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INTAS

Deliverable 4.3: Evaluation of costs, benefits and new methods of compliance verification

[Evaluation of costs, benefits and new methods of testing, and common issues found in large product testing]

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About the INTAS project

The aim of the INTAS project is to provide technical and cooperative support, as well as capacity building activities, to Market Surveillance Authorities (MSAs). The need for the INTAS project arises from the difficulty that MSAs and market actors face in establishing and verifying compliance with energy performance requirements for large industrial products subject to requirements of the Ecodesign Directive, specifically transformers and industrial fans. Therefore, the project aims to:

- Support European Member State MSAs deliver compliance for large products (specifically for transformers and large fans);
- Support industry to be sure of what their obligations are under the Ecodesign Directive and to deliver compliance in a manner that will be broadly accepted by MSAs;
- Foster a common European approach to the delivery and verification of compliance for these products.

List of project partners:

WIP Renewable Energies	Europe
European Environmental Citizens' Organisation for Standardisation	Europe
European Copper Institute	Europe
Engineering Consulting and Design	Europe
Waide Strategic Efficiency	Europe
Austrian Energy Agency	Austria
Federal Public Service Health, Foodchain, Safety and Environment	Belgium
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Food and Economic Safety Authority	Portugal

1. Introduction

Building on the work conducted in Work Package 3 this task evaluates the costs and benefits of all potential options to determine the likelihood that a product's energy performance is compliant with Eco-design requirements.

Specifically, it assesses the panoply of compliance assessment options (testing in third party labs, testing in situ, witness testing at manufacturer's premises, simulation modelling, scrutiny of design engineering calculations, documentation inspection and physical inspection) and determines their scope of applicability, costs, and reliability as a compliance assessment indicator. The results of this activity feed into Work Package 5 to support the development of a coordinated screening methodology. It further explores the technical options to derive alternative energy performance assessment methods for those products that it is not currently practicable to test (for either financial or physical reasons) with a mind to inform potential future research and developments in the Ecodesign legislation and testing standards. Furthermore, it assesses generic relationships between large product types to determine whether aspects of the INTAS methodology could be easily exported to other large products such as pumps, large commercial refrigeration products, etc.

The report is informed by the outcomes and results from previous assessments in Work Packages 2 and 3 as well as the feedback gained from the pilot tests of the Work Package 3 methodology conducted for Work Package 4.1 and 4.2.

2. Costs of different conformity and risk assessment options

2.1 Introduction – what costs are considered?

When MSAs conduct conformity assessment actions they incur costs. These are associated with "fixed" staff time and overhead costs, and with "variable" costs such as sub-contracting (of experts or test laboratories), travel and any specific equipment costs. In principle, depending on the outcome of the conformity verification process, there could also be legal costs associated with bringing a case against a non-compliant supplier or even with defending the MSA against actions bought by a plaintiff; however, the current investigation is confined to consideration of the costs associated with initially verifying conformity of a product with the regulatory requirements, and does not consider additional costs which could subsequently be incurred. The discussion above puts the terms "fixed" and "variable" costs in quotation marks because it is a moot point how fixed the "fixed" costs are. Within a given annual operating budget an MSA will employ a given number of staff and once those are on the books their associated costs (wages plus overheads (social security, pensions, insurance and building/equipment costs) become a fixed cost that will be incurred almost independently of what the staff member does with their time. On the other hand, the allocation of MSA budgets and resources, is not independent of the value added that the MSA activity brings and hence it is important to establish both how much it will cost to conduct market surveillance activities and how much benefit will accrue from it. This section of the report considers the costs, while section 3 considers the benefits, but both need to be compared to understand the value proposition of conformity verification assessment for the products within the purview of the INTAS project.

The subsequent analysis considers the costs (both for staff and variable costs) for conducting conformity verification assessment actions for the INTAS products. As a starting point, data on staff costs were gathered from MSAs that participated in the methodology verification actions of WP4.1 and WP4.2 and work package 3. These reported staff costs as shown in Table 1 (note, the overhead estimates are applied in a common manner across the MSAs and are based on responses from a subset of these MSAs).

Table 1: Summary of staffing hourly costs reported by INTAS MSAs

	Staff costs (€/hour)		
	Wages	Overhead (approximate)	Total
MSA A	€ 37	€ 25	€ 62
MSA B	€ 39	€ 25	€ 64
MSA C	€ 13	€ 25	€ 37
MSA D	€ 25	€ 25	€ 51
Average	€ 28	€ 25	€ 53

Not surprisingly, the reported staffing costs varied substantially across the MSA's concerned and thus in the analyses that follow the focus is on the level of effort (LoE) as much as on the financial costs. This is to allow the results to be capable of extrapolation to any particular MSA's staff cost profile. The overhead costs are average values across all MSAs and for this exercise are treated as if they are identical; however, in practice they will depend on a number of local variables that are not directly correlated with wage rates.

2.2 Preparatory work

Whatever the conformity verification assessment process to be undertaken it will involve conducting preparatory work to know the market, to determine which suppliers are present, to establish the channels by which products are procured and placed on the market, to select suppliers and specific products for conformity assessment and to decide what kind of conformity assessment actions are to be conducted. As this preparatory work is required regardless of the conformity assessment process being followed, its steps and costs need to be accounted for in the overall cost of conducting market surveillance conformity verification actions.

The experience from the MSA's involved in the methodology verification process of WP 4.1 and WP 4.2 and in the activities of WP3.2 revealed that the level of effort (LoE) required to do this preparatory work was typically of the order of 2-3 days (full time equivalents, FTEs).

If the average hourly staff costs, including overheads, of Table 1 are applied this would equate to financial costs to an average MSA of about €1066 for the preparatory work.

The activities that are to be conducted in doing this preparatory work can include:

- researching the market
- actions to attain notification
- product identification and confirmation of being within scope
- screening and risk-based sample selection.

More detailed descriptions of these actions now follow.

2.2.1 MSA preparatory actions necessary to conduct Ecodesign conformity verification

Researching the market

Given the B2B nature of the market for large industrial products, it may require additional effort to identify the relevant market actors compared to that necessary for consumer products. The reason is that data on product suppliers and their procurers has to be compiled and this is not always readily in the public domain. Undertaking the activity helps with establishing channels to be notified when a product is being placed on the market (see the next sub-section) and then supports the creation of non-compliance risk profiles of suppliers, which is important for screening and the optimal selection of products for verification actions. The relevant market actors are:

- manufacturers (local/national)
- international manufacturers/suppliers with local/national representation
- principal end-users (local/national)
- principal procurers (local/national)
- main contractors with local/national representation.

Power transformers are predominantly used in the power sector (by TSOs, DSOs and generators) but also in industry and to a lesser extent by commercial businesses. Procurers can be directly within these organisations or within Engineering, Procurement and Construction contractors (EPCs) hired to build a specific facility where a transformer will be sited. Large industrial fans are mainly used in the following business segments:

- industrial processes (pharma, paint, chemical, drying, ovens, kilns etc.)
- tunnels and metros
- mining
- power plants
- shipbuilding.

The procurers of these fans can either be end-users, or EPCs that are building facilities on their behalf.

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Actions to attain notification

In order for MSAs to be aware of when products are being placed on the market they need to establish notification arrangements with the relevant actors. As discussed in INTAS deliverables 3.6 and 3.7 these can be:

- customs and excise authorities
- operative agencies responsible for approving transportation of large loads for road or rail (this would mostly be relevant for large power transformers)
- product end users and EPCs
- product suppliers[1].

Depending on the type of actor concerned the request for notification could be done:

- before the transformer or fan is placed on the market
- after the product is placed on the market but before it is put into service.

Collaborative information exchange between MSAs is also likely to be necessary to help ensure there are no loop-holes in the notification process.

Product identification and confirmation of being within scope

Once notification that a product is due to be placed on the market is received the MSA needs to identify the specific product and determine whether it is within scope of the regulations and/or subject to an exemption. If a product has come to the attention of a frontline agency such as customs authorities or a large transportation licensing operative then there may be an opportunity to do a visual inspection of the product; however, this is discussed under section 2.4. If a product is entering a country from outside the EEA then the customs authorities can conduct a first screening for scope by matching it's customs codes (under the 6- digit Harmonised System) and TARIC code[2] to those of products that might be eligible to fall within the scope of Ecodesign regulations. Thus, MSAs should consider establishing a system with Customs where there are automatic alerts when products are received at the borders with codes that are consistent with eligibility for Ecodesign regulations. If such systems are already in-place then MSAs may need to adapt them so that the codes applicable to Power transformers and industrial fans are included.

Screening and risk-based sample selection

Large industrial products such as industrial fans and power transformers are likely to be poorly suited to the product selection techniques that MSAs have established and deployed for Ecodesign conformity verification for smaller mass-produced products. The sampling process is discussed in

[1] INTAS is exploring the possibility of a mandatory notification for the MSAs to know if a transformer/fan has been installed (or produced), but currently there is no obligation for suppliers to inform MSAs that they have placed products on the market.
[2] https://en.wikipedia.org/wiki/TARIC_code

INTAS deliverables 4.1 and 4.2 for industrial fans and power transformers respectively; while the process of establishing risk-based screening of suppliers and products is discussed in INTAS deliverable 3.8.

2.2.2 Other supporting MSA actions

The above actions have described preparatory actions MSAs will need to do to be able to conduct conformity verification actions; however, as the real objective of MSAs is to maximise compliance with regulatory requirements they will also need to conduct actions that support product suppliers to comply with the regulations and build the capacity of the MSA, as explained below.

Creating awareness of the requirements

This is an essential initial step that should be carried out before any conformity verification actions are envisaged to ensure that suppliers and relevant economic operators are aware of the Ecodesign requirements that pertain to the equipment they are concerned with. Awareness raising can be done through various activities, such as:

- a national webpage on the Ecodesign regulations for different products
- newsletters
- guidelines for industry
- product focussed national information meetings for industry and other stakeholders
- information diffusion via industry and professional associations and chambers of commerce
- participation in national industry events
- direct contact with key local suppliers.

