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Dust and Opacity Monitoring Trends in Stacks

Focusing on the Asian Market

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This thesis was conducted for MIP Electronics OY for market research into their dust and opacity monitors. The interest of this subject came about during my working period with MIP and with the prospect of a joint Tekes project.
The goal of this thesis work was to investigate where in Asia to invest and general trends in Asia concerning dust and opacity monitoring in order to further develop MIP's own dust and opacity monitors. The theoretical portion of this thesis consists of two sets: first, proper conduction of market research, techniques and the divisions of marketing research, and secondly, a SWOT analysis and influencing factors.
The practical portion of this thesis describes the application of the marketing research and the examination and comparison of environmental legislation trends in 6 countries. With the research the main competitors and their products were identified.
The results of the market research concluded that MIP should target their product marketing with specific models aimed for individual countries.
The final portion offers strategies for product development and the products to target to each country examined.

Keywords	dust, opacity, continuous monitoring, stack emissions

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1 Introduction

MIP Electronics Oy is an electronics reseller and manufacturer located in Kerava, Finland. This thesis was contracted to study the feasibility of investing in the Asian market when environmental legislation, competitors, and other influencing factors are examined. In this thesis, marketing research techniques are applied and the legislative trends of six different countries are examined in order to create a comprehensive strategy for MIP to be able to take forward and present for an upcoming project with Tekes.

2 Marketing Research

The objective of marketing research, or market research, is to find a real need and to fulfil the need in the most cost-effective and efficient manner. According to the American Marketing Association (2016, p.1), “marketing is the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large” whereas, marketing research is “the function that links the consumer, customer, and public to the marketer through information--information used to identify and define marketing opportunities and problems; generate, refine, and evaluate marketing actions; monitor marketing performance; and improve understanding of marketing as a process.” With marketing research, there is a process that is typically followed to achieve the most optimal results based on information and evaluation of said information. Or, in other words, market research is the process of collecting valuable information to determine if there is a market for a company’s product or service, or in MIP’s case, a specific market area.

2.1 Market Research Process

The process of market research involves different steps, and there are many types of market research. First, there is primary research. The goal of primary research is to gather as much information as possible by analyzing current sales and their effectiveness. This can be done through the following means:

- Interviews
- Surveys
- Focus groups asking for direct feedback

MIP chose the route of a survey to complete the research as the region of focus is not ideal for in-person interviews or focus groups.

Next is secondary research. This is research that requires analysis of data already published. With this, you can identify the competition and benchmark further, i.e. identifying your demographics/industries you should focus on. For the secondary research, the concentration is on competitor analysis and the legislative trends in the six countries of focus.

2.2 Techniques

Primarily the techniques in market research focus on three things: qualitative research, quantitative research, and secondary data analysis.

2.2.1 Qualitative

Qualitative research methods are conducted in a variety of ways. Primarily, they are number based and work through a deductive process. Data is collected through surveys, structured interviews and observations, as well as reviewing records or documentation for numeric information. Additionally, it is more objective, it provides observed effects of a program on a problem or condition. Qualitative research is less in-depth, but covers a larger amount of information. It allows only for fixed responses and uses statistics for analysis. This is a valid and reliable way of collecting data depending on the measurement device and sample size.

Since MIP has a relatively small customer base, structured surveys did not seem to fit the needs of MIP at this time. It was decided to send, instead, an open question in order to allow a variety of answers from current customers. When investigating a more structured survey, MIP felt that giving pre-written choices would limit the variety of answers and not allow survey takers the freedom to come up with original ideas for innovation. Since structured surveys were out of the question, MIP also considered having interviews with controlled topics and subjects, but again, with the small customer base, it did not seem viable to collect information in this manner.

2.2.2 Quantitative

Quantitative research methods are conducted in a less generalizable way. It primarily is an inductive process that is used to formulate a theory or hypothesis. It is best used in

situations where not very much information is known. It can help to generate hypotheses that can later be tested with quantitative methods. Generally, this method is less structured and more subjective. It often has open questions, is text-based, and had no statistical basis. This can be a valid form of research if conducted properly with a skilled researcher who can accurately identify trends and categorize the responses. Common criticisms to quantitative research are that it is difficult to tell if the findings are biased and if a small sample size creates a too generalized view of the results that may not reflect the overall population.

There are some ethical issues that are present with quantitative research methods which primarily fall onto the researcher. Tom Beauchamp and Jim Childress address four areas of concern all researchers should be aware of:

1. Autonomy/respect of the rights of the individual
2. Not doing harm, non-maleficence
3. Doing good, beneficence
4. Justice

Quantitative research methods were applied in this thesis work though open questions sent to our distributers on their experience with MIP Electronics' products as well as the areas of design or innovation that they would like to see.

2.2.3 Secondary Data Analysis

Secondary data analysis can be defined as using pre-existing data to analyze and evaluate how the data was collected in order to improve techniques and new data collection. The largest advantage to using secondary data is that the grunt work has already been completed and complied, and often larger scale research is available that may have been completed on a more professional level. All in all, secondary data analysis lets a researcher compare, become more familiar with, and organize their own research more effectively and efficiently.

3 SWOT Analysis and Influencing Factors

3.1 SWOT Analysis

Through using a SWOT analysis, you can identify a variety of factors within a process or product. SWOT is an acronym for "strengths, weaknesses, opportunities, and threats" of an organization. The use of this tool was helpful in providing a structure to

analyze MIP's dust and opacity monitors and gave a guideline for features and framework for assessing their monitors. A SWOT analysis is analytical and gives a company the framework needed to product an accurate representation of their product in comparison to similar products.

With a SWOT analysis, it allows a company to take information from an environmental analysis and then separate it into internal strengths and weaknesses, as well as, its external opportunities and threats. A SWOT analysis needs to assess the current status of the company and where the company may be positioned in the future. Once completed, a company can use the results of the SWOT analysis to determine what steps they should take to achieve their preferred results.

In order to achieve a successful SWOT analysis, it should be specific, avoiding any unclear language in relation to the competitor's products. By avoiding complex language, over-analysis, and keeping the descriptions short and simple, it allows for a clear comparison.

