Harnessing the Potential of Industrial Insulation

Survey of 180 TIPCHECK Audits

If you would like to learn more about the activities of the European Industrial Insulation Foundation, please contact: info@eiif.org / www.eiif.org

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I am pleased that EiiF has undertaken the task of evaluating the effectiveness of the TIPCHECK programme during its first five years of operation. The findings of this survey will help to inform our ongoing work to make European industry more efficient, more competitive, more sustainable, and less dependent on foreign energy imports.

The survey findings demonstrate the usefulness of standardised thermal energy audits as well as the cost-effectiveness of remediating problems with industrial insulation to save energy and reduce emissions.

In particular, the findings prompt me to highlight two aspects:

First, when dealing with technologies that demonstrate rapid payback, such as industrial insulation, the technology providers should work proactively to raise awareness among industrial users regarding the savings potential associated with the technology. In this regard, it is my hope that this report will motivate the insulation industry to accelerate its marketing efforts with respect to TIPCHECK-style audits and thereby create opportunities to make use of this approach more fully throughout Europe and its industrial sectors.

Second, energy-intensive industries and SMEs should look deeper into the cost-effective potential that can be provided by Best Available Technologies (BATs) like industrial insulation. European industry has made great strides in recent years, as highlighted in the EU Heating and Cooling Strategy; however, industrial energy costs could be further reduced by 4-10% with investments in already existing and proven technologies that pay for themselves in less than five years.

Dominique Ristori

The survey findings demonstrate the usefulness of standardised thermal energy audits as well as the cost-effectiveness of remediating problems with industrial insulation to save energy and reduce emissions.

One of the main priorities of the European Commission for the next years is to achieve an "Energy Union". Making better use of energy and reducing the costs are key for this strategy. 2016 will be a significant year of delivery of the Energy Union and we will come forward with proposals and strategies in particular on energy efficiency and publish a report on prices and costs. To be able to create an Energy Union, we need to work together, share ideas and visions.

Dominique Ristori, Director-General

DG Energy, European Commission

As a business manager running a worldwide company with more than 28.000 employees, I am accustomed to thinking in big-picture terms and looking for opportunities to reduce costs and increase competitiveness whenever possible.

A 2012 report that the European Industrial Insulation Foundation (EiiF) commissioned from the energy experts at Ecofys suggested that the intelligent use of industrial insulation represents just such an opportunity, not only for individual companies but for the entire European Union. And although it made sense to me that industrial insulation could provide a cost-effective way to reduce EU-wide energy use and CO_2 emissions, the potential impact identified in the Ecofys report exceeded my expectations by quite a bit. I was also encouraged by the report's suggestion that the TIPCHECK programme, created by EiiF in 2010 to help plant managers identify and fix their insulation problems, could contribute significantly to helping realise that potential.

