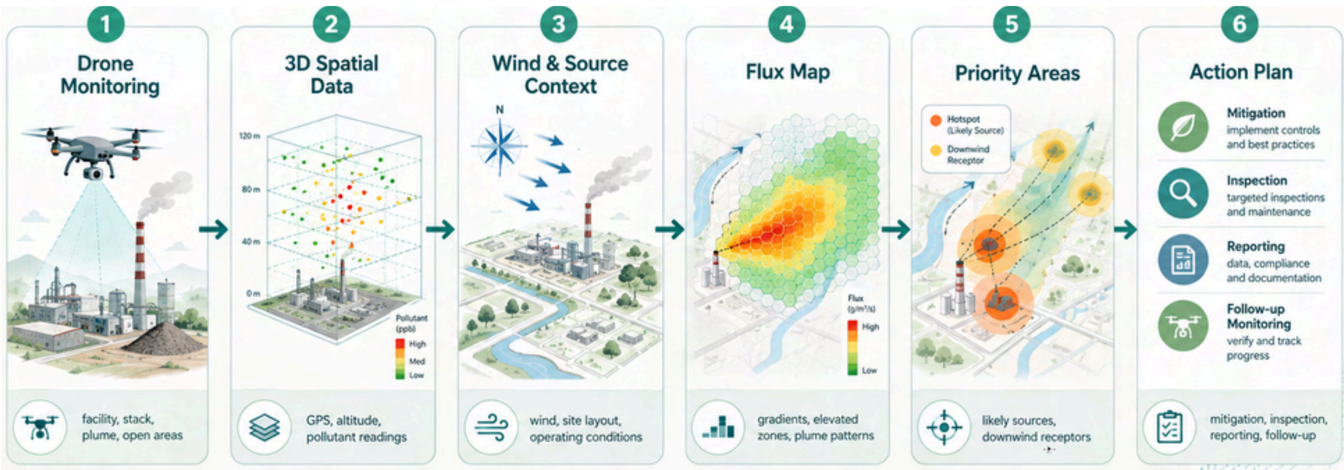
Drone-enabled emissions intelligence for hard-to-map sources

ESI's emissions flux mapping capability uses drone-based monitoring to collect high-resolution environmental data around facilities, stacks, process areas, and diffuse emission sources. By collecting data in three-dimensional space, ESI can help clients better understand where emissions are moving, where concentrations are elevated, and how pollutants may be affecting surrounding areas.

This capability is especially useful for industrial facilities, cement plants, mining operations, landfills, wastewater facilities, oil and gas sites, remediation areas, and other sites where fixed monitoring alone may not capture the full emissions picture.

What It Enables

Capability	What It Supports
Drone-Based Data Collection	Capture emissions data across vertical, horizontal, and hard-to-access areas.
Flux Mapping	Visualize how pollutant concentrations vary across space and near potential source areas.
Diffuse Source Assessment	Support evaluation of emissions from open areas, process zones, stockpiles, tanks, vents, or facility boundaries.
Stack & Source Screening	Assess emissions patterns near primary stacks and other facility sources.
Community Impact Insight	Better understand potential movement of emissions toward nearby communities or sensitive receptors.
Targeted Investigation	Identify priority areas for follow-up monitoring, maintenance, mitigation, or source control.



Advanced Intelligence - Modelling

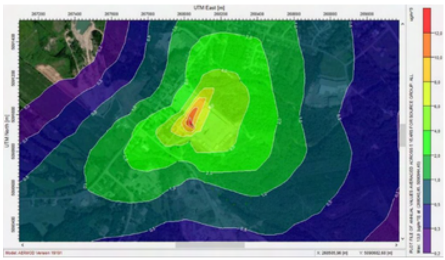
Understanding how pollutants move, where impacts may occur, and what actions can reduce exposure

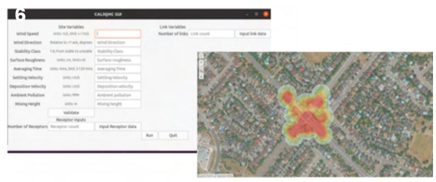
ESI's modelling capability helps clients understand how emissions, odours, dust, and other pollutants may travel from a source to surrounding areas and the impacts of traffic related emissions. By combining real-time monitoring data, meteorology, source information, site context, and modelling tools, ESI can support impact analysis, source investigation, scenario planning, regulatory-support studies, and community communication.