To further define the aspects of a SWOT analysis, a definition of strengths and weaknesses are needed. Strengths are easily defined as what an organization is great at, where they excel. It also includes their competitive advantages, an example in MIP's case would be that their dust and opacity monitors feature an easy filter audit without having to remove anything from the installation site, a feature that most competitors do not have. The strengths of the product are then used to plan how to attract a wider customer base or more investment into the product.

Next, what are weaknesses? Weaknesses prevent an organization from performing at their best level. A weakness hurts an organization's efficiency and may lead to giving a competitor an advantage or 'edge'. Once identified, organizations can use the information to minimize the weaknesses and analyze how they can improve.

Opportunities refer to external factors that an organization can utilize to their improvement and have the potential to create a competitive advantage, whereas, threats refer to the factors that can potentially have a negative impact on an organization.

3.2 Influencing Factors

There are many factors that influence the market research into dust and opacity monitors. First, are the legislative trends that vary in the Asian countries researched. Second, are the advantages specific to each country, such as infrastructure and economy. Last are the advantages and disadvantages to each distributer and reseller currently in each country.

3.2.1 Legislative Trends

The legislative trends are based on the collection of applicable law to stack emissions in select countries in Asia. Most legislation was provided by MIP Electronics' reselling network from the local employees. With the help of google translation and then the verification from native speakers that the information translated was correct, the legislation was evaluated for common trends in the legislation.

The primary research was conducted to see if individual countries in Asia are following pre-existing standards, for example US EPA standards, or if they were modelling their legislation from other sources. It was also important to note if legislative trends were heading towards smaller particulate measurement and if MIP Electronics should adjust its model accordingly.

3.2.2 Country Specific Advantages

When conducting market research, it is important to consider the advantages that are pre-existing. In the case of MIP dust and opacity monitors, the market that is being targeted is primarily Asia. The country specific advantages are what may exist when countries in Asia and compared to other markets. A large amount of competition for MIP stems from China. The primary reason that China is so competitive is their impressive labor productivity which has been increasing 11% from 2007-2012. China also still retains low wages, even after a yearly increase of an average of 12%. When this is compared to that of neighboring countries, such as Thailand, which had an 8% increase, and Indonesia, who only had an increase of 7% in productivity, it is clear that China is still holding onto the majority of the market.

3.2.3 Reseller / Distributor Advantages

Various factors can influence the advantages that a reseller or distributer may have in their region. In some cases, MIP Electronics has allowed for numerous resellers or

distributors to have the ability to sell within a country, whereas other resellers or distributers may have exclusive selling rights in an individual country. Some examples of this can be seen in India, which currently has three separate distributers located around the country, in comparison to Indonesia, which currently has a single distributer with exclusive selling rights.

Other advantages can stem from legislative requirements within their country or region. Countries that have new legislation entering into effect that require dust and opacity monitoring will have an advantage over counties in which it is not required or not in their legislation.

4 Application

4.1 Competitor Analysis

A competitor analysis is fundamental in understanding the market for a product or service. The competitor analysis was completed by first identifying the companies which produce similar products. Some were known from information received from current customers, others were identified by product information sent to the office. Lastly, competitors were identified through an internet search with keywords such as dust and opacity monitor, stack monitor, stack emission monitor, and opacity measurement.

4.2 Market Research Divisions

Market research is divided into four sub-groups: customer research, product research, distribution research, and legislative trends. These four sub-groups were chosen so that the SWOT analysis would, once completed, be as clear and simple as possible. Typically marketing research might only include customer and product research, or it can feature more sub-groups depending on the product or service.

4.2.1 Customer Research

When market research is being conducted, it is important to understand the customer base for a product. This can be achieved through a variety of ways; however, MIP chose to conduct primary research at this time and send out a questionnaire. MIP's dust and opacity monitors appeal to a very specific group of businesses and have specific applications, so the customer base is not large to being with. To have a better understanding of what the potential and current customers in the dust and opacity market

were interested in, MIP conducted an open survey, consisting of a single question, of where the current contacts would want to see improvement, innovation and new design features. Unfortunately, the current customer base was relatively inactive. All in all, five responses were received and all of which had a similar tone: develop a feature for a specific, uncommon use case. Due to the nature of the responses received, MIP concluded that the individual customers sought only to duplicate MIP technology at a cheaper price.

It is often that when market research is conducted, both primary and secondary research is included in the findings in order to utilize all available resources to generate a more comprehensive analysis. In the case of dust and opacity monitoring, specifically for stack measurement, there was not existing up-to-date secondary research that could be evaluated and included in this analysis.

4.2.2 Product Research

Product research is an extremely important aspect of any market research. This was conducted primarily through the research and evaluation of similar competitor products. All in all, 12 models from competitors were similar enough to the three different MIP dust and opacity monitors, and were used to compare and examine. By utilizing the data sheets from the competitor's products, comparisons of light source, measuring range, accuracy and certifications were made.

It is necessary to describe the key differences between each product to define the categories later used. The LM 3086 SE and LM 3086 EPA3 are extremely similar products with more or less the same functions and features. The primary difference between the two is the laser light source used in each and the certifications that they possess. The LM 3086 SE uses a red diode laser with synchronized pulse whereas the LM 3086 EPA3 uses a green LED, which falls within the EPA required 500-600nm frequency. Additionally, the LM 3086 SE is only TÜV certified and the LM 3086 EPA3 is US EPA certified. Aside from the difference in laser light source and their certifications, the SE and EPA3 models are extremely similar, possessing the same features such as data collection, dirty window correction, and easy filter auditing. The LM 3189 is their most simplified model, and is also their cheapest. The easiest way to describe it is what is does not feature in comparison to the other two models.

The LM 3189 does not feature the following:

- Data collection
- Filter auditing
- An automatic zero and span
- Dirty window correction
- A fail-safe shutter
- Or any certifications

All in all, the LM 3189 is a dust and opacity monitor at its most basic, intended for those who need a product for monitoring but not necessarily for any auditing.