Building MSA capacity

MSAs need to build their own capacity to be able to conduct effective outreach and market surveillance for the products in question. As power transformers and industrial fans are specialised products this will likely require that the MSA takes some direct steps to ensure they have the necessary competences to be able to fulfil their function. MSA capacity building can be realised through:

- exchange of knowledge with other national market surveillance authorities and legislators (including market surveillance authorities focussing on other product related EU-legislation)
- exchange of knowledge with other EU market surveillance authorities and legislators
- identifying/consulting technical experts in the field of the specific products which could be:
  - participants of the national standardisation mirror groups of the product relevant standards
  - specialists at consultancies, technical institutes, test laboratories or universities

- secretary members of engineering, industry, trade or end-user associations.

2.3 Documentation inspection

Once the preparatory work is done the most common conformity verification assessment action is documentation inspection. To conduct documentation inspection involves preparatory work to establish which suppliers' products are to be checked, the establishment of which products are within scope of the regulations, the acquisition of the documents and then finally the checking of the documents to see if they comply with the requirements.

Much of the preparatory work is the same regardless of the conformity assessment or risk assessment procedure to be applied as each procedure requires knowing which suppliers' products are to be checked, establishing which of their products are within scope of the regulation(s) and then selecting the product(s) for the conformity verification procedure.

The actual document inspection is done by:

a) sending an official request for the supplier to provide the documents. Usually, these then arrive by e-mail and the inspector goes through them and completes the relevant entries in the MSA database where all cases are stored

b) a customs authority may ask an MSA for technical advice before a product enters the border. In this case the technical advice is based on documentation inspection

c) as part of a physical inspection

d) in the event that the necessary documents are not present at the inspected location, the inspected economic operator is given a fixed number of days (say 10) to provide the documents to the MSA.

The experience of the MSAs involved in WP4.1 and WP4.2 suggests that documentation inspection especially for case a) above (the most common case), will take an inspector about 3 to 8 hours per model. The processing time reported is asymmetric with most reporting around 3 hours and an average of about 4.5 hours. The time required seems to be relatively invariant on the type of product (at least for transformers or industrial fans) and the size of the model. This is not surprising as the number of items requiring checking is similar across the products and there is nothing that differs in the process as a function of the product size.

If the average hourly staff costs, including overheads, of Table 1 are applied and it is assumed that 4.5 hours are needed this would equate to financial costs to the MSA of about €240 per model for which the documentation was inspected.

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2.4 Physical inspection - rating plate

Rating plate inspections are not always done by an MSA themselves, but often by a third party, such as the Customs authorities or an agency involved in safety checks for installed equipment. There was rather limited experience among the MSAs involved in the WP4.1 and WP4.2 methodology verification step with this action. In one case it was reported that for transformers that the agency responsible for safety checks could also do a rating plate inspection, and that this would typically add about an hour to their inspection time. For the front-line agency to check the rating plate information and liaise with the MSA to establish its validity would probably take about a total of 2 hours at an indicative average cost of €106 per product inspected.

In the event that MSA staff are required to travel to a site, say a manufacturer's premises, to conduct such an inspection then the LoE rises considerably. A figure of 4 days of FTE has been reported for this action, which would equate to about €1075 plus travel costs (usually minor); however, in such a case it is highly unlikely that a check would be conducted on a single model and rather this LoE would be associated with checking a sample of models from a specific supplier or manufacturer. Thus, on a per model basis it could be imagined that the LoE would be about 2 hours (~ €106) per unit in this instance, and thus be equivalent to the customs check case.

As with documentation inspection there is no reason to imagine that there will be any systematic difference in the inspection times required per type of equipment (transformers or industrial fans) or that the time will be dependent on the size of the product.

Whenever a physical inspection of the rating plate is conducted it could also be an opportunity to do other plausibility checks as is discussed under section 2.9.

2.5 Testing in third party labs

Testing in third party labs requires an MSA to engage with the lab to arrange the testing to be conducted, arrange for a sample or samples to be sent to the lab, arrange the transportation, conduct the tests and process the results. Depending on the legal situation applicable in the MSA's jurisdiction the MSA may need to purchase the samples to be tested, or alternatively, they may have the power to oblige the economic operator to supply the product for testing free of charge.

The actual set of actions directly done by the MSA can be as little as engaging with the 3rd party test lab and processing the results, or could also include the sampling, sample acquisition and transportation to the test lab and back. In many cases the MSA will sub-contract the test lab to also do the sampling, sample collection and manage the transportation but in all cases the 3rd party test lab will do the actual product verification testing and will produce the test report.

2.5.1 The case of power transformers

The experience of INTAS MSAs doing verification testing on more than 40 power transformers has been synthesised in the results reported in Table 2. This shows “averaged” findings of analysis from six MSAs representing geographically and economically diverse member states and aims to give an indication of costs and levels of effort associated with organising 3rd party testing of power transformers of a rated capacity ranging from 400kVA to 40 MVA. In practice none of the MSA’s had to purchase the transformers to do 3rd party verification testing; however, the final column includes estimates of what purchase costs might be expected to be were this to be necessary (based on findings from the recent Ecodesign Lot 2 preparatory study). Freight (travel) costs can also be significant for power transformers and could become a very significant cost if the products are moved by road and out of country. Overall the cost of the test in the 3rd party lab is roughly equivalent to the cost of the MSA staff time to manage the process. The transportation costs can be less than or more than either of these cost bins depending on the size and weight of the transformers, the extent by which transportation is by road (as opposed to boat or rail) and the distance to be travelled. The cost of purchasing a transformer are considerably greater than these costs.

What is clear from this data is that if an MSA would need to pay to acquire a large power transformer for Ecodesign conformity verification testing it would become prohibitively expensive within current MSA budgets. Happily, many MSAs have other options to oblige verification testing without needing to purchase the product, while witness testing of factory acceptance tests, see section 2.8, is also a legally viable option for large power transformers.

Table 2: Indicative 3rd party conformity verification testing costs for MSAs for power transformers
(costs expressed per transformer tested)

kVA	Lab test cost	MSA hours	MSA staff cost	Estimated product to lab travel costs € (by road and in country)	Total cost ex acquisition	Estimated product to lab travel costs € (by road and ex country)	Total cost ex acquisition with ex country testing	Acquisition cost if product must be purchased
400	€ 356	7	€ 371	€ 98	€ 978	€ 298	€ 1,178	€ 7,824
1000	€ 380	14	€ 742	€ 246	€ 1,910	€ 744	€ 2,408	€ 13,567
4000	€ 500	21	€ 1,113	€ 983	€ 2,434	€ 2,978	€ 4,429	€ 67,593
40000	€ 1,940	28	€ 1,484	€ 9,827	€ 13,258	€ 29,778	€ 33,209	€ 313,554

2.5.2 The case of industrial fans

The experience of INTAS MSAs doing verification testing on several industrial fans has been synthesised in the results reported in Table 3. This shows "averaged" findings of cost data from three MSAs.

Table 3: Indicative 3rd party conformity verification testing costs for MSAs for industrial fans (costs expressed per fan tested)

kW	Lab test cost	MSA hours	MSA staff cost	Estimated product to lab travel costs € (by road and in country)	Total cost ex acquisition	Estimated product to lab travel costs € (by road and ex country)	Total cost ex acquisition with ex country testing	Acquisition cost if product must be purchased
10	€ 3,250	3.5	€ 186	€ 125	€ 3,561	€ 250	€ 3,686	€ 3,696
25	€ 5,393	4	€ 204	€ 286	€ 5,883	€ 443	€ 6,040	€ 6,567
45	€ 8,250	4.2	€ 223	€ 500	€ 8,973	€ 700	€ 9,173	€ 10,395

The data above only concerns large fans, i.e. those in the 10-100kW range, and does not consider extra-large fans (i.e. those in the 100 to 500kW range). The reason for this is because currently there are no 3rd party test labs capable of doing full capacity testing of large fans about 40kW in Europe. The only means of testing such fans currently is in manufacturer laboratories (see the discussion of witness testing in section 2.8) or via the use of either scale model testing or reduced speed testing in a 3rd party laboratory (see discussion in section 2.9).

2.6 Testing in situ - at final site

Testing in situ at the final site only appears to be a potentially viable option for power transformers as there are too many variables in the manner in which a fan is installed that can affect its energy performance results and also it is challenging to extrapolate to the best efficiency point (BEP) for fans outside of a test lab.

In the case of transformers there are more grounds for confidence; however, it is still an area where there are some uncertainties and so it will not necessarily produce a legally enforceable result – at least until such time as a common European in situ test standard has been established. In particular, it is currently difficult to assure a controlled temperature environment at the final site (as would normally be done at a test laboratory) and also to elevate the temperature to the level used in the test standard (i.e. to 70°C). Furthermore, all the above supposes it is possible to test

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the transformer under the loading test points applied in the standard. For power transformers with a rated power of up to 3750 kVA it is possible to measure no-load and full conditions, per the test standard, by short-circuiting the transformer. For larger transformers it is more problematic to determine the peak efficiency index (PEI) as this requires varying the load applied to the transformer; however, this can be done with specialist mobile testing equipment that have very large power supplies albeit at a substantial cost. Unfortunately, there were no instances within the INTAS MSA testing effort of Work Package 3 when transformers were tested at their final site and thus there is no specific cost data available for this option at present; however, some companies are known to provide mobile testing services and thus this remains a theoretical option. Table 4 presents indicative estimates of what these costs could be for power transformers.