This capability connects ESI's field monitoring strengths with advanced interpretation: measure what is happening, model where it may go, and support decisions on what to do next.

Modelling Tools & Use Cases

Capability	What It Supports
Gaussian Plume Modelling	Quick, non-regulatory screening to estimate basic pollutant movement from a source.
CALINE3	Roadway and highway-related air pollution concentration modelling, including transportation planning scenarios.
AERMOD	U.S. EPA-developed model commonly used for regulatory air dispersion applications, typically for impacts within shorter regional distances.
HYSPLIT	NOAA-developed model used for larger-scale dispersion and forward / reverse trajectory analysis.
CALPLUFF	Advanced puff dispersion model for longer-distance, non-steady-state conditions and complex meteorology.
MOVES	Roadway and highway-related air pollution concentration modelling, including transportation planning scenarios.





What This Enables

Capability	Supports
Odour & Dust Dispersion	Movement of odours, PM, and dust from site sources.
Source Impact Analysis	Potential impacts on communities and sensitive receptors.
Scenario Modelling	Comparison of mitigation, traffic, expansion, or operating scenarios.
Complaint Investigation	Wind- and source-aligned review of measured events.
Regulatory Support	Permitting, reporting, planning, and technical review.
Decision Visuals	Plume maps, hotspots, receptors, and scenario outputs.

Advanced Intelligence - InService Emissions Monitoring

Real-world emissions testing for vehicles, fleets, mobile equipment and small-scale stacks

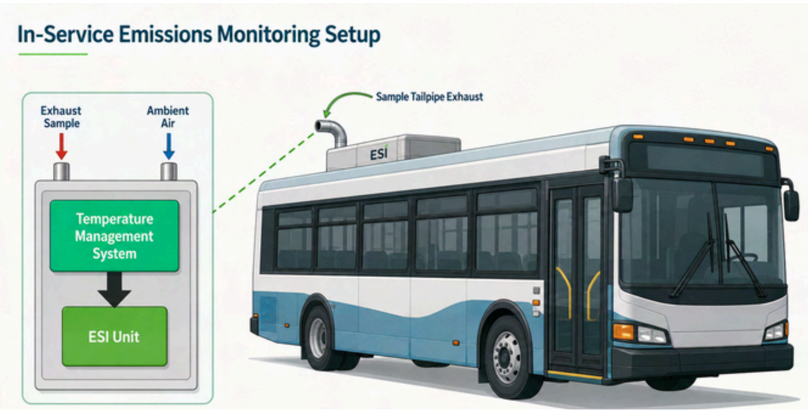
ESI's in-service emissions intelligence capability brings emissions testing out of controlled laboratory environments and into real-world operating conditions. Using custom mobile monitoring configurations, ESI can capture emissions data while vehicles or equipment are operating normally, helping clients understand actual emissions performance under real duty cycles, routes, loads, seasons, and operating conditions.

This capability is especially relevant for transit fleets, heavy-duty vehicles, municipal fleets, construction equipment, mining vehicles, port equipment, industrial mobile assets, and small-scale stacks such as diesel generators and waste incinerators.

Performance Approach

Capability	What It Supports
Real-World Emissions Testing	Measures emissions during normal operation, rather than relying only on controlled laboratory or certification results.
Mobile & Stationary Source Monitoring	Supports testing of vehicles, equipment, auxiliary systems, generators, heaters, boilers, incinerators, and other small-scale combustion sources.
Operational Performance Insight	Helps clients understand how emissions change under real routes, loads, duty cycles, seasons, and operating conditions.
Fleet & Equipment Screening	Identifies high-emitting vehicles, aging assets, inefficient equipment, or sources that may require maintenance or replacement planning.
Secondary Source Testing	Captures emissions from auxiliary systems such as onboard heaters or other non-primary combustion sources.
Benchmarking & Reporting	Compares measured emissions against certified values, expected outputs, internal baselines, or project-specific performance targets where applicable.

ESI conducted an in-service emissions testing case study for heavy-duty transit buses in Baltimore. The project evaluated real-world tailpipe emissions across buses from model years 2010 to 2024, using phased deployment to capture a broader fleet dataset across different seasons and operating conditions. The work also included testing onboard auxiliary heating systems, which can create independent emissions even on electric buses that use diesel-powered auxiliary heaters.



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