Table 1: Comparison of features between MIP Electronics Oy products

Feature	LM 3086 EPA3	LM 3086 SE	LM 3189
Light Source	LED (500-700nm)	Diode laser synchro-nized pulse (655nm)	Red semiconductor laser (655nm)
Config.	Single-pass, dual-path	Single-pass, dual-path	Single-pass
Meas.dist.	0-20 m	0-20 m	0-20 m
Mod.light	Yes	Yes	Yes
Digital display	Yes	Yes	Yes
Data processing	RS 232	RS 232	RS 232
Data collection	Yes	Yes	No
Filter audit (w. all opt. comp. On site)	Yes	Yes	No
OP or density	OP 0-99 %	OP 0-99 %	OP 0-100 %
or mg/m3	D 0 - 3.0D	D 0 - 3.0D	D 0 - 1.0D, D 0 - 3.0D
	or mg/m3	or mg/m3	or mg/m3
Automatic zero and span	Yes	Yes	No
Meas.range	0 mg/m3 -	0 mg/m3 -	0 mg/m3 -20 g/m3
	10 g/m3	10 g/m3	depending on dis-tance
Accuracy	<0.5 %OP	<0.5 %OP	<5 % (against d value on lowest range)
Dirty window correc-tion	Automatic	Automatic	No
Fail safe shutter	Yes	Yes	No
Instrument Air or blower	Both 10 - 100	Both 10 - 100	10 l/min transmitter, 80 l/min receiver
Approvals, certs	TÜV, USEPA	TÜV	None

The majority of products did not fit the same capabilities of MIP dust and opacity moni-tors. The products were broken down into three categories: similar to LM 3086 SE & LM 3189, models that claim to be ‘EPA compliant’ but do not have certification, and

models comparable to the LM 3086 EPA3. This distinction was extremely important in completing the product research for MIP. From previous experience, customers believed that they were purchasing EPA compliant products (with certification) for a lower price, when in fact they were purchasing or receiving bids for a product comparable to MIP's LM 3086 SE.

When compared to other products on the market, MIP's dust and opacity monitors have clear advantages. For the LM 3086 SE, there were numerous models from competitors which were implying US EPA compliance. The primary reason these models are comparable to the LM 3086 SE is the simple fact that they do not have US EPA Certification. Another clear advantage that the LM 3086 SE possess is its simple filter auditing system, which allows for filter auditing without removing the monitors from the jig.

The LM 3086 SE had only a few competitor products that were comparable. The selection process was based on feedback received from resellers who believed that they were purchasing an EPA certified model, but were in fact purchasing a model that was only "compliant" (having features of an EPA certified model, but without the certificate). With this feedback, products on the market that labeled themselves as "EPA compliant" were chosen. The LM 3086 SE has all of the features of its EPA3 sibling, including a data processer, automatic zero, dirty window correction, a digital display and easy filter auditing, only with a different laser source and without an EPA certification. The LM 3086 SE does, however, feature a TÜV certification. A TÜV certification is issued by TÜV SÜD, a German based product testing and certification organization. TÜV certifications are based on standards set according to internationally recognized benchmarks; thus, this guarantees the quality of a product. Considering the similarities to the LM 3086 EPA3, which has the EPA certification but at a higher price point, MIP felt it was extremely important to identify the products who advertise as "EPA compliant" and compare them to the LM 3086 SE model.

Table 2: Comparison between models similar to LM 3086 SE

Feature	LM 3086 SE	Land 4500 MKII	Teledyne LightHawk Model 560	EMS422
Light Source	Diode laser (655nm)	Green Led (520 +-20 nm)	LED (500-600nm)	Green LED (500-600nm)
Config.	Single-pass, dual-path	Double-pass	Double-pass	N/A
Meas.dist.	0-20 m	0.7 .. 7 m	0,61-18,3m	0,6-4,6 m
Mod.light	Yes	Yes	N/A	N/A
Digital display	Yes	Yes	Yes	Yes
Data pro-cessing	RS 232	N/A	modbus, RS-232	MODBUS, RS-485, RS-232
Data collection	Yes	N/A	N/A	Yes
Filter audit	Yes	Yes	No	N/A
OP or density or mg/m3	OP 0-99 %, D 0 - 3.0D, or mg/m3	Opacity %, Opt.density, Dust mg/m3	Opacity %, Opt.density	Opacity %, Opt.density
Automatic zero and span	Yes	Yes (Retro re-flector excluded from zero)	manual on com-mand	Yes
Meas.range	0 mg/m3 -10 g/m3	0-100 % OP / 0-1.000 mg/m3		-5-100% OP
Accuracy	<0.5 %OP	<2 % Opacity	<2 % Opacity	+- 1%
Dirty window correction	Automatic	Automatic	Yes	N/A
Fail safe shutter	Yes	Yes	N/A	N/A
Instrument Air	Both 10 - 100	Blower	Blower	N/A
Enclosures Control Unit	N/A	N/A	0-40 C	0-50 degrees C
Enclosure Transceiver	N/A	-20-55 C	-32-60 C	-40-54 degrees C
Approvals, certs	TÜV	TÜV, MCERTS, EN61010-2, EN-50081, EN-50082	CE, ETL	ASTM D 6216 and 40 CFR 60 PS-1 Compliant
compliant w/ (not certified)		UPEPA PS-1, PS-11, ASTM D6216	US EPA Compliant	Meets PS-11 re-quirements 16295 USD starting price

Due to the strict nature of the US EPA requirements and certification process, the models comparable to the LM 3086 EPA3 are all very similar. The laser light source must be green and fall within the spectrum of 450-700nm to receive certification. It must feature a data processer, automatic zero, dirty window correction, a digital display and be able to be audited with a filter. The LM 3086 EPA3 has a distinct advantage with their easy filter auditing and their included fail-safe shutter (which protects the de-vice in the event of a pressure loss).