Table 4: Indicative at-final-site verification testing costs for MSAs for power transformers (costs expressed per transformer tested)

kVA	Mobile test equipment hire cost	MSA hours	MSA staff cost	Estimated testing equipment to lab travel costs € (by road and in country)	Total cost id
400	€ 1,000	7	€ 371	€ 400	€ 1,771
1000	€ 1,000	14	€ 742	€ 400	€ 2,142
4000	€ 1,000	21	€ 1,113	€ 400	€ 2,513
40000	€ 6,000	28	€ 1,484	€ 800	€ 8,284

2.7 Testing in situ - at manufacturer's premises

In principle, MSA's can request conformity verification testing to be done on site at a manufacturer's premises. This was done in Work Package 3 for two cases – one where the MSA used the manufacturer's testing facilities but 3rd party laboratory measuring equipment, and the other where the manufacturers facilities and measuring equipment were used.

2.7.1 The case of power transformers

Slightly less than half of the verification testing done by INTAS MSAs on transformers was done at a manufacturer's premises using testing equipment supplied by an independent laboratory. The cost of verification testing in this case was essentially indistinguishable from that of doing testing at a 3rd party test lab excepting the transportation costs for the independent lab equipment are likely to be less than those necessary to transport power transformers to a 3rd party lab. Accordingly, the average estimated costs are shown in Table 5 as a function of the transformer's rated power.

Table 5: Indicative costs for MSA's of conducting verification testing at a manufacturer's premises using 3rd party laboratory test equipment (costs expressed per transformer tested)

kVA	Test cost including hiring 3rd party test equipment and 3rd party testing expertise	MSA hours	MSA staff cost	Staff and test equipment travel costs € (by road and in country)	Total cost
400	€ 621	7	€ 371	€ 400	€ 1,392
1000	€ 645	14	€ 742	€ 400	€ 1,787
4000	€ 765	21	€ 1,113	€ 400	€ 2,278
40000	€ 2,205	28	€ 1,484	€ 800	€ 4,489

In this case there is no issue of transformer acquisition costs as the product is tested in situ at the manufacturer's premises. Rather, this option invokes the powers granted under Regulation 548-2014 Annex III for an MSA to conduct verification testing at a manufacturer's premises.

2.7.2 The case of industrial fans

The option of testing fans at a manufacturer's premises using testing equipment supplied by an independent laboratory was not examined in the INTAS testing activities and it is probably not a feasible option as the key part of the test rig would have to be the manufacturer's own equipment. Therefore, this option is not explored further for fans.

2.8 Witness testing at manufacturer's premises

Witness testing at manufacturers premises, in the form of witnessing a Factory Acceptance Test (FAT) is a very common commercial process for large power transformers; however, it is a much less common procedure for industrial fans. In the latter case it only currently routinely occurs for large industrial fans destined for use in ATEX regulated environments (e.g. for environments with a risk of explosions), for fans destined for use in large road tunnels and for fans for other sensitive applications such as large power stations or ships.

In the case of large power transformers Ecodesign Regulation 548-2014, Annex III on *Verification procedure* explicitly states that:

Given the weight and size limitations in the transportation of medium and large power transformers, Member States authorities may decide to undertake the verification procedure at the premises of manufacturers, before they are put into service in their final destination.

This authorises MSAs to use witness testing of a FAT as one of the means by which they can verify conformity with the regulations. Indeed, the provision leaves it open as to how the verification testing is to be done, by whom and using whose equipment. Thus, in actuality, the following cases are permitted:

- an MSA (or agencies hired on their behalf) witnessing a FAT conducted by the manufacturer on behalf of the final client
- an MSA (or agencies hired on their behalf) using a manufacturer's test facilities and equipment to conduct testing of a manufacturer's product that has not yet left the premises
- an MSA (or agencies hired on their behalf) using a manufacturer's test facilities but using the MSA's test equipment to conduct testing of a manufacturer's product that has not yet left the premises.

2.8.1 The case of power transformers

Witness testing of a FAT was done by INTAS MSAs for two transformers in Work Package 3. Based on this experience, and the data supplied by the MSA's engaged in Work Package 4.1 and 4.2 activities to verify the INTAS market surveillance methodologies, the estimated indicative costs of doing witness testing for power transformers are as shown in Table 6.

Table 6: Indicative costs for MSA's of conducting witness testing of a manufacturer's factory acceptance test (costs expressed per transformer tested)

kVA	Test cost including hiring 3rd party test equipment and 3rd party testing expertise	MSA hours	MSA staff cost	Staff travel costs € (by road and in country)	Total cost
400	€ 1,500	7	€ 371	€ 100	€ 1,971
1000	€ 1,500	14	€ 742	€ 100	€ 2,342
4000	€ 1,500	21	€ 1,113	€ 100	€ 2,713
40000	€ 2,000	28	€ 1,484	€ 100	€ 3,584

If the FAT is to be done in another EU country extra travel costs of from €200 to €900 could be added to this.

In this case there is no issue of incurring transformer acquisition costs as the product is tested in situ at the manufacturer's premises. Rather, this option invokes the powers granted under Regulation 548-2014 Annex III for an MSA to conduct verification testing at a manufacturer's premises.

2.8.2 The case of industrial fans

Factory acceptance testing (FAT) is not very common in the industrial fan business – at least not for fans in the scope of Regulation (EU) No. 327. However, for those manufacturers doing FATs on a regular basis, there is the option that the MSA could participate in a FAT witness test with the customer where the performance of the fan is demonstrated to both the customer and MSA. In this case the MSA and fan manufacturer should agree on the conditions of the test which could be based on commercial practice e.g. with reference to EN ISO 13348 but with tolerances according to Regulation (EU) No. 327.

In the case where an MSA representative is going to witness a FAT for a large industrial fan, the costs are estimated to be equivalent to one week's work including preparation, participation and reporting. Anticipating the MSA representative being an external specialist with a day-rate of €800 this will amount to approximately €4000.

2.9 Non-conformity risk assessment methods

Aside from the conformity verification actions described above, there is also the option for MSAs to conduct other actions to determine non-conformity risk. These methods are summarised below.

2.9.1 Plausibility checks via physical inspection

Section 2.4 discussed physical inspection of product rating plates to determine conformity with Ecodesign requirements; however, in principle whenever a product is undergoing a visual inspection it could also be an opportunity to conduct physical inspection plausibility checks that could be used to determine non-compliance risk. In the case of power transformers these could entail weighing the product and checking its dimensions to provide evidence to be used in a bill of materials (BOM) check and a related plausibility check (see section 2.9). For fans this could include some basic visual inspection of fan blade clearances and other physical properties to see if it is likely that the product might not pass the energy performance requirements as has been proposed by EVIA via a plausibility check process.

There is currently no data on the limits of applicability of these methods or the time and costs they would require to be conducted. However, one could imagine that the inspection and weighing time required to gather the plausibility data for a transformer might be of the order of from 3 to 5 hours, depending on the size of the transformer and hence cost in the range of from €159 to €265. This presumes that the product is in a location, such as a Customs control area, where it can be weighed and that the amortised cost of this equipment per weighing operation is minimal.

For fans one could imagine a visual inspection process might take ~ 2 hours per product (assuming a check list and an experienced operator) and hence could cost €106.

2.9.2 Simulation modelling (scrutiny of design engineering calculations)

Design simulation modelling is universally used by manufacturers of power transformers and large industrial fans. In each case the producers use their own proprietary simulation tools to develop their product designs and to estimate their energy performance. In general, these tools are widely understood to be capable of producing accurate and reliable results; however, it is a challenge for an MSA to use them in conformity verification applications because:

- they are either proprietary to the producers, or
- if they are used by an independent economic actor, such as a 3rd party design engineering consultancy, they would require detailed data on the product from the manufacturer to be able to conduct the simulation.

There is no experience of using such services or simulation tools among the INTAS partners nor is there any data available on the cost of hiring such services. However, standard engineering consultancy fees are typically of the order of €800/day and it can be imagined that it might take up to 4 days of a consultancies time to conduct a simulation of a large industrial product (in part, due to the time taken liaise with the manufacturer to acquire the required data in the format needed, but then to load the data, conduct the simulation, produce the report and liaise with the MSA and economic actor on the findings).

In principle, much simpler simulations could be done for very basic non-compliance risk assessments. For example, if the BOM and basic dimensions of a transformer are known then it should be possible to use simulation tools to assess if the transformer could comply with the requirements within a certain margin of error. Again, the lack of data on this actual process hinders the ability to make a cost estimation but with the right software set-up (which could entail a one-off cost) then it should be possible to do such an assessment for about 2 working days of a consulting engineer's time.

To the consultant engineer's costs should be added the MSA staff costs, which would be estimated to be about 10 hours per unit on top of the general preparatory costs discussed in section 2.2. Thus, this would add approximately €530 to the cost of the exercise. Overall then a very approximate estimate is that a one-off detailed design simulation would cost of the order of €3630 per unit, while a one-off BOM plausibility screening simulation might cost €2130 per unit. However, these figures would be expected to be significantly lower on a per-unit basis if a large number of products were being assessed, and especially if those products were from the same supplier (as this minimises the time taken to ensure the necessary data is supplied in the required format per unit to be assessed).

An alternative approach involving simulation is for an MSA to engage 3rd party consulting engineers to check a manufacturer's own simulation files and results; potentially making use of the manufacturer's own design software. This would be a plausibility assessment that could entail an MSA requesting that their design engineer should be granted access to the software tool and data files for a random selection of models. Such a check would be intended to establish that the manufacturer uses robust design software, and that the reported results are consistent with their own simulations and claimed performance. Typically, under this kind of scenario a factory visit would need to be conducted wherein one could imagine a manufacturer's simulation results for about 20 models would be checked against the declared performance of the products. This could involve something like two days of expert time and about 10 hours of MSA staff time, making a total cost of about €2330 including travel costs, i.e. about €117 per model checked.

