KEY FACTS

Bringing forward innovation on the sector of environmental technologies and realizing ecological and economical benefits from an early stage is a huge challenge. Many new and improved environmental technologies require proven information on their performance under real or field conditions because manufactures, especially small and medium sized enterprises (SME's), purchasers and permitting authorities face difficulties to realize those benefits.

The European Commission is preparing a EU-wide voluntary system, offering credible verification of the performance of innovative and new technologies: Environmental Technology Verification (ETV). Verification is to be understood as an independent quantitative assessment of the performance of an environmental technology, based on performance claims and pre-determined protocols.

AIRTV was funded by the EC within the FP6 addressing requirements and protocols for verification of air emission abatement technologies. The results of the project provide for the upcoming European ETV system:

- A verification procedure for air emission abatement technologies,
- Generic protocols for all steps of the procedure,
- First reference reports on verified technologies.

Manifold consultations with stakeholders and pilot verifications result in recommendations for the European ETV system.

Major key messages are:

- A European system must be uncomplicated, time and cost efficient – especially for SME's.
- ETV has to be voluntary; a mandatory system may decrease innovation.
- ETV should help opening markets and realizing ecological benefits – in Europe and beyond.
- A link between ETV and the BREF documents should be established.
- Overcoming language barriers is a major factor for a successful European ETV system.
- The system shall ease the market access for innovative air emission abatement technologies in foreign countries.
- Available data have to be considered carefully and do not necessarily lead to a reduction in time and cost efforts.
- Testing performed by different organisations must not differ.
- Discover opportunities to connect similar labels in order to avoid confusion or doubeling of work.
- To guarantee trustworthiness, the system needs clear criteria for being eligible at an adequate level.
- Need of good communication: Definition of terms.

To bridge the time until the European ETV system is fully operable, AIRTV has elaborated guidance for the performance verification:

The CEN workshop agreement 42: Environmental technology verification for air emission abatement technologies

Please learn more about the AIRTV results on the web:

www.airtv.eu • www.eu-etv-strategy.eu

AIRTV ETV

Testing network for verification of air emissions abatement technologies

Results & Recommendations

www.airtv.eu • www.eu-etv-strategy.eu

A SPECIFIC TARGETED RESEARCH PROJECT FUNDED BY THE 6TH FRAMEWORK PROGRAMME OF THE EUROPEAN UNION

Contents

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We also owe thanks to the stakeholders of the project for their opinions and good ideas on how an upcoming EU ETV system should look like.

Finally, the contributions of the AIRTV advisory board together with the exchange information exchange with the other ETV related European projects and initiatives has helped the project to achieve its objectives.

The AIRTV Team

AIRTV: Protocols, Reports & Documents

Further information

The information provided in this brochure gives an overview on major outcomes of the AIRTV project. On the website you will find more detailed information, e.g. on:

- Protocols and procedures for verifying air emission abatement technologies
- Full reference reports of verified products
- Verification reports of third party products
- Stakeholder comments on ETV

www.airtv.eu
www.eu-etv-stragety.de

The full description of the CEN Workshop Agreement 42 is available via CEN:

www.cen.eu

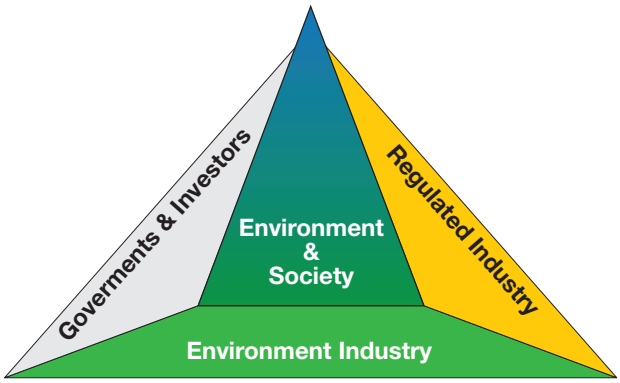
Setting the Scene

Environmental pollution and climate change are emerging as a major challenge for European and global society. Therefore the European Union has the ambitious plan to reduce emissions in the community significantly, to improve environment and well being of inhabitants. To realize these objectives the development and wider use of innovative environmental-friendly technologies must be promoted.

Thus our environment will be improved, new technology fields will be opened up and novel business opportunities will be created – eco-innovation could become a driver for future growth.

However, new technologies are affected by a lack of proven information on their performance under real field conditions. Due to perceived risks it is difficult for their manufactures to convince first customers, to secure sources of finance essential to fund industrial developments and sometimes it delays necessary authorisations to place the technologies on the market.

One way to overcome the handicap and to speed up the implementation of new environmentally sound technologies could be reliable technology verification by qualified third parties using recognised procedures – Environmental Technology Verification (ETV). At the moment the European Commission is considering to propose the establishment of such a system at EU level to offer a wide recognition both within Europe and globally, to make it unnecessary to repeat verification in every country where the technology is sold and to be used as valid input in national-type approval or certification procedures.



The benefit of such a system would be multi-purpose as a clean and healthy environment is essential for the well-being and prosperity of society. It would be an **improvement tool** by speeding up the wider use of environment-friendly technologies.

Government and investors could use ETV as a **decision support tool** for programme managers, regulators, policy makers, procurement officers or financiers. By helping innovators in the environment industry to bring new environmental technologies into the domestic and international market place it could work as **marketing tool** and it could support the regulated industry as **benchmarking tool** employing multi-stakeholders to develop test plans and protocols for technology performance claims encompassing regulatory, economic and social criteria.

At this stage several Environmental Technology Verification systems (e.g. US, Canada, South Korea, and Japan) exist already world-wide. However, in order to obtain reliable information and sector specific recommendations and protocols for a possible European ETV system the European Commission supported several research projects covering different application fields of environmental sound technologies (e.g. PROMOTE, TESTNET, AIRTV, etc.) in the framework of the Environmental Technologies Action Plan.