Table 3: Comparison between models similar to LM 3086 EPA3

Feature	LM 3086 EPA3	Durag DR290	Thermo EE Model 445	PCME Stack 710	SICK - dust-hunter T200
Light Source	Laser tube	Wide Band LED	LED	LED (525 +- 20)	Wide light LED (450-700)
Config.	Single-pass, dual path	Double-pass	Double-pass, single path	double-pass	Double-pass
Meas.dist.	0-20 m	1-12 m	0,5-15 m	1-10m	3 models: 0.5-2.5; 2-5; 4-12m
Mod.light	Yes	No			
Digital display	Yes	Yes	Yes	Yes	Yes
Data pro-cessing	RS 232	Bus interface for progr. & results	RS 232	RS 232, RS 485, modbus	RS232, RS485
Data collection	Yes		Yes	Yes	
Easy filter audit	Yes	No	No	No	No
OP or density or mg/m3	OP 0-99 %, D 0 - 3.0D, or mg/m3	OP 0..20…100 %, D 0-0.1 .. 1.6 Ext.	Opacity %, Mass Density	Opacity %, Opt.density	Opacity %, Dust mg/m4
Automatic zero and span	Yes	Yes	Yes (1-24 hours)	Yes (<10s-24h)	Yes
Meas.range	0 mg/m3 - 10 g/m3	0-200 mg/m3, 0-4000 mg/m3	0-100 % OP, 0-999 mg/m3	0-10% or 0-100%	0-100%, 0-10000mg/m3
Accuracy	<0.5 %OP	<2 % full scale	+-2 %	<2 % Opacity	+- 2%
Dirty window correction	Automatic	Yes			Has EPA lim-its,
Fail safe shut-ter	Yes	Optional			Yes
Instrument Air or blower	Both 10 - 100	Blower (80m3/h)	Blower (50-200 L/min)	Blower	Blower
Enclosures Control Unit	N/A	N/A	N/A	-20-55	-40-60 C
Enclosure Transceiver	N/A	-20-50 C	-40-125 F	-20-55 C	-40-60 C
Approvals, certs	TÜV, USEPA	TÜV, EPA, CE, MCERTS, PCT, EX	U.S. EPA incl. PS1, CE, TÜV (German Technical In-spection), Clean Air Act (13th Impl. Ord.), GOST	USEPA, ISO9001, UKAS7E-QUEENS AWARD	2001/80/EC 27. BImSchV, erman Clean Air Regula-tions, EN 15267, EN 14181, MCERTS, 2010/75/EU, U.S. EPA PS-1

When comparing models to the LM 3189, MIP stresses the features that the LM 3189 does not have. Since its conception, the LM 3189 was designed for those who need the most basic dust and opacity monitor. It features no certifications, no automatic zero, fail safe shutter, dirty window correction, or data collection; and this is what sets it apart from the competitor products.

Table 4: Comparison between models similar to the LM 3189

Feature	MIP LM3189	Codel CEM2100	SICK - dust-hunter T100	DataTest DT109S	Dynoptic DSL-220M	PCME Stack 602
Light Source	Red semi-conductor laser (655nm)	LED (637nm OR 580nm)	Wide band LED (450-700nm)	Tungsten lamp (400-700nm)	Green Led (510-540nm)	Green LED
Config.	Single-pass	Dual-beam	Double-pass	Single-pass	Single-pass	N/A
Meas.dist.	0-20 m	0,5-15 m	0.5-2.5; 2-5; 4-12m	1-10ft	0,5-5m	1-15m
Mod.light	Yes	Yes	N/A	N/A	N/A	N/A
Digital dis-play	Yes	Yes	Yes	Yes	Yes	Yes
Data pro-cessing	RS 232	RS232, RS485	TCP, OPC, RS485	RS 232, RS 422, RS 485	MODBUS, R485	RS485
Data collec-tion	No	N/A	N/A	N/A	Yes	Yes
Filter audit	No	No	No	No	No	No
OP or densi-ty, or mg/m3	OP 0-100 %, D 0 - 1.0D, D 0 - 3.0D, or mg/m3	% opacity, mg/m3, mg/Nm3	Opacity %, Dust mg/m3	Opacity %	Opacity %	Opacity %, Opt.density
Automatic zero & span	No	Yes	Yes	N/A	Yes	Yes
Meas.range	0 mg/m3 -20 g/m3	0-10 mg/m3 at 5 m	0-10000mg/m3	0-100 % OP	0-100 % OP	<10-1000mg/m3
Accuracy	<5 %	<0.2 % (OP)	+- 4%	<1% Opacity	<2 % Opaci-ty	N/A
Dirty window correction	No	No	No	No	No	No
Fail safe shutter	No	Yes	Yes	N/A	Yes	N/A
Instrument Air or blower	80 l/min receiver	1 l/sec/, 4 bar	Blower	Blower, 15cfm/port	Blower	Blower 30-60l /min
Enclosures Control Unit		-20-50 C	-40-60 C	-20-125 F	N/A	N/A
Enclosure Transceiver		-20-50 C	-40-600 C	-20-150 F	-20-55 C	-25-600 C
Approvals, certs	None	TÜV, MCERT	EN15267, EN14181		Lloyds type approval EVV1, ENV2, ENV3	TÜV, ISO9001, UKAS7E-QUEENS AWARD

Each of MIP's dust and opacity monitor models are made to work for different use cases and customer needs. The LM 3086 SE is a model for those seeking all of the features of an EPA compliant model, but are not in need of an EPA certification. The LM 3086 EPA3 fulfills the US EPA certification and the requirement of countries with legislation requiring such. Lastly, the LM 3189 is the most basic model for simple monitoring and has the lowest price point.

4.2.3 Distribution Research

MIP Electronics works on a network of distributers located worldwide. The majority of sales have been from India, with Hong Kong and Thailand following suit. Due to India having the most sales, it is clear that they hold the largest advantage in the eyes of MIP. India also currently has three distributers located in the country, each having their own regions in which they sell to. Hong Kong currently has only a single distributer; however, they have been consistent in generating new sales and have had consistent forecasts. Thailand is a relatively new distributor for MIP; they officially became a distributer of MIP products only last year but they have also been consistent in their forecasts. All in all, when determining the areas in Asia to research, the distributers were key in deciding the focus. The sales in the past five years have been from the following six countries: Hong Kong, India, Indonesia, Taiwan, Thailand and Vietnam. With the help of local distributers with acquiring local legislation and translation experience, the countries legislation and specific advantages were decided.

4.2.4 Legislative Trends

The legislative trends were examined to determine whether there would exist similar trends in a variety of countries within Asia that would benefit MIP Electronics to design their product improvements around. In total, only legislation from six countries was received that specifically targeted dust and opacity monitoring for stack emissions. The countries included Hong Kong, India, Indonesia, Taiwan, Thailand, and Vietnam.