2.9.3 Scale model testing (or part-load testing) and simulation modelling of large industrial fans

Scale model testing combined with scale-effect simulation modelling has been identified by the Work Package 3 activities in INTAS as a potentially viable means, from a technical perspective, of verifying the energy performance of large industrial fans. Currently, this method (and the equivalent of reduced speed testing) is the only means by which 3rd party labs could be used to verify energy performance of large fans (i.e. those that have a capacity greater than any existing 3rd party laboratory in Europe is capable of testing at full load). Having noted this, such methods do not currently produce a legally enforceable result and thus changes in the legislation and/or accepted test methods would be necessary for them to be used to produce legally enforceable results. The costs of these methods are essentially those reported in Table 3 for large fans and are repeated below in Table 7.

Table 7: Indicative 3rd party conformity verification testing costs for MSAs for large industrial fans using scale-model or part-load testing (costs expressed per fan tested)

kW	Lab test cost	MSA hours	MSA staff cost	Estimated product to lab travel costs € (by road and in country)	Total cost ex acquisition	Estimated product to lab travel costs € (by road and ex country)	Total cost ex acquisition with ex country testing	Acquisition cost if product must be purchased
45	€ 8,250	4.2	€ 223	€ 500	€ 8,973	€ 700	€ 9,173	€ 10,395

Note, that while scale model testing costs could be broadly in line with the values reported above it may also require including some check of the design of the large fan compared to the scaled fan to be tested that will introduce additional costs. Also, both the scale-model testing approach and part-load testing approach require application of scaling-law algorithms to project the performance of the fan at full scale, or speed and hence entail an aspect of performance simulation; however, this is already integrated into the above cost estimates.

2.9.4 Checking manufacturer quality assurance systems

In principle checking manufacturer quality assurance systems could provide an indicator of the likelihood that their products could comply with the Ecodesign requirements. There is not yet any experience among INTAS MSAs in doing such checks that could be drawn upon to provide cost estimates of this activity.

2.10 Summary of costs by method

This section summarises the indicative costs reported in the sections above to facilitate comparisons across the various conformity verification methods. The results are reported separately for power transformers and industrial fans, with distinctions made between those methods which are currently able to produce legally enforceable results, those that are indicative but not currently legally enforceable (yet might be in the future) and those that provide an indicator of non-conformity risk.

2.10.1 Summary of conformity verification costs for power transformers

The summary of costs per conformity verification method for power transformers are shown in Table 8. The average unit costs are averaged across the 400kVA, 1000kVA, 4000kVA and 40MVA cases. The 40MVA costs are also reported as a specific case of a large power transformer. The 2nd and 3rd columns show the actual indicative costs whereas the 4th and 5th columns show the costs relative to verification testing in a 3rd party laboratory.

From these comparisons it is evident that 3rd party testing is between 50 and a 100-times more costly than documentation inspection or inspection of rating plates for very large transformers, although these methods are not verifying equivalent types of conformity with the regulations. Witness testing at a manufacturer's facilities is probably about a quarter of the cost of 3rd party laboratory testing for such products. Among the risk assessment methods, checking consistency of a manufacturer's simulation software results with those declared would probably cost about 1/5th of the cost of doing 3rd party verification testing, but does not in itself produce a legally enforceable outcome. This is based on an assumption of a factory visit to check the simulation results for a single product, but in fact it would probably be possible to check such results for about 10-15 products for almost the same cost as to check one and so the per-unit cost would decline significantly were this approach used.

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Table 8: Summary of indicative costs for MSAs per conformity verification method for power transformers (costs expressed per unit tested)

Method	Indicative verification costs per unit		Indicative verification costs per unit relative to testing in a 3rd party laboratory	
	Average unit	40 MVA unit	Average unit cost	40 MVA unit cost
1. Documentation inspection	€ 239	€ 239	6%	2%
2. Physical inspections	€ 106	€ 106	3%	1%
3. 3rd party testing	€ 3,688	€ 13,258	100%	100%
4. Verification testing in situ - at final site	€ 3,166	€ 8,284	86%	62%
5. Verification testing in situ - at manufacturer's premises	€ 2,264	€ 4,489	61%	34%
6. Witness testing at manufacturer's premises	€ 2,549	€ 3,584	69%	27%
Risk assessment methods				
7. Detailed simulation modelling	€ 614	€ 3,730	17%	28%
8. Simplified plausibility simulation modelling	€ 459	€ 2,130	12%	16%
9. Checking consistency of manufacturer's simulation modelling with declared results	€ 117	€ 2,330	3%	18%

2.10.2 Summary of verification costs for industrial fans

The summary of costs per conformity verification method for industrial fans are shown in Table 9. The average unit costs are averaged across the 10kW, 25kW, and 45kW cases. The 45kW costs are also reported as a specific case of a large industrial fan. The 2nd and 3rd columns show the actual indicative costs whereas the 4th and 5th columns show the costs relative to verification testing in a 3rd party laboratory.

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Table 9: Summary of indicative costs for MSAs per conformity verification method for industrial fans (costs expressed per unit tested)

Method	Indicative verification costs per unit		Indicative verification costs per unit relative to testing in a 3rd party laboratory	
	Average unit	45 kW unit	Average unit cost	45 kW unit cost
1. Documentation inspection	€ 239	€ 239	4%	3%
2. Physical inspections	€ 106	€ 106	2%	1%
3. 3rd party testing	€ 6,139	€ 8,973	100%	100%
4. Verification testing in situ - at final site	NA	NA	NA	NA
5. Verification testing in situ - at manufacturer's premises	€ 6,404	€ 9,238	104%	103%
6. Witness testing at manufacturer’s premises	€ 508	€ 723	8%	8%
Risk assessment methods				
7. Detailed simulation modelling	€ 2,477	€ 2,530	40%	28%
8. Simplified plausibility simulation modelling	€ 2,077	€ 2,130	34%	24%
9. Checking consistency of manufacturer's simulation modelling with declared results	€ 155	€ 2,330	3%	26%
10. Scale model testing or part-load for fans (only applicable to very large fans)		€ 8,973	NA	100%

From these comparisons it is evident that 3rd party testing is between 33 and a 100-times more costly than documentation inspection or inspection of rating plates for large fans, although these methods are not verifying equivalent types of conformity with the regulations. Witness testing at a manufacturer’s facilities is probably less than a 10th of the cost of 3rd party laboratory testing for such products; however, such testing is only done for certain types of fans and hence is not a widely applicable option (nor does it currently produce legally enforceable outcomes). The three risk assessment methods of: detailed simulation modelling, simplified plausibility modelling, and checking consistency of a manufacturer’s simulation software results with those declared; would probably cost about 1/4th of the cost of doing 3rd party verification testing but do not produce legally enforceable outcomes. However, practically this is also the situation currently confronted by 3rd party testing of such products because existing independent laboratories are not (yet) capable of testing such large fans (e.g. the 45kW example above) due to capacity limitations. The only way they could test such products is via scale-model or reduced speed methods, yet these do not currently produce legally enforceable results (note, the values reported above for both method 4 of 3rd party testing and method 10 of scale-model or part-load testing are therefore exactly the same).

3. Benefits of different conformity and risk assessment options

This section considers the benefits associated with the various conformity assessment options and then for the various risk assessment options. In particular, it includes an analysis of the value of benefits that would be expected from the energy savings that would accrue each time a non-compliant product is made to comply with the regulations with regard to its energy performance. In making these estimates the following simple working assumptions are used for power transformers and industrial fans respectively.

Power transformers

Assumed annual run time (hrs)	8760
Assumed life span (years)	30
Value of conserved electricity (€/kWh)	0.05
Average loading	40%

Industrial fans

Assumed annual run time (hrs)	3000
Assumed life span (years)	10
Value of conserved electricity (€/kWh)	0.10

In practice both products could have quite different values e.g. fans can last for much longer than 10 years and transformers for much longer than 30 years. Similarly, the value of conserved electricity for power transformers is considered to be significantly lower than for industrial fans because the former is mostly paid by TSOs and DSOs while the latter is mostly paid by end-user business clients. For simplicity, it is assumed that the cost of electricity does not vary over time but in practice net present value discount rates and price escalation rates will cause countervailing effects on the future value of electricity when expressed today. The annual operating hours of fans can also be much higher or lower than 3000 hours, although for large fans they will tend to be high. Overall then the assumptions are rather conservative; however, while the macro-economic impact analysis to be conducted in Work Package 5.2 will investigate the cost-benefits for society under scenarios fully aligned with previous EU regulatory impact assessments, the analysis presented below works on the above assumptions.

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The benefit analysis is presented first for the various conformity verification options discussed in section 2 before repeating the exercise for the risk assessment options (also presented in section 2).

3.1 Conformity verification options

The conformity verification methods considered in this section are suited to producing a legally enforceable outcome. They begin with the case of performance verification testing in a 3rd party laboratory as this produces definitive energy performance compliance results. Other methods can then be compared to this.

3.1.1 3rd party testing

Conformity verification testing in a 3rd party laboratory will produce a clear independent measure of whether a product's energy performance complies with the Ecodesign requirements. It is thus, the most unambiguous conformity verification option open to MSAs.

Cost per legally enforceable outcome

On average, verification testing in a 3rd party laboratory is estimated to cost €3,688/unit (€0.45/kVA) per power transformer and €6139 (€273/kW) per industrial fan in cases where the testing occurs in the same country as the MSA.

If it is assumed that for a virgin market, i.e. one where no Ecodesign compliance activities have previously been implemented, that the non-compliance rate with the energy performance requirements is 10% (i.e. that one in ten products has non-compliant energy performance) then the initial cost of establishing one case of non-conformity would be €36,880 (€4.5/kVA) for power transformers and €61,390 (€2,730/kW) for industrial fans.

If an MSA were to conduct a sustained, i.e. year on year, verification testing exercise then it could be expected that their earlier results would have a deterrent effect, as non-compliant suppliers are identified and enforcement actions taken, so that the non-compliance rate would decline. Evidently, this would increase the cost per legally enforceable outcome, so that if after a few years of effort the non-compliance rate had dropped to 1% the cost per failed verification test would increase to €45/kVA for power transformers and €27,300/kW for industrial fans respectively. However, this situation would also only arise in response to the market surveillance activity and demonstrate that it is producing an effective deterrent to non-compliant energy performance.