In this context AIRTV was successfully investigating potential procedures for the verification of air emissions abatement technologies and provides:

- a verification procedure for air emissions abatement technologies including a generic protocol and nine specific protocols
- nine reference reports on verified technologies
- recommendations for a European ETV system in the field of air emissions abatement technologies, based on communications with stakeholders and the nine test cases
- a CEN Workshop Agreement (nº 42) as guidance document for verification of air emission abatement technologies.

Additional, AIRTV considered specially SMEs during the development of the project both as suppliers of technologies and test sites for technology verification as well as by means of a SME-focused dissemination strategy. However the AIRTV partners would like to thank all industrial partners and stakeholders for their support, which was crucial for the successful performance of our project.

Thomas Dietrich
AIRTV Co-ordinator

Environmental Technology Verification System – Research and Pilot experiences from the AIRTV project

AIRTV investigated how to design a European system for verification of air emission abatement technologies. A number of practical experiences from case studies and stakeholder workshops influenced the recommendations on how a verification scheme should be formed. The goal was to develop a system that is credible, cost efficient, and increasing the confidence in positively tested products in order to increase the market acceptance.

The proposed scheme for verification as outcome from AIRTV

The verification process as proposed from the AIRTV project has been developed to be slim-lined for efficiency while still ensuring quality of the output. It is anticipated to be vendor driven, i.e. the vendor of a product takes the initiative.

In the first stage, the vendor who wants a technology to be tested, contacts either a Verification body or a national contact point. At this stage a "quick-check" is done in order to check if the product is suitable for verification and what kind of data is available and might be used for the verification.

If the product is suitable and the vendor decides to go for verification, a contract is set up. In the next step a protocol is developed, where the parameters to be tested are defined in order to give sufficient information for customers. If there is an existing protocol for comparable products, this will be used and adapted.

If the existing data are sufficient, they will be used together with the protocol to produce the verification report.

If the available data are not sufficient, a test plan is developed with expertise from technology and measurement experts. At this point the test location is chosen in agreement between the verification manager, the experts and the vendor as the test location is needed to write an appropriate test plan. With the test plan and test location the vendor asks different (ETV recognised) test labs for offers. The verification manager and/or experts assess the quality of the offers. The vendor can choose a test lab from the labs with complying offers. In the next stage, the product is tested in order to generate the missing data for verification, i.e. the amount of testing depends on the availability of suitable data that have been produced earlier.

Results and conclusions from the data compared to the protocol are provided in a verification report. The vendor gets the opportunity to comment on the test report as well as the verification report.

During the verification, a number of functions held by different organisations are needed. All functions can be covered by **existing organisations**, which might be different types of organisations in different countries. In order to facilitate the entry, **national contact points** are needed that can guide vendors in verification questions in a local language.

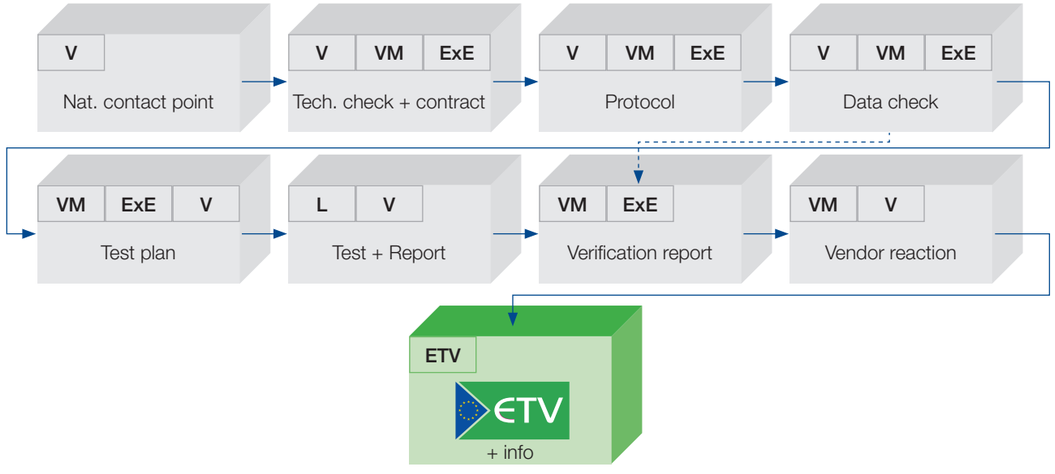


Figure 1: The proposed scheme for verification (V=Vendor, VM= Verification manager/organisation, L= Laboratory, ExE= External Expert, ETV= European ETV body), Dotted line: alternative path when no additional testing is needed

The **verification manager** is an organisation that manages the verification process from the quick-check to the final verification report. This organisation is responsible for performing the verification. During verification, **external experts** are needed in order to set up a relevant set of parameters for the technology to be verified. Also, they assure the claim to be realistic and verifiable, i.e. both technology and measurement experts are needed. When testing is needed, a **test laboratory** performs the tests according to the test plan and reports the test results. In the final stage of the verification, the EU ETV body approves the verification report and provides the logo. The **EU ETV body** is also responsible for the overall management and quality assurance of the verification in Europe and for co-ordination internationally.

The generic protocol

Within the project, a generic protocol has been developed. The generic protocol serves as a template for the specific protocol to be produced for new technologies or new applications. Each specific protocol is derived in the protocol development procedure, making use of existing protocols and the generic protocol, in which it is described what information is needed under specific headlines. The generic protocol consists of 6 main chapters:

1. **Introduction:** Information about ETV and the purpose of the verification is provided as well as reference to similar protocols

2. **Generic description of the product/technology:** The technology and its benefits are described as well as its field of application, possible environmental impact and reference to BAT (Best available technology) reference documents.

3. **Detailed description of the parameters to be verified:** Both parameters that verify the achievement of the benefit and additional parameters like environmental and cost parameters to verify the technology are described.

4. **Test related issues:** This part includes requirements for the test location and a description of the test methods to be used. The parameters to be verified are summarised including the methods to be used.

5. **References**

6. **Appendices:** Among the appendices, the author of the protocol is mentioned and a liability exclusion can be added.

