MEASUREMENT & ANALYTICS

Predictive Emission Monitoring Systems (PEMS)

Accurate, compliant, machine learning-based solution reducing lifecycle costs

ABB couples its comprehensive CEMS offering with future-proof Predictive Emission Monitoring Systems (PEMS), to bring you the largest range of solutions tailored to cover the needs of any emission monitoring application.

ABB PEMS leverages the most advanced machine learning algorithms to ensure your emission data delivers best-in-class availability, reliability and accuracy.

ABB PEMS helps you comply with regulations while reducing investment and optimizing implementation and maintenance activities.

Measurement made easy.

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Predictive Emission Monitoring Systems (PEMS)

Emission monitoring made easy

Plant owners and operators are facing many challenges to improve efficiency and operations. ABB PEMS solutions makes emission monitoring easy.

Introduction
Sustainability is a key strategic pillar for all companies. This reflects the need to minimize environmental footprint and effectively measure and report emissions from the production sites.

At ABB, we embed sustainability in everything we do in order to create long-term value. This starts with helping our customers reduce their emissions and preserve resources. We recognize that it represents one of the top priorities for modern industry.

You cannot reduce what you don't measure

ABB Predictive Emission Monitoring Systems (PEMS) responds to industry needs by providing compliance with international, national and local environmental directives for emission monitoring and reporting.

The challenge
Plant owners and operators face a number of challenges that affect the operations and the productivity of their facilities: e.g. tightening environmental regulations. e.g. tightening environmental regulations and emission limit, reducing plant work force, etc.

Additionally customers are focused on reducing operational costs and bridging the skills gap as a result of an aging workforce. Finding solutions to address these challenges is becoming increasingly important.

The solution
PEMS address these challenges in an effective way and delivers on ABB's promise to make measurement easy.

PEMS is an example of how digital technologies and machine learning provide the solutions to help customers be more sustainable.

It is a software-based system, able to estimate pollutant concentrations through advanced models and machine learning algorithms.

Emission estimations are provided by PEMS models exploiting the correlations existing between process variables (e.g. flow, temperature, pressure, etc.), ambient conditions and emissions (i.e. NOx, SO2, CO, CO2, etc.).

PEMS provide accurate emission monitoring - comparable with conventional hardware analyzers - while reducing CAPEX and OPEX as well as minimizing process downtime.

PEMS help plant operators achieve regulatory compliance:

- As a primary source without investing in CEMS hardware
- As a cost effective backup of existing CEMS, increasing availability

Market leader in emission monitoring
Decades of soft sensor experience

ABB has a long history in developing model-based solutions, dating back to the early 2000s. Proving successful in oil & gas, pulp and paper, power industry, leveraging a dedicated and proprietary software solution – Inferential Modeling Platform (IMP).

As a market leader in emission monitoring applications, ABB has recognized the challenges customers face and identified the possibilities provided by latest machine learning algorithms in order to launch a new, more complete version of IMP tailored for PEMS applications, enriched with best-in-class modeling techniques and specific features in order to meet the evolving regulation requirements.

ABB's approach to PEMS
ABB provides comprehensive PEMS solutions offering turn key services to customers, from design to implementation of the PEMS system.

ABB identified empirical (also known as “data-driven”) models as the most effective approach for PEMS implementation. In particular ABB has standardized Neural Networks as the modeling algorithm for PEMS applications as they proved to be the most effective and robust in terms of both reliability and accuracy.

ABB PEMS is a robust and reliable solution. Tried and tested in the field, the solution meets the requirements of US-EPA 40 CFR 60 Performance Specification 16 and Technical Specification TS-17198, the latest European specification dedicated to PEMS applications.