Value of energy savings

To estimate the value of energy savings benefits attributable to 3rd party verification testing it is assumed that:

- verification testing identifies 100% of cases where a product's actual energy performance does not comply with the Ecodesign requirements

- in cases where it is established that the energy performance of a product does not comply with the Ecodesign requirements the fact of being caught being non-compliant and the associated sanctions will deter the same supplier from putting other non-compliant models on the market in future according to the following, hypothetical, schema:

Table 10: Working assumptions on how non-compliance detection will affect future levels of non-compliance by the same supplier

Instance non-compliance detected	Non-compliance recurrence rate
First instance	75%
Second instance	55%
Third instance	40%
Fourth instance or more	25%

To correctly interpret the above schema, it is important to appreciate that the notion of non-compliance detection instances assumes that there is a temporal gap between each instance of non-compliance detected that is sufficiently long for the product supplier to amend their practices to be compliant, thus it entails at least a 6-month gap between non-compliance detection instances. This means that the same supplier could be found to have a number of non-compliant models in an initial documentation inspection action, but these would all still count as a first instance of non-compliance detection; albeit, that it would indicate a systematic issue with the practices of the supplier and hence raise their risk profile with the MSA. It should also be understood that the non-compliance recurrence rate refers to the working assumptions regarding the likelihood that a supplier will be a repeat offender with other products. It does not mean with the same model will remain uncompliant and still on the market – as it is expected that MSAs will pursue measures that ensure any non-compliant model has to be demonstrably brought into compliance before it can be put back on the market.

To then translate the above assumptions into estimated energy savings the following assumptions are made about energy-performance non-compliance levels for models that are in markets where Ecodesign market surveillance actions have not yet occurred:

- the share of models that have non-compliant energy performance is 10%
- the average level of non-compliance for non-compliant power transformer models is 27% above the permitted loss levels under the Ecodesign regulations

- the average level of non-compliance for non-compliant industrial fan models is 15% below the minimum permitted efficiency levels under the Ecodesign regulations.

In the case of power transformers these values are consistent with the available MSA data. Note, that although the non-compliance value of 27% is assumed to be greater than for fans (15%) this is applicable to transformer losses, whereas the fan working assumption is for efficiency levels at the Best Efficiency Point. Currently, there is insufficient data to be have a good idea of what level of non-compliance to actually expect for industrial fans. The testing base in Work Package 3 was limited and more concerned with demonstrating alternative energy performance measurement methods to allow the energy performance of large fans to be tested in current test lab facilities than with establishing non-compliance levels. Industry discussions reveal a wide and contrasting set of views about probable/likely non-compliance levels for fans and so there is a dearth of hard evidence on which to base numbers; thus, the actual levels of non-compliance could be quite different to these assumptions. Even for power transformers, while the evidence base is much stronger, it is still far from sufficient to be sure it is representative of the whole EU market.

3.1.1.1 Power transformers

Considering these factors the following value of lifetime energy savings to the end-user can be estimated from ensuring that an otherwise non-compliant power transformer is rendered compliant with the regulatory requirements, Table 11.

Table 11: Estimated value of lifetime energy savings per power transformer from making a non-compliant transformer comply with the Ecodesign regulations [value of saved electricity (€/lifespan/ kVA)]

	Transformer power rating (kVA)				
Assumed average extra losses above the limit	100	1000	10000	40000	100000
27%	€ 36.19	€ 21.36	€ 18.20	€ 7.68	€ 6.91
30%	€ 40.21	€ 23.73	€ 20.22	€ 8.53	€ 7.68
20%	€ 26.81	€ 15.82	€ 13.48	€ 5.69	€ 5.12
10%	€ 13.40	€ 7.91	€ 6.74	€ 2.84	€ 2.56

The value of energy saved per transformer made compliant with the regulations ranges from €36/kVA to ~€7/kVA depending on the size of the transformer for the central assumption case of average losses of a non-compliant transformer being 27% above the permitted regulatory limit. For a large, 40MVA power transformer this equates to total savings of a value of €307,000 for a single unit over its lifetime. For a smaller 1MVA transformer the central value of lifetime savings are estimated at €21,400.

To put these values into context the value of the energy savings for the central case (i.e. where an average non-compliant model has losses 27% above the Ecodesign limit) can be compared to the expected cost incurred by an MSA of doing 3rd party testing to verify that a product conforms with the regulations as shown in Table 12.

Table 12: Estimated value of lifetime energy savings per power transformer from making a non-compliant transformer comply with the Ecodesign regulations via 3rd party testing [value of saved electricity (€/lifespan/ kVA)]

	Transformer power rating (kVA)				
Case	100	1000	10000	40000	100000
Life time cost of non-compliant losses (€/kVA)					
losses 27% above limit	€ 36.19	€ 21.36	€ 18.20	€ 7.68	€ 6.91
Cost of 3rd party testing (€/kVA)					
Cost of 3rd party testing per kVA for a single non-compliant model	€ 3.30	€ 1.91	€ 0.56	€ 0.33	€ 0.20
Cost of 3rd party testing per kVA for 10 non-compliant models	€ 33.30	€ 19.10	€ 5.60	€ 3.30	€ 2.00

The MSA costs incurred to test a single model varies between €3.30/kVA and €0.20/kVA. As, under the central assumption, an average of 10 models would need to be tested to identify one non-compliant one, then the value of electricity savings over a non-compliant product's lifetime should be compared to the cost of doing 10 tests i.e. the average number needed to identify a non-compliant model. In this case the cost of testing 10 models is between a factor of 3.4 and 1.1 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers.

This analysis suggests that even on these simplistic terms there is a societal value proposition from conducting this form of market surveillance. However, this comparison ignores the wider deterrence effect of non-compliance detection. The magnitude of this effect is not known but it should lead to energy savings that are orders of magnitude greater than those attributable to rendering a single non-compliant model compliant. This issue, and the wider macro-economic impacts of market surveillance for INTAS products will be explored further in Work Package 5.2.

In making the comparisons above it is understood that the MSA is not a direct beneficiary of the energy savings its work produces and rather the end-user/owner of the product (whomever pays the energy bills) would be the actual beneficiary. However, as MSAs are charged with their responsibilities for the public good and the justification for their actions is related to this, then it is important to derive estimates of cost-benefits even if they occur at the wider societal level.

3.1.1.2 Industrial fans

In the case of fans and considering the same factors then the following value of lifetime energy savings to the end-user can be estimated from ensuring that a non-compliant industrial fan is compliant with the regulatory requirements, Table 13.

Table 13: Estimated value of lifetime energy savings per industrial fan from making a non-compliant industrial fan comply with the Ecodesign regulations via 3rd party testing [value of saved electricity (€/lifespan/ kW)]

	Fan power rating (kW)				
Assumed degree by which the fan efficiency is below the limit	10	25	45	100	500
15%	€ 450	€ 450	€ 450	€ 450	€ 450
20%	€ 600	€ 600	€ 600	€ 600	€ 600
10%	€ 300	€ 300	€ 300	€ 300	€ 300
5%	€ 150	€ 150	€ 150	€ 150	€ 150

The value of energy saved per fan made compliant with the regulations is €350/kW for the central assumption case of the average efficiency of a non-compliant fan being 15% below the permitted regulatory limit. For a 45 kW fan this equates to total savings of a value of €20,250 for a single unit over its lifetime. For a smaller 10 kW fan the central value of lifetime savings are estimated at €4,500 while for a very large 500kW fan they are €225,000.

To put these values into context the value of the energy savings for the central case (i.e. where an average non-compliant model has an efficiency at BEP of 15% below the Ecodesign limit) can be compared to the expected cost incurred by an MSA of doing 3rd party testing to verify that a product conforms with the regulations as shown in Table 14.

Table 14: Estimated value of lifetime energy savings per industrial fan from making a non-compliant industrial fan comply with the Ecodesign regulations [value of saved electricity (€/lifespan/ kW)]

	Fan power rating (kW)				
Case	10	25	45	100	500
Life time cost of non-compliance (€/kW)					
efficiency 15% below limit	€ 450	€ 450	€ 450	€ 450	€ 450
Cost of 3rd party testing (€/kW)					
Cost of 3rd party testing per kW for a single non-compliant model	€ 356	€ 235	€ 199	€ 143	€ 76
Cost of 3rd party testing per kW for 10 non-compliant models	€ 3560	€ 2350	€ 1990	€ 1430	€ 760

The estimated MSA costs incurred to test a single model varies between €356/kW and €76/kW. As, under the central assumption, an average of 10 models would need to be tested to identify one non-compliant one, then the value of electricity savings over a non-compliant product's lifetime should be compared to the cost of doing 10 tests i.e. the average number needed to identify a non-compliant model. In this case the cost of testing 10 models is between a factor of 7.9 and 1.7 times greater than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest fans.

On face value this analysis suggests that it is not cost-effective to do 3rd party verification testing of fans on a single model basis; however, this ignores the deterrence impact that such testing has, which will produce savings many times greater (probably by orders of magnitude) than those attributable to removing a single none compliant model from the market. This will be explored further in work package 5.2.

3.1.2 Documentation inspection

Documentation inspection is a first means of establishing whether a product is in conformity with the Ecodesign regulations. The inspection produces a clear and legally enforceable result with regard to the product's conformity. It is also an exercise that is comparatively cheap to conduct and can often be managed directly by an MSA (i.e. sub-contracting or using the services of other entities is not usually required but is an option).

The qualitative benefits of documentation inspection are:

- a comparatively cheap means of determining whether a product complies with one aspect of the regulatory requirements
- a check whose feasibility is not directly affected by the product size or cost and hence is viable for products under the purview of INTAS
- a check that produces a clear legally enforceable outcome
- a check that also provides a potential risk indicator of whether a product might be non-compliant with product performance requirements.