Practical experiences and general recommendations from the project

The project including the performed case studies showed that the proposed verification scheme is an option for a EU ETV system. Outcomes from the project are:

- A **quick-check** at the beginning of the process is very helpful in order to assess if the technology is suitable and how extensive the verification can be.
- It was possible to use only **one generic protocol** as template including instructions how to fill in for all cases, which probably also is possible when different technology areas are addressed. The protocol procedure is necessary, probably also, in a simplified form, if protocols are available from similar technologies. In order to avoid mistakes in protocols and test plans, **the early involvement of technology and measurement experts** (e.g. from the testing laboratory) is necessary.
- The definition of the **performance parameters** is important: a parameter has to be measurable. A realistic rather than the highest possible value avoids a change of claim.
- Performance parameters have to include **important parameters for customers**. Including life-cycle aspects for environment and costs in ETV provides additional arguments for vendors with innovative technologies and is useful for customers, as many new technologies might have a higher price, but better total performance.
- Clear **criteria for the involved organisations** are important for the verification output. An adequate level has to be found in order to allow competition between a number of organisations whilst assuring the quality.
- During verification a number of documents are produced. The structure of the document is developed to avoid double work, but some further evaluation can make **simplified documents** to make the verification more efficient.
- When **taking verification into account during product development**, testing results can be used for future verification, reducing the total costs. Thus, clear criteria for usage of existing data are needed. The effort for checking existing data has to be compared to the effort for measuring new data.
- **Access to the European and international market** is an important argument for ETV.
- ETV should provide a shortcut for successful technologies to be regarded as **"best available technology" BAT**.
- Costs for verification depend on the complexity of the product. Although the verification scheme can be designed to work efficiently, especially for SME additional funding might be needed in order to provide **verification at acceptable costs**. There are often national and possible EU-funding schemes that could be used for that purpose.

Overview of Case Studies

The main aim of the AIRTV Project is the obtaining of a workable scheme for an Environmental Technologies Verification (ETV) system in the field of air emissions abatement technologies for Europe. During the first steps of the project, the possible structure of this scheme was developed, together with the necessary documents for the verification processes (principally Generic and Specific Verification Protocols). After the establishment of this theoretical framework, the AIRTV project went a step beyond, by confronting these scheme and tools with nine real test cases.

Through this practical application, the AIRTV consortium was able to find out the possible limits, hurdles and potential improvements for the proposed scheme, allowing also the refinement of the draft verification protocols, which will be a valuable tool for the future European ETV system.

To achieve these objectives, nine air emission abatement technologies were selected, applying the criteria developed during the first stages of the project in order to prioritize particular technologies as more suitable for ETV (Figure 2).

Apart from these criteria, it was considered that only technologies in an advanced step of development (ready to market) should be considered as potential beneficiaries of ETV.

The nine selected technologies (Table 1) covered a broad range of pollutants, sizes and technological complexity (from indoor air quality to industrial plants) and applications (end of pipe technologies but also source oriented technologies). Thus, the weak and strong points of the proposed system and protocols were clearly determined for several different scenarios in the field of air emission abatement technologies.

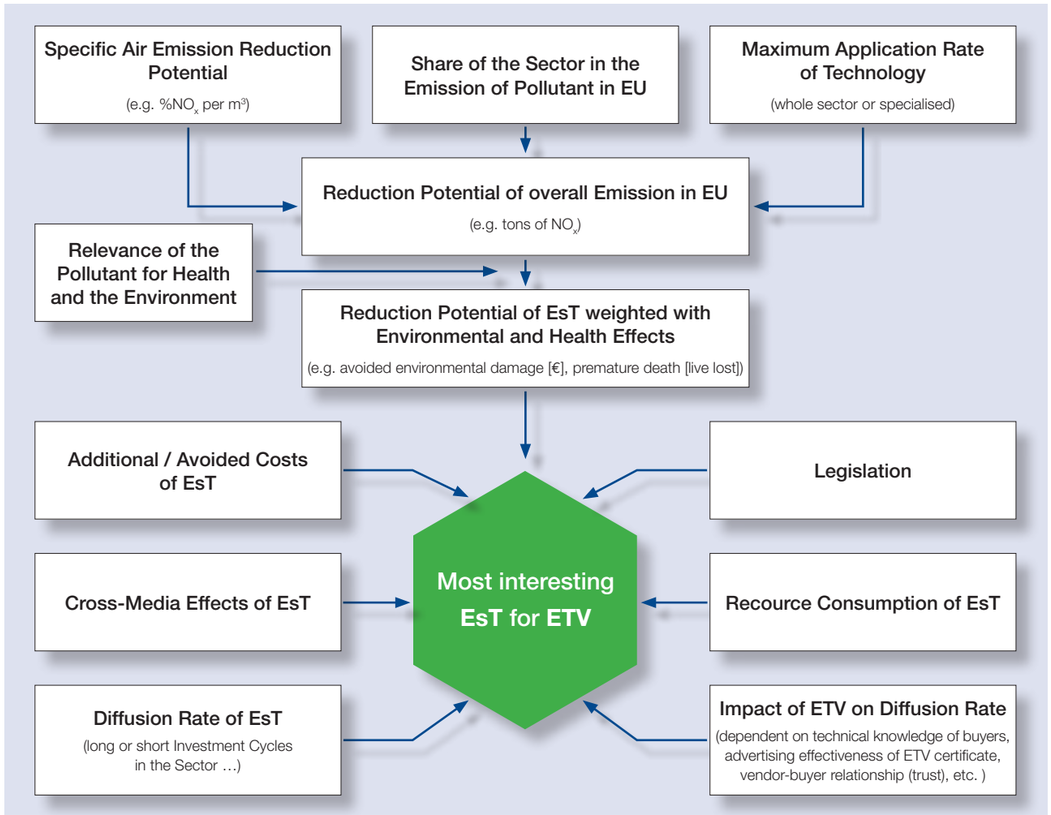


Figure 2: Criteria for the prioritization of Environmentally sound Technologies (EsT)