4.2.4.1 By Country

4.2.4.1.1 Hong Kong

The authority that controls air pollution in Hong Kong falls to the Director of Environmental Protection. From 1 January 1999, no new legislation has come into force regarding stack emissions. The regulations apply specifically to the following industries:

- Coal-fired power plants which are equal or greater than 200MW (electrical output of aggregated generating capacity)
- Gas-fired gas turbines equal to or greater than 15MW (electrical output)
- Oil-fired gas turbines equal to or greater than 15MW (electrical output)
- Peak lopping plants equal or greater than 15MW (electrical output)
- Incinerators (such as municipal waste incinerators)
- Crematoriums

The emission limits for each industry regarding particulate matter are as follows:

Table 5: Particulate maximum limits in Hong Kong

Industry	Particulate max. limit (mg/m^3)
Coal-fired power plant	50
Gas-fired gas turbines	5
Oil-fired gas turbines	10
Peak lopping plants	5
Incinerators	10
Crematoriums	40

In Hong Kong, the required monitoring of stacks varies per industry. In the monitoring of coal-fired power plants, operators must track oxygen levels, carbon monoxide levels, particulates (opacity in the stack), sulfur dioxide levels, nitrogen levels, and the stack temperature. In gas-fired gas turbines and oil-fired gas turbines, operators must monitor nitrogen, sulfur dioxide levels, ammonia levels, oxygen, carbon, and the stack temperature. Whereas in peak lopping plants, no stack monitoring is required.

With incinerators (municipal waste incinerators), monitoring also varies from power plants and turbines. Operators of incinerators must monitor carbon monoxide, gaseous and vaporous organic substances, hydrogen chloride, hydrogen fluoride, nitrogen oxides, sulphur dioxide and particulates. To monitor the emissions of an incinerator, it is required to have continuous monitoring. Parameters that may be used in assessing the performance of air pollution control measures include, but are not limited to: pressure, water vapor content, and opacity of the exhaust gas.

For crematoriums, Hong Kong requires continuous monitoring which must be displayed in real-time. Complete real-time monitors must be available at each stack inside of each crematorium for continuous monitoring on both the emission limits mentioned above and all required parameters. Additionally, all continuously monitored readings must be recorded and displayed in real-time for the operators.

Additionally, in Hong Kong any malfunction and breakdown of the process or air pollution control equipment, which would cause exceedance of the emission limits or breaches of other air pollution control requirements, should be reported to the Director of Environmental Protection within three working days.

In Hong Kong, they do not stress the upgrading of units in order to fit current standards. Instead they allow the companies to upgrade older generation units to meet the new standards when it can be achieved both technically and economically.

4.2.4.1.2 India

In India, the general standards on environmental pollutants are from the Environmental (Protection) Rules from 1986, with the most recent amendment in 2005. The authority in India falls onto the Ministry of Environment, Forest and Climate Change.

India utilizes general standards to include all industries, and has expectations for specifically listed industries. This includes limits for effluences, water generation sites, load based standards, general emission standards, load/mass based standards and noise standards.

Table 6: Particulates maximum limit in India

Industry	Particulates max. limit (mg/Nm^3)
General limit	150
Calcinations processes (ex. Aluminum plants)	350
Thermal power plants	350
Lime kilns	500
New thermal power plants built from 2017	30

Overall, India has taken an approach of giving general standards and then chosen to give specific exceptions to industries where needed. Their standards make no mention of monitoring the opacity as a requirement, nor does it mention any form of an audit to track emissions.

4.2.4.1.3 Indonesia

The Indonesian government has decided to follow the United Nations Convention of Climate Change Framework from 1994 as its frame for environmental preservation. Indonesia has taken an interesting stance on how they measure environmental damage. They do not have guidelines for specific emission levels, amounts, etc.; instead they measure the concentration levels of various factors and their impact on surrounding flora and fauna. They do not have specific limits for particulates or opacity in stacks

for prevention, but instead push to penalize those who cause damage to the flora and/or fauna.

The general aim of Indonesia is to improve the welfare and quality of life for all of the people of Indonesia. They are fully aware of their large population growth rate, and want to limit the problems associated with a large population growth. All in all, they want to reduce the pressure of a large population on the natural resources and maintain as much as possible.

To prevent environmental damage, Indonesia wants to increase the understanding of laws, provide technical guidance, education and training, and incentives for those whom they considered instrumental to the economy. In order to assess the environmental damage, inspections are conducted every three months and anyone who has been determined to have damaged the environment is then given a penalty fee or service to complete.

4.2.4.1.4 Taiwan

The agency that governs emission monitoring in Taiwan is the Environmental Protection Administration. Due to their high levels of population, Taiwan has very strict standards when it comes to measurement and monitoring of stack emissions.

Taiwan requires the continuous and automatic monitoring of emissions. All stacks must come equipped with a data logger that track measurements and all measurements must be recorded. In stacks, the opacity must be calibrated manually or automatically recorded every 24-hours, to give an accurate zero-measurement.

The emission limits for particulate matter in stacks are as follows:

Table 7: Particulate maximum limits in Taiwan

Industry	Particulate max. limit (mg/m^3)
Coal-fired power plant	50
Gas-fired gas turbines	5
Oil-fired gas turbines	10
Incinerators	10
Crematoriums	40

In Taiwan, accuracy is key; they require specific installation practices, errors less than 10% and the difference between the measure opacity values at two or more sites to be less than 2%.

4.2.4.1.5 Thailand

The Royal Thai Ministry of Science, Technology and Environment (MOSTE) is Thailand's equivalent of the U.S. Environmental Protection Agency (EPA). In December 2001, the USA and Thailand entered an agreement in which they recognized the importance of joint environmental activities and protection.

Maximum emission levels, as per the US EPA National Ambient Air Quality Standards for Particulate Matter:

Table 8: Maximum particulate matter levels in Thailand.

	Averaging time	Level	Form
$PM_{2.5}$	24 hour	$35\mu g/m^3$	98^{th} percentile, average over 3 years
PM_{10}	24 hour	$150\mu g/m^3$	Not to be exceeded more than once/year on average over a 3-year period

The two sides supported cooperation to strengthen environmental policy-making, and the result lead to Thailand following the guidelines set by the US EPA, even surpassing the US by creating more strict standards for other areas of environmental protection.

4.2.4.1.6 Vietnam

In Vietnam, the Department of Science and Technology as well as the Ministry of Natural Resources and Environment are the authority for emission standards and regulation. The last legislation was amended in 2009 regarding national technical regulations for industrial gases, as well as dust for inorganic substances.