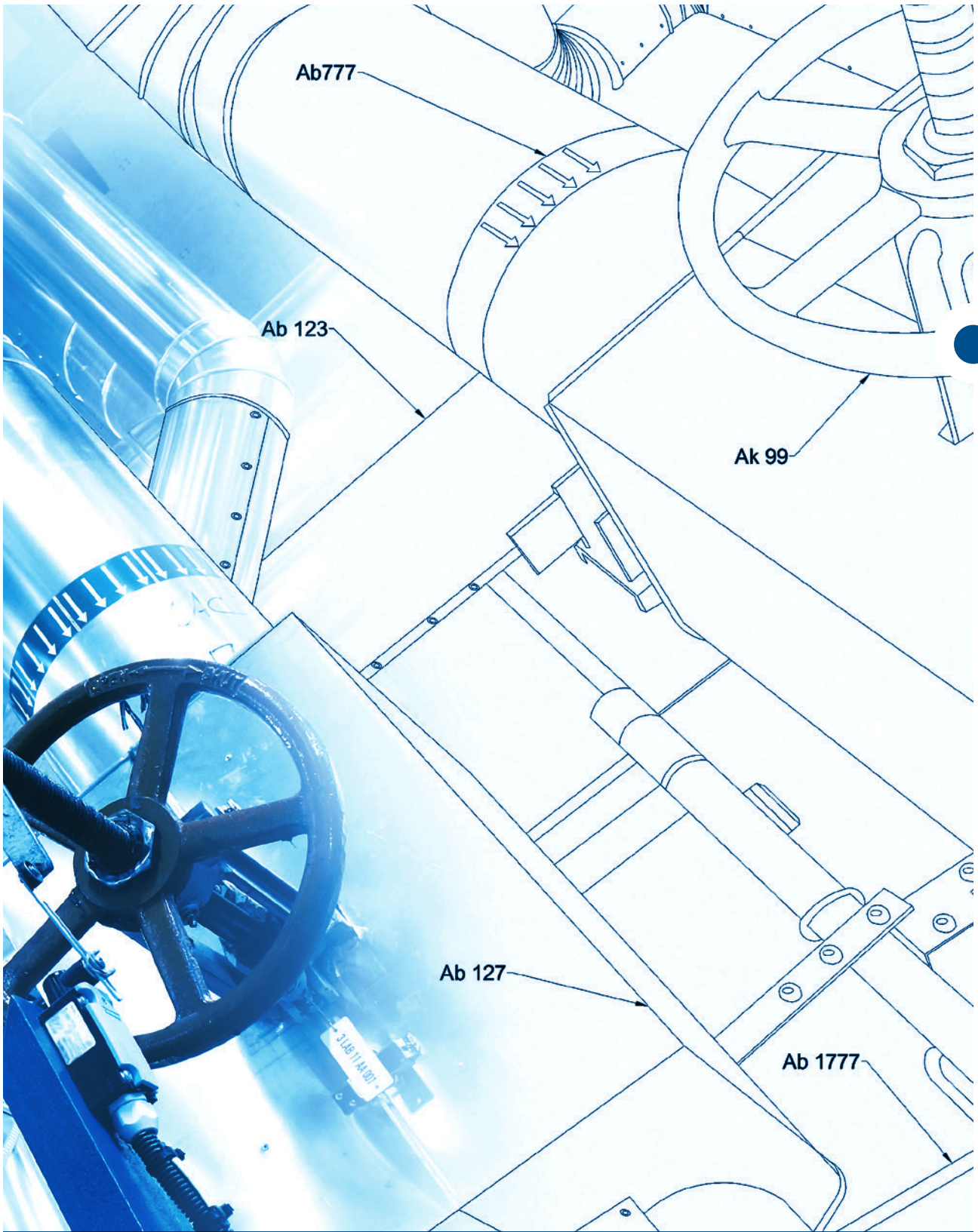
Now, after approximately 180 TIPCHECK audits conducted in plants throughout the EU, it is time to evaluate the effectiveness of the programme in the field, using verifiable statistics and real case studies to demonstrate its "proof in practice." I am pleased to report (without giving away the ending) that the survey findings presented here confirm the purpose of the programme: To provide industrial plant managers with a way of reducing energy use and CO_2 emissions in a cost-effective manner which, in the long run, can help Europe to achieve its energy-savings, energy-security, and climate-focused targets.

Peter Hoedemaker

President, European Industrial Insulation Foundation (EiiF)

Peter Hoedemaker

Industrial insulation provides plant managers with a way of reducing energy use and CO_2 emission in a cost-effective manner.



Executive Summary

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To improve energy security and reduce CO_2 emissions, the EU has taken important steps to reduce energy consumption in major sectors such as buildings, transportation, and power generation. Recent studies have shown, however, that a significant amount of energy is lost in the day-to-day operations of industrial plants by virtue of insufficient industrial insulation—an area that is largely overlooked, not only by the current governmental efforts but even by industry itself.

In 2010, the European Industrial Insulation Foundation (EiiF) created an innovative programme, called Technical Insulation Performance Check (TIPCHECK), to provide a standardised energy auditing tool that plant asset owners and decision makers can use to assess their insulation-related energy losses and identify cost-effective remediation efforts. To date, TIPCHECK energy audits have been conducted at approximately 180 industrial plants, primarily across the EU.

A significant amount of energy is lost in the day-to day operations of industrial plants by virtue of insufficient industrial insulation.