Table 1: Test cases in AIRTV Project

Technology	Provider	Pollutants	Responsible partner
MFI Technology, GENANO Technology	GENANO Ltd.	Small particles	VITO
Wet scrubber Technology, KVK	KOERNER Chemieanlagenbau GmbH	HNO_3, HF, combustion gases	LEIA
Electrostatic precipitator, ELPAC	ALSTOM LTD	Dust and VOC	IVL
ELOSORB Technology	M+W Zander FE GmbH	VOC	DFIU-IFARE
RTO Technology, Megtec VOCsidizer	MTS Environmental GmbH	TOC, NO_x, CO	TNO
Combi-Scrubber Technology, MagiXx	Big dutchman Pig Equipment GmbH	Ammonia, particles, odour	TNO
High Velocity Burners HV TD	TCK Italy	Flue gas, CO_2, reduction of fuel usage	INiG
TURBOSORP Technology	Von Rol Inova GmbH	Acid gases, heavy metals, PCDD/F, dust, organic carbon	UBA-A
APP Odour abatement system	Applied Plasma Physics AS	Odour	VITO

For the verification of the proposed case studies three different approaches were applied, according to the different possibilities that a real verification system will face.

- Verification using existing data (3 test cases)
- Verification on existing data and additional testing (1 test case)
- Verification based on testing – new performance data (4 test cases)

The testings were performed at qualified laboratories provided by the project consortium. Additionally, one technology (Wet Scrubber for fumes abatement) was verified using two different approaches (existing data and performance testing) to find out the differences between the two possibilities, principally in terms of reliability, effort and time needed.

The verification of the case studies was carried out by seven of the AIRTV project partners as a role-play. The roles proposed in the verification scheme (verification managers, experts, laboratories, etc) were taken by the different partners, allowing the composition of plural working teams for each test case. A cross-check and critical review of each test case were also carried out by assigned partners, and the main conclusions and practical challenges were discussed by the whole consortium. After the diagnosis of the potential problems and hurdles, the solutions were found out through internal discussions, and in most cases agreed by consensus.

The practical case studies within the AIRTV project have allowed the obtaining of improved verification protocols and the enhancement of the proposed Verification Scheme, but the results of these experiences have been also useful for going a step beyond. Based on the results, the AIRTV consortium has been able to provide practical solutions for the potential challenges that would appear during real verifications, and the practical experiences have been one of the bases for the project recommendations for an ETV system in Europe.

Test Case 1: The GENANO TECHNOLOGY

Introduction on the Genano technology

One of the technologies verified within the AIRTV project is the GENANO TECHNOLOGY. The Genano technology is based on the corona effect phenomenon and is designed to separate the entire range of particles from indoor air, including ultrafine particles and aerosols in particulate and droplet form. The technology can also – within certain specifications – be used for emission abatement. In the Genano air cleaning method, air is allowed to pass freely between the collection surfaces or through a pipe. An ion spray is directed at the airborne particles, forcing the particles on the collection surface. The accumulated mass of particles is flushed with a water-detergent solution into the sewer system or a separate container. The principle is shown in Figure 3.

By corona discharge, a small amount of ozone is generated. The formed ozone is removed by a small activated carbon filter.

Genano technology: the verification

Several types and sizes of the Genano technology are available. Within the AIRTV project, the performance of the Genano 310 is verified. The Genano 310 is used for room-specific air cleaning. It is a mobile air cleaner with a maximum air cleaning capacity between 100 and 250 m³/h. Required working conditions for the Genano 310 are a temperature between 0 and 60 °C and a relative air humidity between 0 and 100 %. Genano advertises that the Genano 310 removes particles of 0,003 µm and larger with an efficiency up to 99,5 %. From this the following claim was derived: The Genano 310 claims to remove particles with a diameter between 0,020 and 10 µm with a filter efficiency of at least 80 %. Hereby, filter efficiency is defined as the ratio of particles trapped by a filter over the total number of particles found in the air upstream of the filter. When the purifier is operating, ozone is generated. Genano claims that the produced ozone concentration will not exceed 0,05 ppm. Differences between the advertisement of Genano and the final claim are caused by the limitations of measurement principles/standards and legislation. Within this verification, the claim is checked in an office environment. The test set-up is illustrated in Figure 4.

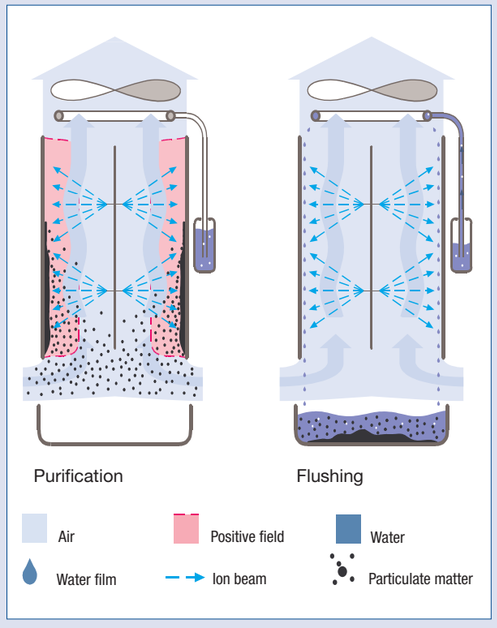


Figure 3: Working principle of the Genano-technology

Figure 4: Test set-up for verification of the Genano-technology

To check the claim, the following parameters are determined while the Genano 310 was running:

- particle concentration at in- and outlet;
- particle size distribution at in- and outlet;
- ozone concentration.

With the two first parameters, the filter efficiency is calculated for different particle sizes. The results of the verification and the claimed values are summarized in the table below. From these data it was concluded that **the claim is verified successfully**.

The verification: experiences of the vendor

Genano experienced no problems during the verification procedure. Their only task was the delivery and installation of the Genano 310 unit. According Genano, the most important benefit of a European verification system is the transnational recognition of the results (hopefully the whole Europe). At this moment, new validation tests are necessary in every country a vendor wants to sell his technology. Of course verification is expensive, but validation tests are expensive too. As long as the verification costs within a European verification system are lower than the sum of the costs of all national validation reports, this is acceptable.

Asking for possible hurdles for the verification system, Genano mentioned a lack of flexibility. Verification is especially interesting for innovative technologies. Per definition, these technologies undergo continuously improvements. If new verification is needed for every improvement, the system becomes time consuming and expensive.