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01 ABB your partner of choice for increased accuracy & efficiency

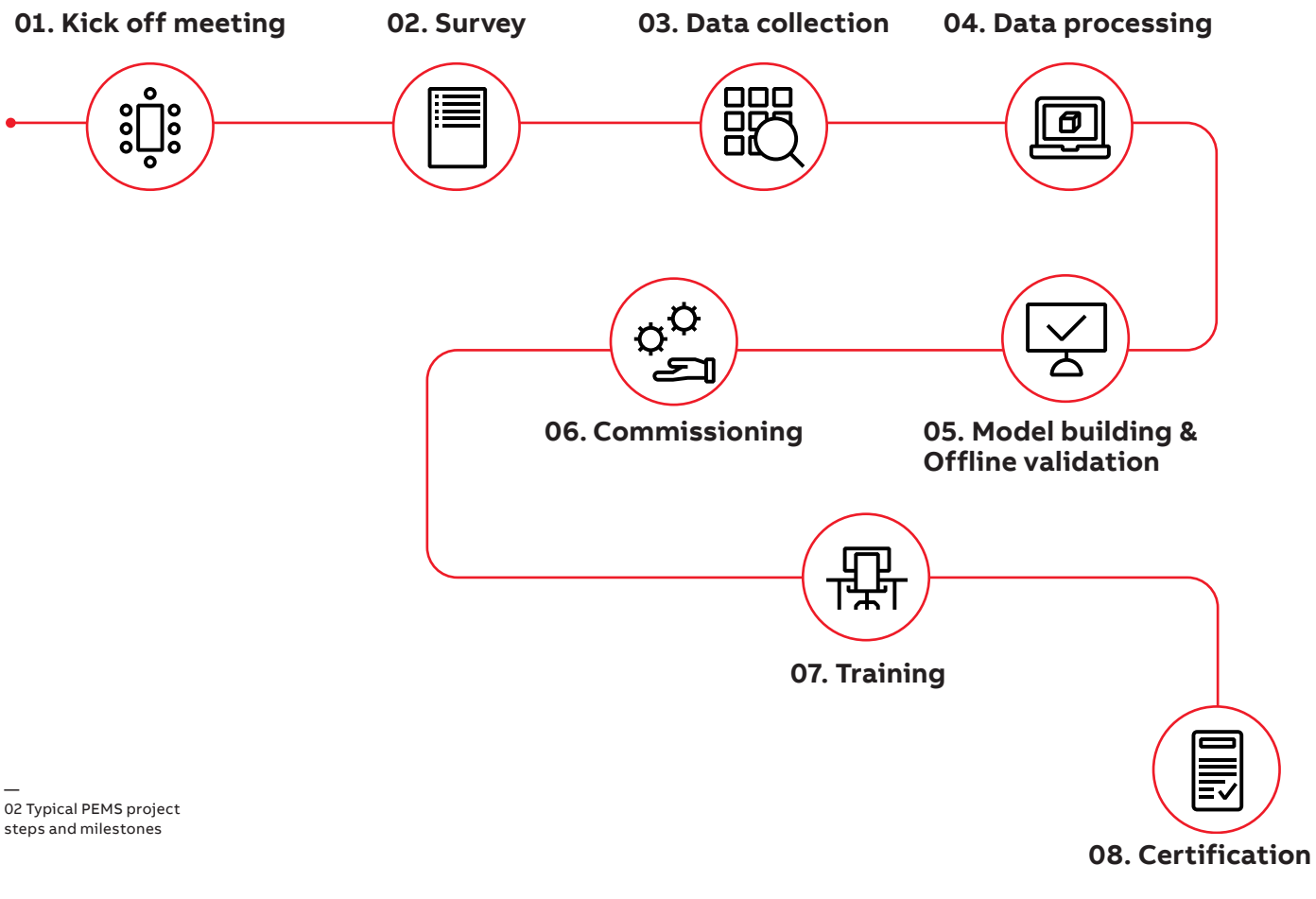
Your partner of choice for PEMS
Develop, deploy and maintain

ABB provides comprehensive PEMS solutions, including hardware and software, engineering services, installation & commissioning and complete lifecycle support.

ABB provides professional training opportunities to up skill staff to ensure safe operation of PEMS solutions.