Vietnam follows ISO standards for emission monitoring. They make no mention of opacity; however, they do monitor concentration of dust and inorganic substances released into the air with ISO 5977:2005, which allows a maximum concentration of 200mg/Nm3 in industrial emissions for activities. Additionally, another used ISO standard refers to the concentrations of, for example, carbon monoxide or nitrogen oxide.

Unfortunately, these ISO standards are not in the scope of this thesis, as MIP does not currently, nor in the future, seek to invest into developing a device for concentration measurement.

4.2.4.2 Comparison to US EPA

The U.S. Environmental Protection Agency (EPA)

All in all, most of the countries evaluated have higher limits than the US EPA, or no defined limits with the same units as the US EPA.

The US EPA limits for particulate matter are listed below, and are also the same limits used by Thailand:

Table 9: Maximum particulate matter levels in the USA.

	Averaging time	Level	Form
$PM_{2.5}$	24 hour	$35\mu g/m^3$	98^{th} percentile, average over 3 years
PM_{10}	24 hour	$150\mu g/m^3$	Not to be exceeded more than once/year on average over a 3-year period

The US EPA's requirements for stack monitoring require the use of an opacity monitor. There must be continuous monitoring as well as recording and the device should have the following features: external calibration filter access, automatic zero, should present measurements as a percentage of opacity, and other features. Additionally, the EPA specifies that a quarterly audit must be performed and an annual zero-alignment audit should be conducted to evaluate whether there are unacceptable results.

Overall, the US EPA is generally more strict in comparison to the six countries examined, and the required monitoring would be more than necessary in most of the six countries evaluated.

5 Investment Strategy

The investment strategy will look at the results of the SWOT analysis, competitor analysis, market research divisions, as well as the legislative trends to offer a strategy for

MIP to further develop their dust and opacity monitors and improve their marketing in the Asian region.

5.1 SWOT Analysis

The results of the SWOT analysis were achieved utilizing the analysis of competitors, comparing the trends of environmental legislation in the six countries examined, and taking into consideration all of the advantages MIP has with their current dust and opacity monitors. The analysis of competitor products can be viewed in the attached appendices. The results of the SWOT analysis are presented below:

Strengths:

- Small company able to customize products to fit a client's needs
- Quality products for different levels of need
- Easy filter auditing – MIP's dust and opacity monitors are one of the few on the market with this technology

Weaknesses:

- High labor costs lead to expensive products
- Inability to compete with prices from some countries with cheaper labor

Opportunities:

- The business sector is expanding with a growing interest and need to monitor opacity and emissions
- Increased legislation and ever-developing regulation of emissions of stack gasses and particulate matter

Threats:

- Developments in emission monitoring may change to only cover concentrations, which in turn is a technology MIP does not currently have.

5.2 Strategies

A strategy is used to summarize the tactics and plans needed for an organization to reach their goals and improve or maintain their position in their industry. This will be broken down into three areas: product strategy, pricing strategy, and primary regions of investment.

5.2.1 Product Strategy

As a result of the SWOT analysis, as well as, the competitor analysis, MIP Electronics may decide to specialize in rapid response, high quality products, and customized products. MIP could also look to developing devices that can measure concentration levels and expand their market portfolio for monitoring equipment.

Marketing should be left to the reselling/distribution network as they are most familiar with the varying marketing trends in their regions. MIP should work to provide marketing material to resellers/distributors in order to support them in their sales process. Lastly, MIP Electronics should keep up-to-date with changes in technology where possible.

5.2.2 Pricing Strategy

MIP Electronics should seek to cut manufacturing costs where they can. This may include sourcing less expensive parts for their dust and opacity monitors or manufacturing their own parts. With the continuous development of manufacturing technology, MIP can look into, for example, 3D printing which could allow them to manufacture parts not previously possible to make in-house and lessen the amount of parts purchased.

Additionally, MIP should seek to push their “made-to-order” customization. With this, they would be able to further sell their higher pricing through fitting customer needs to a better degree than competitors.

As MIP Electronics already runs a relatively lean employee count, reduction in employees in not necessary. MIP should also focus on marketing their LM 3189 to resellers and distributer within countries without strict legislation, as the bare minimum is more than enough for their monitoring needs.

5.2.3 Primary Regions of Investment

The primary regions MIP Electronics should seek to invest in, from the six countries examined, are grouped based on the products that MIP manufactures and their features and certifications.

For the LM 3086 SE, MIP should consider Hong Kong, India, Taiwan and Vietnam. Each of these countries have specific limits for opacity monitoring, and most of the features of the LM 3086 SE, such as a data processer, automatic zero, dirty window correction, a digital display, and easy filter auditing. The do not, however, require EPA certification and in most cases the TÜV certification is more than enough, if certification is needed at all.

With the LM 3086 EPA3, MIP should invest into Thailand. Thailand is the only country, of the six countries studied, that is not only following US EPA legislation but working with the USA in developing their environmental protection legislation and even hoping to surpass the USA. The LM 3086 EPA3 features all of the requires of the US EPA as well as the official certification lacking from many cheaper models offered by competitors.

Finally, MIP should consider Indonesia for the LM 3189 model. As Indonesia has no specific limits set for emission monitoring during a process and they only measure concentrations of damage to the surrounding environment, more complex models like the LM 3086 SE and EPA3 are unnecessary. The LM 3189 is also the most affordable model.

6 Conclusion

The goal of this thesis work was to investigate where in Asia to invest and general trends in Asia concerning dust and opacity monitoring in order to further develop MIP's own dust and opacity monitors. With extensive research into the legislation of the region, competition, strengths and weaknesses of MIP, they produce quality products.

MIP electronics has significant potential in gaining further traction in Asia; their products have features and certifications that vary enough to fulfill the needs of most customers. MIP's small size also allows for them to listen to customer needs and offer solutions including customizing existing products for a better fit.

MIP should see to cut costs where they can, consider manufacturing their own parts, and continuously seek less expensive distributers of parts. The reselling/distribution network that MIP currently possess allows for a targeted sales force with the ability and understanding to sell to the customers in these regions.

With this research, it is clear that MIP should invest into developing their sales in the Asian market through targeting specific models that suit the needs of individual countries. With Tekes funding, MIP would be able to invest more into their reselling/distribution network to further support them in their sales process. Additionally, MIP could invest in more research and collection of environmental legislative changes so that they would be able to keep up-to-date on emission standards.