Table 2: Claim vs. verification values

Parameter	Claim	Measured value Experiment 1 (without extra fine dust)	Measured value Experiment 2 (extra fine dust by printing)
Filter efficiency per particle size fraction			
20 – 50 nm	≥ 80	96	94
50 – 100 nm	≥ 80	95	93
100 – 150 nm	≥ 80	91	91
150 – 200 nm	≥ 80	92	92
200 – 250 nm	≥ 80	92	89
250 – 300 nm	≥ 80	94	90
300 – 350 nm	≥ 80	92	94
350 – 400 nm	≥ 80	88	85
400 – 450 nm	≥ 80	80	100
450 – 500 nm	≥ 80	100	100
500 – 550 nm	≥ 80	100	–
550 – 600 nm	≥ 80	100	100
20 – 1000 nm	≥ 80	98	85
PM 1	≥ 80	97	98
PM 2.5	≥ 80	98	98
PM 10	≥ 80	99	99
Ozone concentration			
Maximal amount	0,05 ppm	0,005 ppm	0,005 ppm

Test Case 2: The Turbosorp® Technology

The Turbosorp® Technology was provided by Austrian Energy & Environment. It is a dry flue gas cleaning process without waste water, which is suitable for treatment of flue gases from waste to energy plants, coal or oil fired power plants or industrial applications. This end-of-pipe reduction technology can be used to reduce emissions of acid gases (e.g. SO_2, HCl, HF), particulate matter including heavy metals (e.g. Hg, Cd, Tl), dioxins and furans and organic carbon.

In the Turbosorp® system, the flue gas flows through the turboabsorber from the bottom to the top. Fly ash from incineration serves as fluidised bed. Fresh additives consisting of either $Ca(OH)_2$ or CaO are fed into the turboabsorber. Active carbon is added when heavy metals or dioxin removal is needed.

Solid material, which has been thrown out of the absorber, is returned to the reactor as recirculate via the dust filter. Water is also fed in to lower the flue gas temperature and achieve higher separation performance. Apart from the evaporation and cooling phases, this results in an increase in relative humidity and thus an activation of the additives. Solid, saltlike reaction products are formed during the reaction of the additive with the acid gases from incineration. These residues are suitable for landfilling.

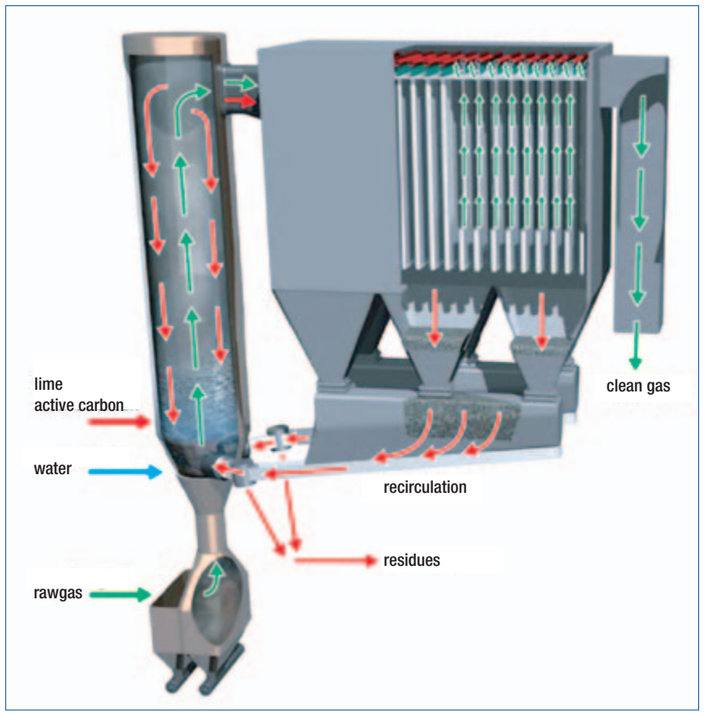


Figure 5: Picture of the absorber, the fabric filter and the recirculation of the gas stream in the Turbosorp® system.

The polluted gas is constantly subjected to a reaction agent surplus with the consequence that continuous pollutant removal is achieved. As a result of intelligent process management with regard to the operational temperature, solids recirculation and the dosed additives, material consumption and the quantities of residues are kept to a minimum.

The multi-pollutant approach is ideal for installations with a limited amount of available space. Furthermore, the necessary investment for the erection of an abatement facility of this type is low in comparison with other technologies, albeit the sorbent costs are higher as compared to the wet process. Due to the simplicity of the design of the system components, very high levels of availability are guaranteed and the technology requires minimum maintenance expenditure. A major advantage of the Turbosorp® technology is that it needs little or no water which makes it suitable for arid regions of the world. Furthermore no reheating of any kind is required. For the treated pollutants the emission limits according to the Waste Incineration Directive (2000/76/EC) can be easily fulfilled.

The Turbosorp® technology claims a reduction of the concentration of acid gases (HCl, HF, SO_2) by 95-99%, heavy metals (Hg, Cd, Tl) and PCDD/F by at least 90% and dust by at least 99,9%. The concentration of organic carbon in the clean gas is lower than 10 mg/Nm³ (legal boundary limit in Austria).

In difference to other test cases the verification was able to rely on already existing data. The used tests had been performed on-site at the thermal treatment plant in Arnoldstein (Kärntner Restmüllverwertung, www.krv.co.at) in the year 2004 by an independent test laboratory from Vienna.

Figure 6: Picture of the flue gas abatement system at KRV Arnoldstein (waste to energy plant) featuring the Turbosorp® system.

Table 3: Values claimed and measured at KRV Arnoldstein in 2004.