A team of dedicated experts are available to support and guide customers through every step of a PEMS project including consultancy services for feasibility studies and installation evaluation, as well as comprehensive on-site and after sales services.

ABB can take care of initial data-collection services and final validation with the support of approved third-party labs and stack testing companies.



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02 Typical PEMS project steps and milestones


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Inferential Modeling Platform (IMP)
PEMS implementation made easy

ABB IMP software has been developed over decades with modeling applications in mind and provides specific functionalities for effective and robust soft sensor applications. It provides an easy-to-use, powerful and efficient tool to develop and deploy advanced mathematical models. On top of best-in-class features for a variety of virtual sensor applications, IMP delivers PEMS specific functionalities prescribed by environmental regulations.

Advanced pre-treatment of input variables

Advanced ML algorithms for model development

Quick & intuitive configuration of PEMS

Seamless integration through OPC protocol

Process emission data

Best-in-class sensor validation routines

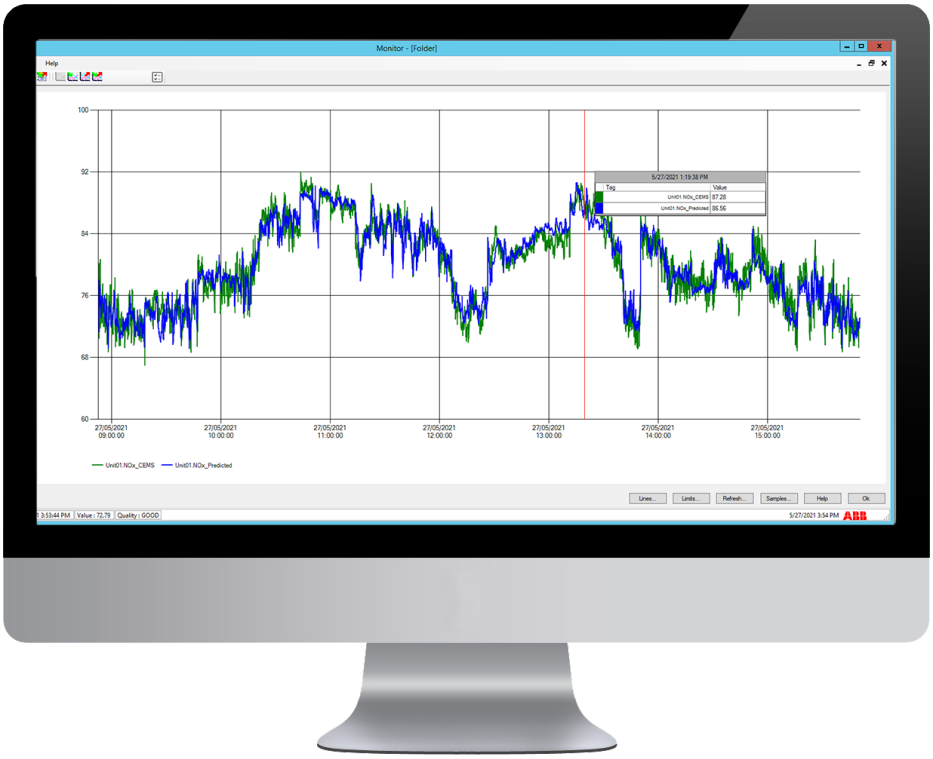
The foundation of PEMS applications

IMP support PEMS implementation from initial steps of the project, up to commissioning and on-line operations:

- IMP secures efficient data processing through dedicated routines and statistical features
- Several outstanding machine learning algorithms are available to develop predictive models
- Advanced regulatory compliant functionalities support PEMS operations to ensure availability and reliability
- Intuitive interface makes easy PEMS implementation and deployment
- IMP passed the rigorous ABB protocol for cybersecurity and complies with most recent cybersecurity standards

Top-class perfomance

ABB PEMS solutions are typically based on Neural Networks algorithms that proved to deliver the highest accuracy, robustness and reliability.