This report presents a survey of those audits and summarises their findings and implications. Its major conclusions are these:

- The annual energy savings potential identified by approximately 180 TIPCHECK audits was more than 750.000 MWh/year (2,7 PJ/year), resulting in an estimated CO_2 emission reduction potential of more than 500.000 t CO_2—equivalent to the annual greenhouse gas emissions of almost 110.000 cars.
- Based on cost savings from a reduction in energy loss, investments in industrial insulation paid back after only one or two years, and some investments paid back in less than one year, resulting in a TIPCHECK-identified cost saving potential for industry of at least € 23,5 million.
- Three out of four (75%) industrial clients who commissioned a TIPCHECK audit have either already acted or plan to act in the near future (for example, at the next turnaround) on the recommendations of their TIPCHECK report by investing in insulation to remediate existing insulation deficiencies.
- Based on the observed implementation rate (55% of TIPCHECK clients have implemented 100% of the identified potential, 13% have implemented parts of the potential, and 14% are considering implementation), the TIPCHECK programme has already resulted in EU-wide annual energy savings of more than 500.000 MWh/year (1,8 PJ/year) and CO_2 reductions of more than 370.000 t CO_2—equivalent to the annual greenhouse gas emissions of almost 80.000 cars.

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- Implemented insulation improvements resulting from the first 119 realised TIPCHECK audits (68% of all TIPCHECK audits) represent approximately € 20 million in insulation business.

These findings confirm the effectiveness of the TIPCHECK programme and reinforce its importance for EU policy makers, industrial plant asset owners and decision makers, and industrial insulation stakeholders.

For policy makers, the TIPCHECK programme results demonstrate the additional energy and CO_2 emissions savings that may be realised by addressing thermal energy losses due to insufficient industrial insulation. Such savings could contribute substantially to the EU 2020 and 2030 energy reduction goals while also lowering EU dependency on foreign energy imports.

For industrial plant asset owners and decision makers, the TIPCHECK results point to the cost-effectiveness of insulation remediation efforts and to operational cost savings that far outweigh the required investments and that lead to rapid payback. The results also highlight the ability of industrial insulation to reduce plant CO_2 emissions, thereby helping industry to meet regulatory requirements and contribute to overall EU emissions reduction goals.

For insulation stakeholders, the TIPCHECK programme provides an invaluable tool that they can use to proactively help EU industry realise energy and operational cost savings by fixing industrial insulation deficiencies. By adding the TIPCHECK programme to their toolbox of offerings, such stakeholders are able to partner with clients for a common operational good rather than merely responding to bids for services. As a result, they may realise the noble goal of "doing well by doing good."

The findings of this report confirm the effectiveness of the TIPCHECK programme and reinforce its importance for EU policy makers, industrial plant asset owners, and industrial insulation stakeholders.

Overview

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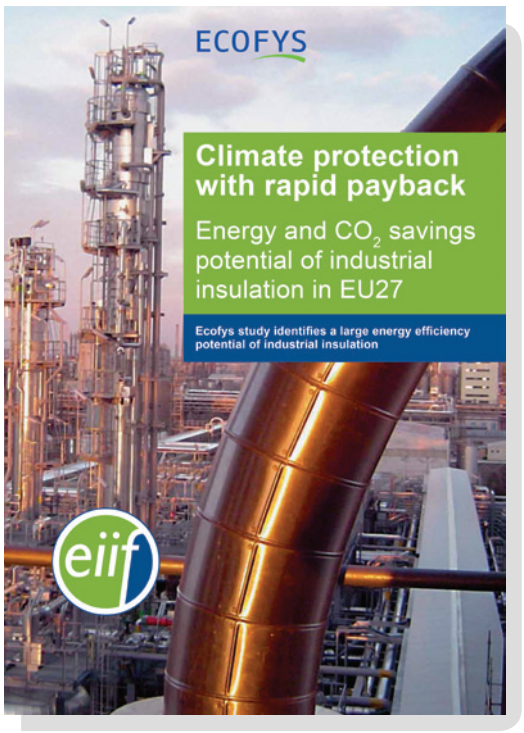
For many years, the European Union (EU) has been actively engaged in efforts to reduce energy use and CO_2 emissions across its Member States. Doing so is imperative not only for ensuring the competitiveness and energy-security of the EU but also for reducing the generation of greenhouse gas emissions. In fact, energy efficiency is so important to the overall energy future of the EU that it stands as one of the five main dimensions of the recently launched Energy Union[1] .