Parameter	Claim	Measured Average Performance
Organic carbon (concentration)	≥ 10 mg/Nm³	0.9 mg/Nm³
PM removal	≥ 99%	100%
HCl removal	≥ 90%	99%
HF removal	≥ 90%	94%
SO_2 removal	≥ 90%	94%
PCDD/F	≥ 90%	96%
Hg	≥ 90%	94%
Cd	≥ 90%	100%
Tl	≥ 90%	100%

Based on these values the claim of the Turbosorp® technology was successfully verified. The verification report includes also additional parameters to assess the side effects of the verified technology. These data have not been verified. Current emission data can also be downloaded from the website of the KRV Arnoldstein, proving that emission limits are still kept.

Additional data (vendor information)

- Flue gas volume
- Power consumption (fan power, other consumers)
- Water consumption
- Active carbon consumption
- Lime consumption
- Man-power needed for operation
- Residues (total amount, fly ash, Cl-amount, S-amount)
- Lifetime of equipment
- Space needed

Vendor statement

“In various conversations with customers across Europe I have encountered activities concerning technology verification. At first I was a bit skeptical but after the project I think that especially the process oriented approach of the system is very good. In the field of air abatement systems it is not as easy as in other fields like machinery to have good regulations, so there is the need for a system such as ETV. The verification process produces a lot of valuable data for producers, buyers and other parties like authorities or the public.

Known organizations should be allowed to verify technologies all over Europe. The central bureau should not have to do any technical work. It should serve as contact point and partner for administrative problems.

Acceptable costs for verification depend hugely on the type of the installation. For technologies like the Turbosorp® the additional costs of the verification would not be the most important decision criterion.

I hope that the activities continue because in some fields like power plants people with a very conservative attitude can only be convinced with reliable data. Furthermore, an ETV system would be a means to distinguish between serious contenders and pretenders, who cannot fulfill their promises. If a European system was established, I would consider entering the process with two technologies currently under development.”

Verification Test Cases: Challenges and Solutions

Introduction

The last year of the AIRTV project was dedicated to the execution of test cases to make sure that the developed procedure for the verification of air treatment technologies ensures good results and is applicable and practical. These tests were performed for very different pollutants ranging from dust, VOC, CO_2, NO_x, ammonia to odour. All these pollutants have their specific points of attention. As expected, challenges occurred during all verification test cases. These challenges are discussed by all project partners. For some problems, a solution was found. For other problems, the opinions were so different that no consensus was reached within the AIRTV project. In those cases, different suggestions to solve the problem are listed. Based on the results of all discussions, the final verification procedure described on page 6 was developed.

Within this article, challenges and solutions are described. Challenges are listed and subdivided in different categories as summarized in the table 4 below.

Table 4: Challenges for the procedure

N°	Category	Challenge
1	**Claim**	How to write the perfect claim?
2		Verification of source-oriented measures: possible or not?
3	**Use of existing data**	Use of existing data: cost-saving or time-consuming?
4		How reliable are existing data?
5	**Test plan, test lab and test location**	Test plan, lab and location: who decides what?
6		What has a test lab to deliver?
7	**Results and reliability**	Interpretation of results: easy job or not?
8		What about the transferability of results?
9		What if verification results are negative?

Challenges and solutions related to the claim

How to write the perfect claim?

- **Include experts for definition of the claim:** A crucial step in the verification process is the vendor claim. During the first discussions with the vendor the claim is in most cases not properly formulated by the vendor and/or not all necessary parameters to evaluate environmental benefits and cross media effects of the technology are in the claim. This is not on purpose but because of lack of specific knowledge on environment vulnerability and threats. Therefore, it is crucial to include experts for the definition of the parameters to be verified, in order to make sure that all relevant parameters including cross-media effects are covered, but also to make sure that the values to be reached are relevant and verifiable. Both experts on the technology and application and on measurements of the parameters will be needed.
- **Claim one limit value instead of a whole range of values:** In some cases when the technology under consideration can give different results in different applications e.g depending on pollutants removed or technological conditions of the process in which the technology is implemented, it is rather difficult to claim one value. Usually it is the range of values that can be achieved and the question arises if the range should be claimed or rather a minimal value of the range (this can not be beneficial for the vendor). By measuring one value you can not be sure that the whole claimed range (for example 80 – 90 %) can be reached. And what will you do as the measured efficiency is higher than the claimed range? Theoretically, this would result in a negative verification (for example 95 % does not comply to 80 – 90 %). Therefore, the claim needs to be a limit (for example > 80 %). To make it clear to the user what efficiency can be expected (minimal and maximal), a range can be included in the supplier info.

Verification of source oriented measures: possible or not?

To verify source-based approaches, frequently a comparison has to be made between sources used by or emissions caused by a more conventional technology and the new technology. In a lot of cases, it can be difficult or even impossible to gather measurement data of the technology which is substituted by the new technology, because the former equipment/installation doesn't exist anymore. Therefore, the preference is given to claim absolute emission values per unit produced (instead of giving reductions compared to more conventional technologies). If this is not possible or not sufficient, comparison with a more conventional technology can be made by using BREF studies. Referring to BREF studies can be valuable anyway as it can promote the verified technology to decision makers. Only if comparison with the BREF is not possible, the ETV system should enable a comparison with achieved absolute emission values from previous measurements at that test site or from the process the technology is applied on.

Challenges and solutions related to the use of existing data

Use of existing data: cost-saving or time-consuming?

- **Cost-saving if the quality of the data can be assured:** The goal of using existing data was decreasing the costs of a verification. In many cases, using existing data can be an efficient solution, especially when data from a full-scale operation are available. The EU system is now set up to use existing data with optional additional measurements (in those cases with insufficient available data). Of course, the data quality has to be assured. The rules, which have to be fulfilled to make existing data sufficient to use for verification, are the following:
  1. Measurements have to be performed by an independent and accredited lab. Rules of independency have to be set up.
  2. Measurement standards have to be used if they are available.
  3. Operational conditions have to be measured.
  4. In- and output have to be measured: if only the output is measured, additional measurements have to be performed because measurements at the in- and outlet have to be gathered simultaneously to ensure the same conditions.
  5. Uncertainty on measurement have to be reported

It is the checking of these rules that makes the use of available data time consuming.

- **Guidelines for measurements during development-have to be set up:** The exact conditions of the measurements and compliance with the test protocol and international standards can often not be judged from the existing documents. Hence it will be an important task to help technology developers to plan the development process in a way that test results can be used for verification. Therefore, clear guidelines should be provided.