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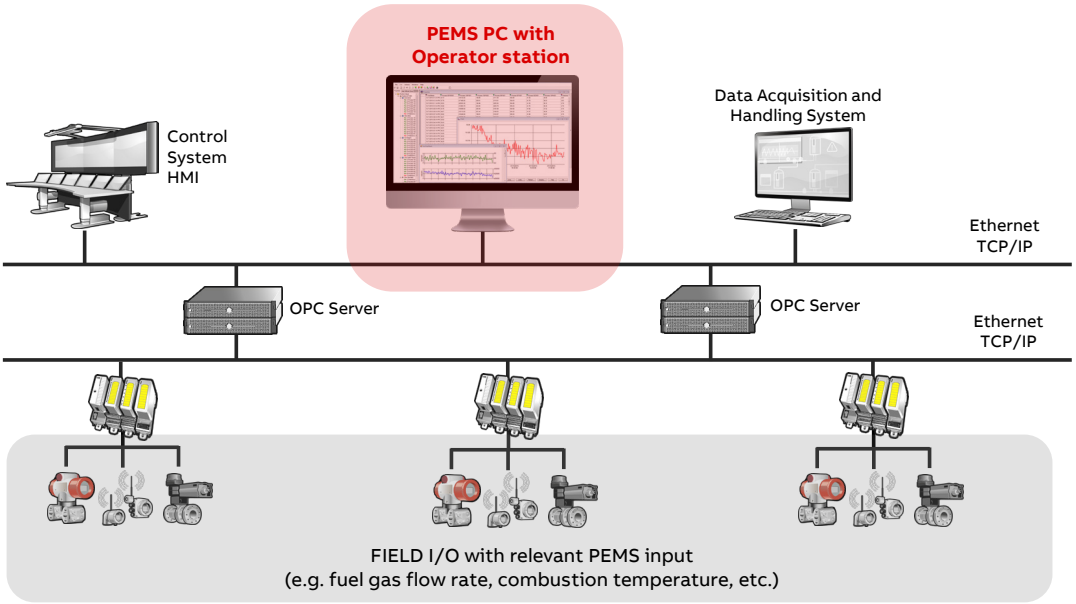
03 IMP-based neural networks provide great accuracy against conventional HW analyzers

PEMS deployment details

ABB PEMS on-site implementation is made easy by IMP standard OPC connection: it allows a seamless integration with plant control systems and other automation platforms in order to exchange real-time data.



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04 PEMS input are acquired through OPC connection with plant DCS

IMP calculates predictions and emission values are made available for further processing

Advanced functionalities
Availability made easy

Sensor validation (SV) algorithms to ensure quality data
IMP software provides the latest machine learning algorithms to protect customers' PEMS solutions from failures in the input sensors.

SV system meet the strict requirements of the latest environmental regulations (i.e. US EPA Performance Specification 16, EU TS-17198).

SV verifies in real-time the consistency of PEMS inputs before feeding to PEMS models and - in case of a fault - replace them with reconciled value. SV prevents PEMS using a non reliable value that would jeopardize the quality of the emissions.

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Sensor Validation enhances the robustness of PEMS leading to 99.5% of quality assured data

SV system provides you with two key advantages:
- It secures PEMS uses only reliable values, keeping PEMS output accurate and quality assured
- It acts as a maintenance trigger providing an early alarm enabling prompt corrective actions

Model Integrity Test (MIT)
IMP has built-in Model Integrity Test routines aimed at verifying the consistency of PEMS models in accordance with legislation requirements:
- Periodically set of known input and output data are injected to each PEMS model
- IMP verifies that the same expected output is reproduced.
- In the case of test failure, IMP raises an alarm to properly trace and inform the user.

The MIT functionality is fully configurable, allowing the user setting the MIT performance at desired time interval, from a daily basis standard up to minutes frequency in order to accommodate more stringent and recurrent verifications.

Traceability
IMP tracks all the modifications in the configuration to protect PEMS application from any possible issue and manipulation.