References

A Guidance Note on the Best Practice Mean for Electrical Works BPM 7/1(2014) Hong Kong. Available at: MIP Electronics Oy [Accessed 3 Dec 2016]

Air Pollution Control Act. Appendix 1 Particulate Pollutants Opacity Standardization Monitoring Facility. Taiwan. Available at: MIP Electronics Oy [Accessed 3 Dec 2016]
American Marketing Association, (2016). [Online] Available at: https://www.ama.org/AboutAMA/Pages/Definition-of-Marketing.aspx [Accessed 12 Jul. 2016]

Businessdictionary.com, (2016). [Online] http://www.businessdictionary.com/definition/marketing-research.html [Accessed 12 Jul. 2016]

ConsumerPsychologist.com, (2016) [Online] Available at: https://www.consumerpsychologist.com/cb_Research_Methods.html [Accessed 13 Aug. 2016]

Economist.com, (2016) [Online] Available at: http://www.economist.com/news/briefing/21646180-rising-chinese-wages-will-only-strengthen-asias-hold-manufacturing-tightening-grip [Accessed 5 Aug. 2016]

Federal Register Volume 78 Number 10 (Tuesday January 15, 2013). USA [Online] Available at: https://www.gpo.gov/fdsys/pkg/FR-2013-01-15/pdf/2012-30946.pdf [Accessed 3 Dec 2016]

Field Research MSF.org, (2014) [Online] Available at: http://fieldresearch.msf.org/msf/bitstream/10144/84230/1/Qualitative%20research%20methodology.pdf [Accessed 14 Jul. 2016]

Global OUP, (2016) [Online] Available at: https://global.oup.com/academic/product/principles-of-biomedical-ethics-9780199924585?cc=fi&lang=en& [Accessed 25 Jul. 2016]

Indonesian Government Regulation Number 4 (2001) Damage Control and or Pollution Environment. Indonesia. Available at: MIP Electronics Oy [Accessed 3 Dec 2016]

Investopedia.com, (2016) [Online] Available at: http://www.investopedia.com/terms/s/swot.asp [Accessed 5 Aug. 2016]

National Technical Regulations About Industrial Gases to Dust And Inorganic Substances, National Technical Regulation on Industrial Emission of Inorganic Substances and Dusts (NTR 19: 2009 / BTNMT). Vietnam. Available at: MIP Electronics Oy [Accessed 3 Dec 2016]

ORAU.gov, (2015) [Online] Available at: https://www.orau.gov/cdcynergy/soc2web/Content/phase05/phase05_step03_deeper_qualitative_and_quantitative.htm [Accessed 14 Jul. 2016]

Pestle Analysis, (2015) [Online] Available at: http://pestleanalysis.com/swot-analysis-definition/

Pyle, L.S. (2010). How to Do Market Research – The Basics. Entrepreneur.com, [Online] Available at: https://www.entrepreneur.com/article/217345 [Accessed 12 Jul. 2016]

Sociology.about.com, (2016) [Online] Available at: http://sociology.about.com/od/Research-Methods/a/Secondary-Data-Analysis.htm [Accessed 2 Aug. 2016]

Standards for Performance for Electric Utility Steam Generating Units, Industrial Commercial Institution Steam Generating Units, and small Industrial Commercial Institutional Steam Generating Units; Final Rule. USA. [Online] Available at: https://www3.epa.gov/airtoxics/utility/fr27fe06.pdf [Accessed 3 Dec 2016]

Studententerprise.ie, (2016). [Online] Available at: http://www.studententerprise.ie/phases/phase-2/module4/what-is-market-research/ [Accessed 12 Jul. 2016]

Table of Historical Particulate Matter (PM) National Ambient Air Quality Standards (NAAQS) USA. [Online] Available at: https://www.epa.gov/pm-pollution/table-historical-particulate-matter-pm-national-ambient-air-quality-standards-naaqs [Accessed 3 Dec 2016]

The Environmental (Protection) Rules, 1986, Schedule IV Rule 3A: General Standards for Discharge of Environmental Pollutants. India. Available at: MIP Electronics Oy [Accessed 3 Dec 2016]

Analysis of Competitors for SWOT Analysis: for both the LM 3086 SE and LM 3189

1. Competitor	2. Product Summary	3. Strengths and weaknesses	4. Why we are better
Codel	CEM2100		
	This model utilizes a LED at 637nm or 580nm and features a dual beam transmission and a range of 0,5-15 m. It utilizes RS232/485, MODBUS software and measures 0-20% opacity and 0-10mg/m3 at 5m with an accuracy of <0,2%. This model operates between -20 to 50C and requires a blower. This model is approved by TÜV and MCERTS	Good measuring distance, TÜV and MCERT certified, features a fail-safe shutter. No dirty window correction, no easy filter auditing	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction.
SICK	Dusthunter T100		
	This model features a wide band LED at 450-700nm and operates with a double-pass configuration. It utilizes MODBUS, TCP, OPC; SOPAS and RS485 and offers 3 measuring ranges of 0.5-2.5m, 2-5m, and 4-12m at 0-100% opacity and 0-10000 mg/m3. Its accuracy is +-4%. This device operates between -40-60 C and requires a blower. This model is approved for EN15267, EN14181.	Has 3 models for different ranges, a wide temperature range (-40 C up to 600 C), certified for EN15267 and EN14181, has a fail-safe shutter. No easy filter auditing.	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction.
DataTest	DT109S		
	This model features a Tungsten lamp at 400-700nm and operates with a single-pass configuration. It utilizes RS232/422/485 and a measuring ranges of 1-10 ft. at 0-100% opacity. Its accuracy is <1% and this device operates between -20-125 F and requires a blower. This model has no approvals.	Single pass. Short measuring range.	You do not have to remove the device to perform a filter audit. We have automated dirty window correction and fail safe shutter. We have a longer measurement range.
PCME	Stack 602		
	This has a green LED and can measure between 1-15m and <10-1000mg/3. It features an automatic zero and utilizes RS485 for data processing. It requires a blower and can operate in temperatures of -25-600 C. It is certified for TÜV, ISO9001, UKAS7E-QUEENS AWARD MCERTS.	Fair measuring range, automatic zero, wide temperature range, is certified for TÜV, ISO9001, UKAS7E-QUEENS AWARD. Does not have easy filter auditing, is not EPA certified.	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction and a fail-safe shutter. We have a longer measuring range. we have an EPA certified model, but our SE is EPA compliant as this model is, but not certified because we have a different light source.
Dynoptic	DSL-220M		
	This model has a green LED at 510-540nm with single pass transmission. It has a measuring distance of 0,5-5m and 0-100% opacity with accuracy error of <2%. It runs MODBUS and R485 for data processing. The model can operate in temperatures of -20-55 C. This is approved /certified for Lloyds type approval EVV1, ENV2, ENV3	This has a single pass configuration, has an automatic zero, dirty window correction, it is certified for Lloyds type approval EVV1, ENV2, ENV3. This has a small measuring range, no easy filter auditing.	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction and a fail-safe shutter. We have a longer measuring range.