How reliable are existing data?

In cases where existing data were measured by independent, accredited testing labs, reliability and good quality of data can be assumed. On the other hand, the supplier will have no incentive to provide measurement reports, which are negative for verification. That way, interesting information may be lost and it could be a problem to know if a positive measurement report is the standard or an exception. This is not avoidable, but this risk also exists when there are extra measurements.

Challenges and solutions related to test plan, test lab and test location

Test plan, lab and location: who decides what?

- **The verification manager will write the test plan with help of a team of experts** and if possible and necessary with the test location in mind. The team of experts needs to be composed of technology experts and measurement experts for the applied field. The test plan has to be checked with the vendor. When offers are asked at the labs, they can give alternative measurement procedures, but then they have to prove that the results are the same (it has to be defined which documents the lab needs to present).
- **The decision on the test lab is taken by agreement between several parties.** The experts and the verification manager will decide on the quality of the lab. The experts or the verification manager can make a list of labs that are sufficient (based on a list of clear criteria set up for the ETV system). The vendor can choose between the listed labs and has in this the final decision (because he has to pay for the measurements).
- A test location is needed when additional measurements have to be performed. **Which test location will be used is a joint decision between vendor, verification manager and if necessary experts.** In many cases, the vendor will suggest a location and suitability is checked by the verification manager (and/or experts). The site manager has also to agree, at least about publishing information of the location (to avoid that confidential information on the test location will be published).

What has a test lab to deliver?

- It is important that the lab delivers **interpretable data**. The lab has to report values that can be checked with the claim. If new measurements are planned, the rules that are described in the verification protocol and the test plan can be used (in these documents the deliverable of the test lab has to be defined clearly).

Kindly provided by Rick Gould, UK EA

- Measurement of **a complete set of parameters** (all in one situation = on one day) is important and not common practice for test labs (as normally only emission limits are checked and operating conditions are not reported). If we want to make it possible to use existing data (from existing measurement reports) it is important to help technology developers to plan the development process in a way that test results can be used for verification.

Challenges and solutions related to results and reliability

Interpretation of results: easy job or not?

Some rules are necessary to make it possible to interpret the measurement results:

- **Measuring uncertainties:** The measured value (average) has to fulfill the claim. Uncertainty has to be reported to get an idea of the meaning of the measured value, but it is the average value that counts.
- **Amount of measurements:** From a statistical point of view, 10 repeating measurements are needed. This number can be decreased if the process is very stable. Such kind of assessment can be done by the judgment of the expert or on the base of preliminary tests. The AIRTV consortium agreed that generally spoken, 3 measurements are needed (if the average complies, verification is OK) unless more strict regulations for the sector/pollutant are available.
- **Avoiding lucky shots:** Repeating measurements (all after each other) are meant to make the measurement error as small as possible. What you don't avoid are lucky positive or rare negative results (for example the only day in a year with bad results caused by a bad combination of wind, humidity, etc.). Avoiding this can only by repeating the whole measurement campaign several times, but this is too time consuming and too expensive. Therefore, using existing data reporting a longer time period can be useful!

What about the transferability of results?

- **Verification under strict conditions:** A supplier defines always a range of operating conditions in which the technology can be used. During verification, it is impossible to test the whole range of operating conditions. Therefore the range of operating conditions is only supplier info and it is described clearly that the claim is only verified under certain conditions: "The vendor claim is successfully verified under following conditions: T = …, …". These results can be used as an indication of the performance that can be reached in similar situations, but give no guarantee!
- **Verification for a certain application:** Verification counts only for the application and circumstances described in the specific verification protocol and verification report. Again, results can give an indication of the performance for similar applications, but give no guarantee!
- **Improvements of technology:** With new technologies improvements are very likely. Only if improvements can affect the efficiency and thus the claim, the improvement has to be checked by experts. They have to conclude if the verification is still useful or not.

What if verification results are negative?

Negative verification results can lead to enormous discussions with technology developers and vendors. This is logical, especially when negative results are published. Therefore, guidelines have to be followed to avoid this situation.

- **Start with realistic claim:** By choosing a relevant but realistic claim, negative verification results can be often avoided. Perhaps, the quick check (one of the first steps of the verification procedure) can be used to determine "typical" efficiencies etc. That way, a reasonable claim will be formulated and gambling (Just give a high efficiency, you never know,… If it doesn't work, lower the claimed efficiency.) can be avoided.
- **Discuss the test plan with the vendor to avoid discussion and ask for new measurements afterwards:** Requests for new measurements have to be possible but rare. Objective reasons have to be given and have to be judged by the experts. Possible reasons of failing can be technical problems on the measurement day, evidence that the measurement wasn't performed like it was planned,…
- **Avoid publication of negative results, although this is difficult if verification is paid (partially) with public money:** There is a conflict between the interests of the technology owners (vendors) and the interests of the technology users. From the view of the technology owners, publishing negative results will be a hurdle to enter the verification system. For them it is important that only positive verifications will be published. From the view of the technology user, it is also interesting to know which technologies were not successfully. Especially when public money is involved, it seems obligatory to publish negative results.

CEN workshop agreement 42

Developing the CEN Workshop Agreement (CWA) for air emission abatement systems

To allow immediate use of results, the AIRTV team decided to develop a CWA in parallel with the development of the core procedures for the European ETV scheme. This CWA will then bridge the gap between the end of the AIRTV project and the implementation of a European ETV system.

The CEN Workshop Procedure, resulting in a CWA is a tool to elaborate a common agreement on specific procedures. For AIRTV, this consensus comprises the establishment of a generic system that gives systematic and documented proof of a technology as being sound in terms of its claims of operation and the environment. So the CWA provides a procedure to prove the performance of a product and not, for example, certify the conformity with certain standards or norms. In other words, the role of this CWA is to prove performance, rather than certify a product under a formal product certification scheme (e.g. product certification to EN 45011 or ISO 17065).