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05 In case sensor reading deviates from actual process value, without Sensor Validation PEMS models would be fed with unreliable values (red line) until a maintenance is performed on the sensor. SV allows identifying the divergence and compensates it by replacing PEMS input values with reconciled data. In addition, raising a timely alarm, SV provides valuable information to the maintenance team anticipating the fault identification.

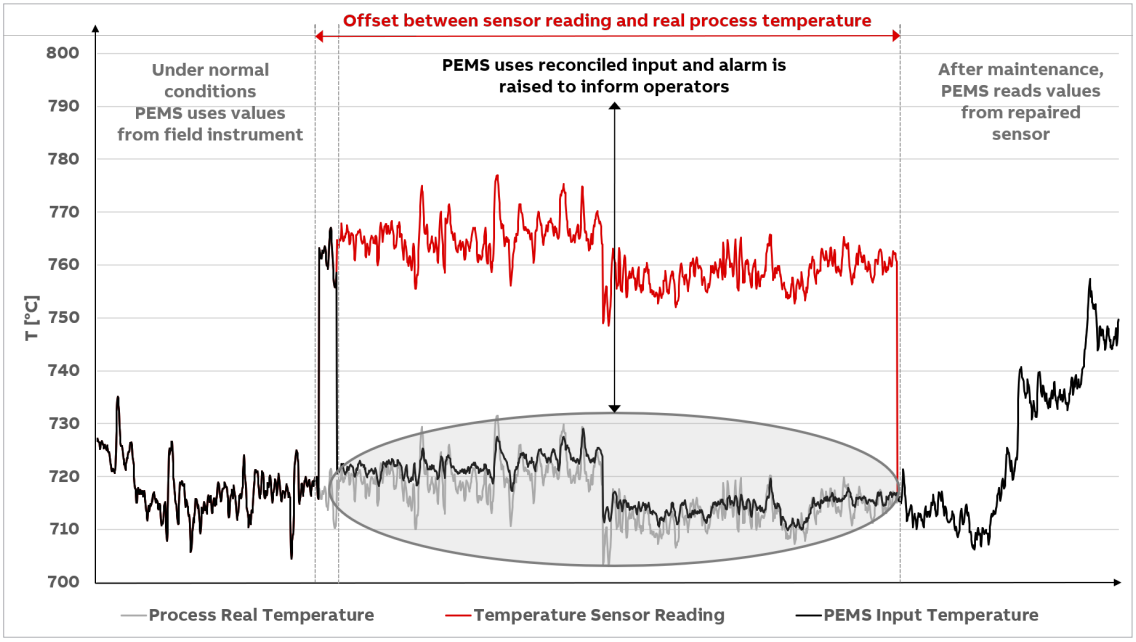

ABB PEMS Solutions
Customer value

Accuracy and reliability
PEMS provides same accuracy as conventional CEMS solutions with extended availability (up to 99.5%).

Affordable and no unexpected costs
Most effective emission monitoring technology in terms of initial investment right through the entire lifecycle. No unexpected failures enables tight control over OPEX.

Environmental regulations compliant
PEMS implementation follows legislation requirements and IMP software is continously updated to meet evolving standards.

Cybesecurity
IMP complies with present requirements and industry standards.

Compact solution
ABB PEMS requires just a PC connected with the control system. It does not require additional field devices or dedicated cabinets.

Smart and non-invasive technology
Unlike CEMS hardware, PEMS does not require difficult-to-maintain infrastruture such as sample extraction and conditioning systems.

Quick delivery time
Projects can be completed within a few weeks. The commissioning follows the model building phase, avoiding any delay.

What-if analysis
PEMS models developed with IMP can be used off-line in order to simulate emission behavior at varying process conditions, analyzing the effect of each parameter on emissions.

Minimal maintenance
Does not require specific maintenance. Only a periodic recalibration may be useful to ensure optimal performance over extended periods.

No consumables and spare parts
As a software solution, PEMS does not require any specific spare components saving warehouse & maintenance costs.

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