The limitations of documentation inspection are:

- The check only determines whether the paperwork of the product is in order but does not explicitly verify whether the performance values (such as the energy efficiency) reported in the documentation are correct, thus, it would be possible for an unscrupulous supplier to present documentation that purports that the product conforms to the Ecodesign requirement when in reality it may not. This is especially the case if the supporting test lab report is:
    - falsified
    - does not actually pertain to the product claimed
    - conducted in a test lab that produces erroneous results.
- As with all other compliance assessment pathways the conduct of documentation inspections is only possible when an MSA is aware that a product is placed on the market, which is not straightforward for the B2B products addressed in the INTAS project.

As mentioned in section 2.3, practically there are different pathways by which documentation inspection can be conducted including:

- an MSA or its operative making an at-a-distance request to an economic operator to supply documentation on specified models
- an MSA or its operative making a visit to the site of the economic operator and requesting the documentation on selected models while at the site
- customs authorities requesting documentation of imported products at the borders and either conducting the documentation checks themselves or passing them to the MSA or its operatives for checking

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As there are relatively modest differences in costs associated with these pathways then the cost-benefit assessment below is assumed to be common to all of them, however, for any specific MSA's situation there are likely to be some differences.

Cost per legally enforceable outcome

On average documentation inspection is estimated to cost €239 per power transformer or industrial fan. If we assume that for a virgin market, i.e. one where no Ecodesign compliance activities have previously been implemented, that the non-compliance rate with documentation inspection is 33.3% then the initial cost of establishing one case of non-conformity would be €717 for both power transformers and industrial fans. If an MSA were to conduct a sustained, i.e. year on year, documentation checking exercise then it could be expected that their earlier results would have a deterrent effect, as non-compliant suppliers are identified and enforcement actions taken, so that the non-compliance rate would decline. Evidently, this would increase the cost per legally enforceable outcome, so that if after a few years of effort the non-compliance rate had dropped to 1% the cost per failed documentation inspection would increase to €23,900 for both power transformers and industrial fans respectively. However, this situation would also provide direct evidence that the market surveillance activity is producing an effective deterrent to non-compliant documentation.

Value of energy savings

Estimating the energy savings that could accrue from documentation inspection is much more challenging than for verification testing and requires making certain additional assumptions. Because documentation inspection includes checking that a test report of the product energy performance is supplied, that the values reported within it are the same as those declared by the supplier as being the products' performance and that the values (in the test report and declared) are consistent with (i.e. respect the requirements of) the Ecodesign regulation, then conducting documentation inspection will encourage suppliers who may not otherwise have done so to respect the regulations. At the very least, to be able to pass such a check a supplier would need to produce a credible looking energy performance test report that supports the claimed product performance; however, it is still possible that such a test report could be: a) fabricated, b) pertain to a different product and/or c) be produced by an unreliable test laboratory and hence such checks do not eliminate the need for 3rd party energy performance verification checks. Although the first two cases (a and b) carry greater legal risk (in terms of the severity of applicable penalties) for a perpetrator if malfeasance were to be discovered than does case c), even in the latter case there is reputational and cost risk. Thus, documentation checks will clearly bring some extra encouragement and rationale to abide by the regulations with regard to the actual energy performance of products and not just the nominal declared performance. Nonetheless, suppliers may be non-compliant because they mistakenly believe that the test laboratories they are using are correctly recording the product's performance and thus in some instances could be putting out incorrect declarations by default (i.e. in good faith).

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Unfortunately, there is very little data available to really analyse the nature and magnitude of these effects so the following assumptions are made to produce estimates of energy savings benefits attributable to documentation inspection:

- documentation inspection will identify 50% of cases where a product's actual energy performance does not comply with the Ecodesign requirements (in other words, for every two energy-performance non-compliant models subject to documentation inspection one will be identified as having non-compliant energy performance)

- in cases where documentation inspection establishes that the energy performance of a product does not comply with the Ecodesign requirements the fact of being caught being non-compliant and the associated sanctions will deter the same supplier from putting other non-compliant models on the market in future according to the hypothetical schema shown in Table 10.

Cost-benefits of energy savings

3.1.2.1 Power transformers

The value of the energy savings for the central case (i.e. where an average non-compliant model has losses 27% above the Ecodesign limit) can be compared to the expected cost incurred by an MSA of doing document inspection to verify that a product conforms with the regulations as shown in Table 15.

Table 15: Estimated value of lifetime energy savings per power transformer from making a non-compliant transformer comply with the Ecodesign regulations via documentation inspection [value of saved electricity (€/lifespan/ kVA)]

	Transformer power rating (kVA)				
Case	100	1000	10000	40000	100000
Life time cost of non-compliant losses (€/kVA)					
losses 27% above limit	€ 36.19	€ 21.36	€ 18.20	€ 7.68	€ 6.91
Cost of document inspection (€/kVA)					
Cost of document inspection per kVA for 20 models	€ 47.80	€ 4.78	€ 0.48	€ 0.12	€ 0.05

As it is assumed that 1 in 20 documentation checks will directly result in a product with non-compliant energy performance being identified and made compliant (or replaced in the market by a compliant one) then the cost of doing 20 checks can be compared with the lifetime value of the energy benefits. The cost of testing 20 models is found to be between a factor of 0.75 and 138 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers.

This analysis suggests that even on these simplistic terms there is a societal value proposition from conducting this form of market surveillance. However, this comparison ignores the wider deterrence effect of non-compliance detection. The magnitude of this effect is not known but it should lead to energy savings that are orders of magnitude greater than those attributable to rendering a single non-compliant model compliant. This issue, and the wider macro-economic impacts of market surveillance for INTAS products will be explored further in Work Package 5.2.

3.1.2.2 Industrial fans

The value of the energy savings for the central case (i.e. where an average non-compliant model has a BEP 15% below the Ecodesign limit) can be compared to the expected cost incurred by an MSA of doing document inspection to verify that a product conforms with the regulations as shown in Table 16.

Table 16: Estimated value of lifetime energy savings per industrial fan from making a non-compliant industrial fan comply with the Ecodesign regulations via documentation inspection [value of saved electricity (€/lifespan/ kW)]

	Fan power rating (kW)				
Case	10	25	45	100	500
Life time cost of non-compliance (€/kW)					
efficiency 15% below limit	€ 450	€ 450	€ 450	€ 450	€ 450
Cost of document inspection (€/kW)					
Cost of document inspection per kVA for 20 models	€ 478	€ 191	€ 106	€ 48	€ 10

As it is assumed that 1 in 20 documentation checks will directly result in a product with non-compliant energy performance being identified and made compliant (or replaced in the market by a compliant one) then the cost of doing 20 checks can be compared with the lifetime value of the energy benefits. The cost of testing 20 models is found to be between a factor of 0.94 and 45 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers.

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This analysis suggests that even on these simplistic terms there is a societal value proposition from conducting this form of market surveillance. The benefits will be much greater if the wider deterrence effect of non-compliance detection are also taken into account.

3.1.3 Physical inspection - rating plate

Like documentation inspection rating plate inspection is a primary means of establishing whether a product is in conformity with the Ecodesign regulations.

3.1.3.1 Power transformers

The value of the energy savings for the central case (i.e. where an average non-compliant model has losses 27% above the Ecodesign limit) can be compared to the expected cost incurred by an MSA of doing rating plate inspection to verify that a product conforms with the regulations as shown in Table 17.

Table 17: Estimated value of lifetime energy savings per power transformer from making a non-compliant transformer comply with the Ecodesign regulations via inspection of rating plates [value of saved electricity (€/lifespan/ kVA)]

	Transformer power rating (kVA)				
Case	100	1000	10000	40000	100000
Life time cost of non-compliant losses (€/kVA)					
losses 27% above limit	€ 36.19	€ 21.36	€ 18.20	€ 7.68	€ 6.91
Cost of rating plate check (€/kVA)					
Cost of rating plate inspection per kVA for 20 models	€ 21.20	€ 2.12	€ 0.21	€ 0.05	€ 0.02

As it is assumed that 1 in 20 rating plate checks will directly result in a product with non-compliant energy performance being identified and made compliant (or replaced in the market by a compliant one) then the cost of doing 20 checks can be compared with the lifetime value of the energy benefits. The cost of checking 20 models is found to be between a factor of 1.7 and 326 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers.

This analysis suggests that even on these simplistic terms there is a societal value proposition from conducting this form of market surveillance. The benefits will be much greater if the wider deterrence effect of non-compliance detection are also taken into account.

3.1.3.2 Industrial fans

The value of the energy savings for the central case (i.e. where an average non-compliant model has a BEP 15% below the Ecodesign limit) can be compared to the expected cost incurred by an MSA of doing rating plate inspection to verify that a product conforms with the regulations as shown in Table 18.

Table 18: Estimated value of lifetime energy savings per industrial fan from making a non-compliant industrial fan comply with the Ecodesign regulations via inspection of rating plates [value of saved electricity (€/lifespan/ kW)]

	Fan power rating (kW)				
Case	10	25	45	100	500
Life time cost of non-compliance (€/kW)					
efficiency 15% below limit	€ 450	€ 450	€ 450	€ 450	€ 450
Cost of rating plate inspection (€/kW)					
Cost of rating plate inspection per kVA for 20 models	€ 212	€ 85	€ 47	€ 21	€ 4

As it is assumed that 1 in 20 rating plate checks will directly result in a product with non-compliant energy performance being identified and made compliant (or replaced in the market by a compliant one) then the cost of doing 20 checks can be compared with the lifetime value of the energy benefits. The cost of checking 20 models is found to be between a factor of 2 and 106 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers.

This analysis suggests that even on these simplistic terms there is a societal value proposition from conducting this form of market surveillance. The benefits will be much greater if the wider deterrence effect of non-compliance detection are also taken into account.