The main advantage of the CWA is its characteristic of having a streamlined process for development. However, the process is still fair and transparent, cost-efficient and fast. The CWA 42 *Environmental technology verification – Air emission abatement technologies (ETV-AEA)* was developed in just 17 months.

CWA 42 provides a guideline for the verification of air emission abatement technologies. It specifies a verification process and reporting structure for a verified vendor claim for the performance of a specific air emission abatement technology. The technology can comprise hardware (devices, apparatus and tools), software (e. g. for process control and improvement) and physical, chemical and biotechnological processes with their adaptation to site-specific conditions.

Following the procedure laid down in CWA 42 (Figure 7) results into a systematic process and report for a verified product. This report provides standardized key information about an air emission abatement technology when applied. The report aims to illustrate the technology's performance and can be used to help all stakeholders (e.g. experts, regulators, administrators, potential customers and investors) for decision making, i.e. to evaluate if a particular technology is suitable for the specific pollutant(s) and conditions for the application that is under consideration.

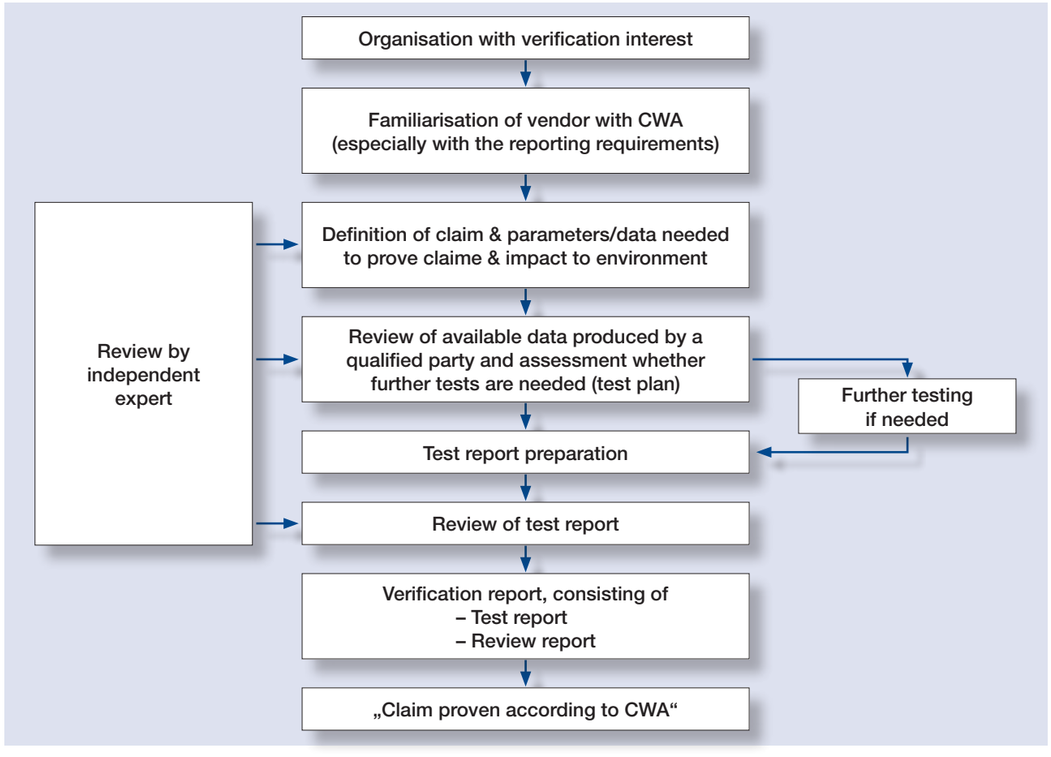


Figure 7: The framework for air-emissions abatement-verification, as described by CWA 42

The CWA will provide a substantial input to a future European ETV system. The CWA gives guidance on technology verification on a voluntary basis to bridge the gap until a European ETV system is established.

The verification of an air emission abatement technology shall be performed stepwise, using a generic verification procedure, which is indirectly given by the standard reporting system. Additional testing is not mandatory within the verification procedure. It depends on the claims and the quality of existing data. The decision whether further testing is needed is made during the verification procedure.

At three stages, an independent feedback is needed: The definition of claims and performance criteria, the assessment of quality of available data together with the test plan (if needed) and the prepared test report need to undergo external review. For the review all given information has to be approved as being comprehensive and correct resulting in the review report.

Thus, when setting-up the test report the review criteria should be considered. In the review the information given in the test report has to be approved as being comprehensible and correct.

The reviews shall be performed by any qualified independent party, i.e. technology developer, external consultant, analytical laboratory, vendor etc. Verification has to be documented by the verification report: consisting of part I the test report and part II the review report.

The present CEN Workshop Agreement ETV-AEA is meant to help all stakeholders generating quality controlled and significant information about particular technologies. The verification as based on this CWA relies on the skill of the data generating and reviewing party. The CWA cannot provide protection against potential misinformation or misinterpretation.

Fraud, liability, and warranty issues arising from incorrect information in the quality controlled and disseminated report are not within the scope of the present CWA. Thereof the issues of the latter lie with the general jurisdiction that applies for a particular country or case.

AIRTV Consortium

CEN – European Committee for Standardization (Belgium) · www.cen.eu

DECHEMA e.V. – Society for Chemical Engineering and Biotechnology (Germany) · www.dechema.de

EUCETSA – European Committee of Environmental Technology Suppliers Associations (Belgium) · www.eucetsa.net

Fundación LEIA C.T.D. (Spain) · www.leia.es

IFARE – French-German Institute for Environmental Research (Germany) · www.dfiu.kit.edu

INIG – Oil and Gas Institute (Poland) · www.inig.pl

IVL – Swedish Environmental Research Institute Ltd. (Sweden) · www.ivl.se

JRC-IPTS – Institute for Prospective Technological Studies (Spain) · www.jrc.es

TNO – The Netherlands Organisation for Applied Scientific Research (The Netherlands) · www.tno.nl

UBA-A – Federal Environment Agency (Austria) · www.umweltbundesamt.at

VITO – Flemish Institute for Technological Research (Belgium) · www.vito.be