Analysis of Competitors for SWOT Analysis: LM 3086 SE with Models that Claim EPA "Compliance"

1. Competitor	2. Competitor Product Summary	3. Strengths and weaknesses	4. Why we are better
Teledyne	Lighthawk Model 560		
	This model features a green LED at 500-600nm with double pass transmission. It has a measuring range of 0,62-18,3m and can measure both opacity % and density. It uses MODBUS and RS232. It features a manual zero, can operate in -32-60C, and requires a blower. This model is approved by CE and ETL. They 'meet' US EPA, but are not certified.	Good measurement range, manual zero, has a fail-safe shutter, CE and ETL compliant. No easy filter auditing, not US EPA certified.	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction. We have a longer measuring range. we have an EPA certified model, but our SE is EPA compliant as this model is, but not certified because we have a different light source.
EMS	EMS422		
	This model has a green LED at 500-600nm. This uses MODBUS, RS485 and RS232. It measures between 0,6-4,6m and -5-100% opacity. It operates in -40-54C. This model is ASTM D 6216 and 40 CFR 60 PS-1 Compliant. It 'meets' Meets PS-11 requirements but is not certified.	Has an automatic zero, is ASTM D 6216 and 40 CFR 60 PS-1 certified. Does not have easy filter auditing, has a small measurement range.	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction and a fail-safe shutter. We have a longer measuring range. we have an EPA certified model, but our SE is EPA compliant as this model is, but not certified because we have a different light source.
Land	4500 MKII		
	This model features a green LED at 520 +-20nm with double-pass transmission. It operates in a range of 0,7-7 m and measures a range of 0-100% opacity and 0-1000 mg/m3. This has automatic dirty window correction and requires a blower. This model can stand temperatures of -20-55 C and a max of 600 C. This model also features easy auditing, you can audit without removing the built-in jig and apply filters. It is approved for TÜV, MCERTS, EN61010-2, EN-50081, EN-50082 and states that it "meets the requirements" of UPEPA PS-1, PS-11, ASTM D6216 but is not certified.	Has an automatic zero, easy filter auditing, automatic dirty window correction, TÜV, MCERTS, EN61010-2, EN-50081, EN-50082 certified. Small measuring range, not EPA certified.	We have a larger measuring range, we have an EPA certified model, but our SE is EPA compliant as this model is, but not certified because we have a different light source. Our device is more accurate (accuracy <0.5% vs theirs at <2%).

Analysis of Competitors for SWOT Analysis: LM 3086 EPA3

1. Competitor	2. Competitor Product Summary	3. Strengths and weaknesses	4. Why we are better
Thermo Environmental Instruments	Model 445		
	This model has a LED light source and uses double-pass, single path. It operates at a range of 0,5-15 m and measures 0-100% opacity or 0-999 mg/m3. It features an accuracy of +-2% and can operate in temperatures of-40-125 F with a blower. This device is U.S. EPA incl. PS1, CE, TÜV (German Technical Inspection), Clean Air Act (13th Impl. Ord.), GOST approved.	Fair measuring range, has an automatic zero, certified for U.S. EPA incl. PS1, CE, TÜV, Clean Air Act (13th Impl. Ord.), GOST. This does not have easy filter auditing, does not specify if it has a fail-safe shutter or dirty window correction.	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction. We have a longer measuring range
PCME	Stack 710		
	This has a green LED at 525 +-20 with double-pass transmission. This can measure between 1-10m with a range of 0-10% or 0-100%. It runs RS232, RS485 and MODBUS. It has an automatic zero. It operates in -20-55 C and requires a blower. It is certified for USEPA, ISO9001, UKAS7E-QUEENS AWARD.	Has an automatic zero, is certified for USEPA, ISO9001, UKAS7E-QUEENS AWARD. Small measuring range, no easy filter auditing.	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction and a fail-safe shutter. We have a longer measuring range.
Durag	DR290		
	This model has a wide band LED with a double-pass transmission. It operates in a range of 1-12 m measuring 0-200 mg/m3 or 0-4000 mg/m3 or 0-20/0-100% opacity. Its accuracy is <2% full scale between -20-50 C. It uses BUS interface for programming and results. This model features dirty window correction and requires a blower. This device is certified by TÜV, EPA, CE, MCERTS, PCT, EX	Has dirty window correction and an optional fail safe shutter, it is TÜV, EPA, CE, MCERTS, PCT, EX. No easy filter auditing, small range of measurement.	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction and included fail safe shutter. We have a longer measurement range.
SICK	Dusthunter T200		
	This model features a wide band LED at 450-700nm and operates with a double-pass configuration. It utilizes RS232 and RS485 and offers 3 measuring ranges of 0.5-2.5m, 2-5m, and 4-12m at 0-100% opacity and 0-10000 mg/m3. Its accuracy is +-2%. This device operates between -40-60 C and requires a blower. This model is approved for plants requiring approval, 2001/80/EC (13. BImSchV), 2000/76/EC (17. BImSchV), 27. BImSchV, erman Clean Air Regulations, EN 15267, EN 14181, MCERTS, 2010/75/EU, U.S. EPA PS-1	Has 3 models for different ranges, approved for plants requiring approval, 2001/80/EC (13. BImSchV), 2000/76/EC (17. BImSchV), 27. BImSchV, erman Clean Air Regulations, EN 15267, EN 14181, MCERTS, 2010/75/EU, U.S. EPA PS-1, has a fail-safe shutter. No easy filter auditing.	You do not have to remove the device in order to perform a filter audit. We have automated dirty window correction. Our models are certified in the cost of the model, not an additional cost.