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3.1.4 Witness testing at manufacturer’s premises

Witness testing is a legally enforceable compliance verification option for power transformers but not yet for industrial fans. In the case of power transformers, it is routinely done by manufacturers for all large power transformers, and hence would incur negligible additional costs for the supplier were the MSA to request to be present.

In the case of industrial fans, it is much less commonplace and tends only to be done for high value products destined for sensitive applications. When testing is done according to standard ISO 5801, measurement uncertainties of 2% are obtainable for the overall fan efficiency. In practice, manufacturers may use less precise measurement methods or measuring equipment than the independent accredited laboratories if the main purpose of the test rig is for R&D purposes.

3.1.4.1 Power transformers

The value of the energy savings for the central case (i.e. where an average non-compliant model has losses 27% above the Ecodesign limit) can be compared to the expected cost incurred by an MSA of carrying out witness testing to verify that a product conforms with the regulations as shown in Table 19.

The MSA costs incurred to undertake a witness test for a single model varies between €17.10/kVA and €0.04/kVA. As, under the central assumption, an average of 10 models would need to be tested to identify one non-compliant one, then the value of electricity savings over a non-compliant product’s lifetime should be compared to the cost of doing 10 tests i.e. the average number needed to identify a non-compliant model. In this case the cost of testing 10 models is between a factor of 2.1 and 170 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers.

This analysis suggests that even on these simplistic terms there is a societal value proposition from conducting this form of market surveillance. The benefits will be much greater if the wider deterrence effect of non-compliance detection are also taken into account.

Table 19: Estimated value of lifetime energy savings per power transformer from making a non-compliant transformer comply with the Ecodesign regulations via witness testing [value of saved electricity (€/lifespan/ kVA)]

	Transformer power rating (kVA)				
Case	100	1000	10000	40000	100000
Life time cost of non-compliant losses (€/kVA)					
losses 27% above limit	€ 36.19	€ 21.36	€ 18.20	€ 7.68	€ 6.91
Cost of witness testing (€/kVA)					
Cost of witness testing per kVA for a single non-compliant model	€ 17.01	€ 2.34	€ 0.30	€ 0.09	€ 0.04
Cost of witness testing per kVA for 10 non-compliant models	€ 170.10	€ 23.40	€ 3.00	€ 0.90	€ 0.40

3.1.4.2 Industrial fans

The value of the energy savings for the central case (i.e. where an average non-compliant model has a BEP 15% below the Ecodesign limit) can be compared to the expected cost incurred by an MSA of carrying out witness testing to verify that a product conforms with the regulations as shown in Table 20.

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Table 20: Estimated value of lifetime energy savings per industrial fan from making a non-compliant industrial fan comply with the Ecodesign regulations [value of saved electricity via witness testing (€/lifespan/ kW)]

	Fan power rating (kW)				
Case	10	25	45	100	500
Life time cost of non-compliance (€/kW)					
efficiency 15% below limit	€ 450	€ 450	€ 450	€ 450	€ 450
Cost of witness testing (€/kW)					
Cost of witness testing per kW for a single non-compliant model	€ 181.1	€ 79.6	€ 49.4	€ 24.4	€ 6.0
Cost of witness testing per kW for 10 non-compliant models	€ 1811	€ 796	€ 494	€ 244	€ 600

The MSA costs incurred to undertake a witness test for a single model varies between €181/kW and €6.0/kW. As, under the central assumption, an average of 10 models would need to be tested to identify one non-compliant one, then the value of electricity savings over a non-compliant product's lifetime should be compared to the cost of doing 10 tests i.e. the average number needed to identify a non-compliant model. In this case the cost of testing 10 models is between a factor of 0.25 and 7.5 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest fans.

3.1.5 Testing in situ - at manufacturer's premises

Testing in situ at a manufacturer's premises using 3rd party laboratory testing equipment should produce legally enforceable outcomes providing the test facilities are capable of meeting the test standard requirements.

3.1.5.1 Power transformers

The value of the energy savings for the central case (i.e. where an average non-compliant model has losses 27% above the Ecodesign limit) can be compared to the expected cost incurred by an MSA of carrying out witness testing to verify that a product conforms with the regulations as shown in Table 21.

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Table 21: Estimated value of lifetime energy savings per power transformer from making a non-compliant transformer comply with the Ecodesign regulations via testing in situ at a manufacturer's premises [value of saved electricity (€/lifespan/ kVA)]

	Transformer power rating (kVA)				
Case	100	1000	10000	40000	100000
Life time cost of non-compliant losses (€/kVA)					
losses 27% above limit	€ 36.19	€ 21.36	€ 18.20	€ 7.68	€ 6.91
Cost of testing in situ at manufacturer's site (€/kVA)					
Cost of testing per kVA for a single non-compliant model	€ 9.73	€ 1.79	€ 0.31	€ 0.11	€ 0.05
Cost of testing per kVA for 10 non-compliant models	€ 97.30	€ 17.90	€ 3.10	€ 1.10	€ 0.50

The MSA costs incurred to undertake testing in situ for a single model varies between €9.73/kVA and €0.05/kVA. As, under the central assumption, an average of 10 models would need to be tested to identify one non-compliant one, then the value of electricity savings over a non-compliant product's lifetime should be compared to the cost of doing 10 tests i.e. the average number needed to identify a non-compliant model. In this case the cost of testing 10 models is between a factor of 3.7 and 126 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers.

This analysis suggests that even on these simplistic terms there is a societal value proposition from conducting this form or market surveillance. The benefits will be much greater if the wider deterrence effect of non-compliance detection are also taken into account.

3.1.5.2 Industrial fans

The value of the energy savings for the central case (i.e. where an average non-compliant model has a BEP 15% below the Ecodesign limit) can be compared to the expected cost incurred by an MSA of carrying out testing in situ to verify that a product conforms with the regulations as shown in Table 22.

Table 22: Estimated value of lifetime energy savings per industrial fan from making a non-compliant industrial fan comply with the Ecodesign regulations via in situ testing at a manufacturer's premises [value of saved electricity (€/lifespan/ kW)]

	Fan power rating (kW)				
Case	10	25	45	100	500
Life time cost of non-compliance (€/kW)					
efficiency 15% below limit	€ 450	€ 450	€ 450	€ 450	€ 450
Cost of testing in situ at the manufacturer's site (€/kW)					
Cost of testing per kW for a single non-compliant model	€ 382.6	€ 245.9	€ 205.3	€ 143.1	€ 72.8
Cost of testing per kW for 10 non-compliant models	€ 3826	€ 2459	€ 2053	€ 1431	€ 728

The MSA costs incurred to undertake a test in situ for a single model varies between €383/kW and €72.8/kW. As, under the central assumption, an average of 10 models would need to be tested to identify one non-compliant one, then the value of electricity savings over a non-compliant product's lifetime should be compared to the cost of doing 10 tests i.e. the average number needed to identify a non-compliant model. In this case the cost of testing 10 models is between a factor of 0.12 and 0.62 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest fans.

3.2 Risk assessment options

This section considers the benefits associated with various risk assessment options.

3.2.1 Testing in situ - at final site

Testing in situ at the final site of the product using 3rd party laboratory testing equipment does not currently produce legally enforceable outcomes because the test conditions will not fully respect current test standard requirements. While from a technical perspective the results to be expected for transformers should be very close to those found under standard test conditions for industrial fans they are much less likely to be.

3.2.1.1 Power transformers

The value of the energy savings for the central case (i.e. where an average non-compliant model has losses 27% above the Ecodesign limit) can be compared to the expected cost incurred by an MSA of carrying out witness testing to verify that a product conforms with the regulations as shown in Table 23.

Table 23: Estimated value of lifetime energy savings per power transformer from making a non-compliant transformer comply with the Ecodesign regulations via testing in situ at the final site [value of saved electricity (€/lifespan/ kVA)]

	Transformer power rating (kVA)				
Case	100	1000	10000	40000	100000
Life time cost of non-compliant losses (€/kVA)					
losses 27% above limit	€ 36.19	€ 21.36	€ 18.20	€ 7.68	€ 6.91
Cost of testing in situ at the final site (€/kVA)					
Cost of testing per kVA for a single non-compliant model	€ 9.80	€ 2.11	€ 0.45	€ 0.21	€ 0.10
Cost of testing per kVA for 10 non-compliant models	€ 98.1	€ 21.10	€ 4.50	€ 2.10	€ 1.00

The MSA costs incurred to undertake a test in situ at the final site for a single model varies between €9.80/kVA and €0.1/kVA. As, under the central assumption, an average of 10 models would need to be tested to identify one non-compliant one, then the value of electricity savings over a non-compliant product's lifetime should be compared to the cost of doing 10 tests i.e. the average number needed to identify a non-compliant model. In this case the cost of testing 10 models is between a factor of 3.7 and 70 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers.

This analysis suggests that even on these simplistic terms there is a societal value proposition from conducting this form of market surveillance, but only if in situ test results can be legally recognised for the purposes of compliance conformity assessment – which is not currently the case.

3.2.2 Physical inspection - weights etc.

The types of methods considered in section 2.9 are not sufficiently developed yet to have clarity on their benefits; however, in principle their added value is to determine the plausibility of a product's claimed performance and hence their role would be to inform risk screening determinations prior to selecting products for verification testing. As the expected cost is low simple visual inspections against a check list could be a cost-effective means of doing risk assessment, providing there is clear causality between inspection outcomes and the risk of non-conformity. This is most likely to be the case for industrial fans but, despite EVIA's useful work to develop guidelines on this, there is currently no data that allows the causality to be established. Therefore, this remains an option with promise that requires further work before its efficacy can be assessed.

3.2.3 Checking manufacturer simulations (scrutiny of design engineering calculations)

This process assumes that an independent consulting engineer is hired by an MSA to visit a manufacturer's premises and check their energy performance simulation files for consistency with declared performance values and the Ecodesign requirements for a random selection of products. Importantly, there is only a modest increase of effort and cost involved in checking the files for a number of models compared to that required to just check a single model, so most likely this kind of risk assessment would involve checking numerous files in one site visit.

3.2.3.1 Power transformers

The value of the energy savings for the central case (i.e. where an average non-compliant model has losses 27% above the Ecodesign limit) can be compared to the expected cost incurred by an MSA of carrying out simulation file checking to determine risk that a product may not conform with the regulations as shown in Table 24.

The MSA costs incurred to undertake a test in situ at the final site for a single model varies between €21.8/kVA and €0.02/kVA; whereas, checking a selection of 20 models across varying capacities would probably cost about €0.29/kVA. As, under the central assumption, an average of 10 models would need to be tested to identify one non-compliant one, then the value of electricity savings over a non-compliant product's lifetime should be compared to the cost of doing 10 checks i.e. the average number needed to identify a non-compliant model. In this case the cost of checking 10 models as one-off visits to 10 different sites, or repeat visits to the same site, is between a factor of 1.7 and 293 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers. The cost of doing multiple checks at the same site will be about 65 times less than the value of the life time savings expected and thus that there is a societal value proposition from conducting market surveillance, even when not accounting for the wider deterrence effect of non-compliance detection.

Table 24: Estimated value of lifetime energy savings per power transformer from making a non-compliant transformer comply with the Ecodesign regulations via checking manufacturer design engineering calculations [value of saved electricity (€/lifespan/ kVA)]

	Transformer power rating (kVA)				
Case	100	1000	10000	40000	100000
Life time cost of non-compliant losses (€/kVA)					
losses 27% above limit	€ 36.19	€ 21.36	€ 18.20	€ 7.68	€ 6.91
Cost of checking simulation files at the manufacturer's premises (€/kVA)					
Cost of checking per kVA for a single non-compliant model	€ 21.83	€ 2.22	€ 0.23	€ 0.06	€ 0.02

3.2.3.2 Industrial fans

The value of the energy savings for the central case (i.e. where an average non-compliant model has a BEP 15% below the Ecodesign limit) can be compared to the expected cost incurred by an MSA of carrying out testing in situ to verify that a product conforms with the regulations as shown in Table 25.

Table 25: Estimated value of lifetime energy savings per industrial fan from making a non-compliant industrial fan comply with the Ecodesign regulations via checking manufacturer design engineering calculations [value of saved electricity (€/lifespan/ kW)]

	Fan power rating (kW)				
Case	10	25	45	100	500
Life time cost of non-compliance (€/kW)					
efficiency 15% below limit	€ 450	€ 450	€ 450	€ 450	€ 450
Cost of checking simulation files at the manufacturer's premises (€/kW)					
Cost of checking per kW for a single non-compliant model	€ 222.40	€ 91.08	€ 51.78	€ 23.77	€ 4.99

The MSA costs incurred to undertake a test in situ for a single model varies between €222/kW and €5.0/kW. As, under the central assumption, an average of 10 models would need to be tested to identify one non-compliant one, then the value of electricity savings over a non-compliant product's lifetime should be compared to the cost of doing 10 checks i.e. the average number needed to identify a non-compliant model. In this case the cost of checking 10 models as one-off visits to 10 different sites, or repeat visits to the same site, is between a factor of 0.2 and 9 times less than the value of the life time savings from making a single model compliant, with the higher benefit-cost ratios occurring for the largest power transformers. The cost of doing multiple checks at the same site will be about 103 times less than the value of the life time savings expected and thus that there is a societal value proposition from conducting market surveillance, even when not accounting for the wider deterrence effect of non-compliance detection.

3.2.4 Other types of simulation modelling and testing

The potential viability of energy performance verification testing for industrial fans that are too large to test in 3rd part laboratories at full load was discussed in section 2.9 and considered scale model testing and reduced speed testing. The costs of doing this are slightly higher than those associated with normal 3rd part testing and currently the outcomes are not legally enforceable; however, as these are likely to be the only practicable option for verifying the performance of such products if FATs are not being conducted and assuming checking design engineering calculation verification is not a legally enforceable compliance verification method, then there is a case for more development actions to be undertaken to enable such methods to be used in future implementation of the regulations. The value of the benefits from using such methods to detect and remove from the market a single non-compliant model are not likely to exceed the costs incurred by the MSA; however, when the multiplicative value of deterrence is factored in there is likely to be much stronger value proposition, as will be examined in Work Package 5.2.

3.2.5 Checking manufacturer quality assurance systems

As there is currently no MSA experience with this action and its benefits are quite speculative it is premature to attempt to quantify the benefits.

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4. Potential to transpose findings to other large product types

As Ecodesign measures are adopted for a wider array of equipment types a number of large products have now had measures adopted or are under consideration. Professional equipment for which there are already requirements include:

- Air heating and cooling products
- Professional refrigerated storage cabinets
- Ventilation units

Those for which investigations and/or regulatory development are on-going include:

- Commercial refrigeration equipment
- Industrial ovens and furnaces
- Machine tools
- Steam boilers
- Enterprise servers and data storage devices

All of the above products are sold as B2B transactions and hence often face the same issues as the products considered under the INTAS project of difficulty in ascertaining when a product has been placed on the market – this is especially true of the engineered to order products. Furthermore, many of these products are bulky and hence are likely to be costly to test in 3rd party laboratories. If engineered to order, then they will face the same issue of there being no stock of products available to be tested prior to the product being shipped to the client and hence of the need for a system to be set up so MSAs are always informed when a product is due to be placed on the market or installed, and options established to enable MSAs to conduct conformity verification actions prior to the product being put into service. The INTAS team is not aware of whether any of these products might be of a size that renders it impossible to test them according to the prescribed test methods in existing 3rd party laboratory facilities (such as currently occurs for very large industrial fans); however, if this is the case then in principle similar solutions as examined in the INTAS project could be applicable (e.g. witness testing of FATs, checking manufacturer simulation software, part-load testing or scale model testing). With regards to the cost-benefits then a priori one might imagine that:

- the likelihood of non-conformity and the extent of non-conformity could be similar to that of the INTAS products
- the average duty-cycles are most likely quite high (i.e. a large number of operating hours per year)

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- the power levels could be quite high but will generally be less than those for large power transformers and the larger industrial fans
- conformity verification costs per kW could be similar to those for equivalent capacity industrial fans or maybe slightly less
- benefits per kW could be similar to those for equivalent capacity industrial fans.

Broadly speaking then the same set of conformity verification or risk assessment processes and methods examined in the INTAS project should also often be applicable to these products and the benefit-costs of applying such methods rather similar for equivalent power industrial fans. Many of the methods and techniques considered in the INTAS project are therefore applicable by extension.

5. Summary and conclusions

This report has assembled best estimates of the costs and benefits from conducting performance verification or risk assessment actions on power transformers and large industrial fans. In the case of power transformers it has established that in most instances the societal value (expressed in terms of the value of product lifetime energy savings to end-users) of conformity verification actions is greater than the cost that would be incurred by the MSA, even if the deterrent effect of having a product fail a verification check (i.e. the discouragement of non-compliance for other products produced by the same or other suppliers) is ignored. Estimates of the broader scale of this deterrent effect will be made in the work to be reported under INTAs Work Package 5.2; however, inclusion of the deterrence benefit would be expected to increase the overall benefit-cost ratios by several orders of magnitude. Similar, findings are projected for industrial fans, but for this product group there is currently less evidence of the current levels of non-compliance and hence more speculation with regard to be magnitude of benefits expected from conformity verification actions. There are also more constraints with 3rd party testing of very large fans (which is not possible at full load in current 3rd party test facilities) and less potential to routinely use FAT witness testing (due to it only being done under commercial contracts for the more sensitive end-use applications, and not all manufacturers having testing capability).

Broadly speaking it has been established that:

- documentation checks and rating plate inspections are highly cost effective at producing legally enforceable compliance verification outcomes and (at least initially) are likely to rapidly identify non-compliance with Ecodesign requirements; however, as they cannot fully verify the accuracy of declared energy performance they are only a partially effective solution at deterring non-compliance

- if it can be presumed that there is a correlation between supplier non-compliance rates in documentation or rating plate inspections and the non-compliance of the suppliers products with the Ecodesign energy-performance limit requirements then such checks would also provide a cost-effective means of determining product energy-performance non-compliance risk for screening purposes

- energy performance verification testing in 3rd party labs is viable and societally cost-effective for all products which are small enough to be tested in existing facilities (noting the issues identified earlier for large fans) providing an MSA can receive notification of a product being placed on the market in time to minimise supply arrangements

- witness testing of FATs is a significantly cheaper option than 3rd party lab energy performance verification testing whenever such testing was already going to be undertaken for commercial reasons, as is universally the case for large power transformers

- expert checks of manufacturers product energy performance simulations would be likely to provide a cost-effective means of determining non-compliance risk (and possibly actual non-compliance) if the practical limitations on arranging such checks can be overcome

- for very large products, especially industrial fans, it would probably be cost-effective to conduct energy performance verification via part-load or scale-model testing if the accepted test methods and Ecodesign regulations were amended to permit this as a legally enforceable compliance verification option.

The broader macro-economic cost-benefits from MSA conformity verification actions for power transformers and large industrial fans will be assessed in Work package 5.2, which will also include an analysis of the impact of targeted screening techniques.

Abbreviation list

BEP	-	Best Efficiency Point
BOM	-	Bill of Materials
DSO	-	Distribution Services Operator
EC	-	European Community
EEA	-	European Economic Area
EPC	-	Engineering, Procurement and Construction
EU	-	European Union
EVIA	-	European Ventilation Industry Association
FTE	-	Full Time Equivalent
kVA	-	kilo-volt amps
kW	-	kilo watts
LoE	-	level of effort
MSA	-	Market Surveillance Authority
OEM	-	Original Equipment Manufacturer
PEI	-	peak efficiency index
TSO	-	Transmission Services Operator

List of Tables

More information
about the INTAS project activities
and all of its results
are published on:

www.INTAS-testing.eu

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