Although most of the governmental effort has focused on reducing energy use in highly visible sectors—such as buildings, transportation, and power generation—recent studies suggest that attention to less-obvious items, such as industrial ("technical") insulation, may be able to contribute substantially to the ability of the EU to meet its reduction goals. One such study[2] , commissioned by the European Industrial Insulation Foundation (EiiF) and published in 2012, concluded that insufficient, missing, and/or damaged industrial insulation is responsible for energy losses of approximately 480 PJ/year—about 4% of total EU industry fuel consumption—and that similar energy losses in fossil-fuel power generation amount to 140 PJ/year. The cost-effective remediation of these types of energy losses could reduce EU-wide energy use by the equivalent of 10 million households.

Recent studies suggest that attention to industrial insulation may help the EU meet its energy reduction goals.

The 2012 study—conducted by the highly respected European consultancy, Ecofys—highlighted several barriers to addressing this hidden area of energy waste, one of which is a fundamental lack of awareness on the part of industrial plant asset owners and decision makers. This lack of awareness served as the impetus for a programme that EiiF created in 2010, called Technical Insulation Performance Check (TIPCHECK), to help industrial plant managers assess the extent of their insulation-related thermal losses and target cost-effective ways to eliminate them.



Climate protection with rapid payback, ECOFYS 2012.

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The European Industrial Insulation Foundation (EiiF) has created a programme, called TIPCHECK, to help remediate energy losses due to insufficient industrial insulation.

The TIPCHECK programme consists of rigorous training and certification for qualified engineers and a standardised protocol for conducting thermal audits of industrial plants. The audits rely on a proprietary TIPCHECK calculation tool and culminate in a comprehensive report that not only indicates the extent of insulation-related energy losses but quantifies the monetary incentives of remediation actions. Since the inception of the TIPCHECK programme in 2010, TIPCHECK audits have been conducted at approximately 180 industrial plants, primarily within the EU, comprising a diverse set of industries that range from petroleum refining and food processing to paper manufacturing and chemical processing. This report presents the findings of an extensive survey of those audits, including data regarding the rate at which clients act on TIPCHECK report recommendations and the amount of energy and money saved by the resulting remediation actions.

The survey findings reveal that approximately three out of four (75%) industrial plant decision makers who commissioned a TIPCHECK audit have either acted already or plan to act in the near future (for example, at the next turnaround) on its findings and invested or will invest in remediation actions—and that 55% of all TIPCHECK clients implemented 100% of the recommended actions within a short timeframe. On average, the investments paid back in less than two years; however many of the projects evaluated in this report paid back their investment in less than one year. The findings also suggest that the TIPCHECK programme has already resulted in EU-wide annual energy savings of more than 500.000 MWh/year and CO_2 reductions of more than 370.000 t CO_2—equivalent to annual greenhouse gas emissions of almost 80.000 cars.

The TIPCHECK programme has already resulted in EU-wide annual energy savings of more than 500.000 MWh/year.

In addition to presenting the findings of the survey, this report outlines the TIPCHECK programme and its benefits with respect to energy and cost savings, regulatory compliance, process operations, and worker safety. It also includes a few representative case studies that illustrate the effect of the programme on specific industrial applications.

(1) "Energy Union and Climate Change Policy," http://ec.europa.eu/priorities/sites/beta-political/files/energy-union-1-year_en.pdf
(2) "Climate protection with rapid payback: Energy and CO_2 savings potential of industrial insulation in EU27," Report by Ecofys Netherlands BV, 19 June 2012.

The Power of Industrial Insulation

To grasp the powerful potential of industrial insulation to contribute to EU energy reduction efforts and industrial competitiveness, it is necessary to understand:

- What industrial insulation is and why it matters
- Why industrial equipment tends to be deficiently insulated
- How cost-effective remediation of such deficiencies can help the EU meet its short-term and long-term energy and carbon reduction targets while improving plant profitability

What Industrial Insulation Is and Why It Matters

Industrial insulation may be used to inhibit heat transfer either into or away from the piece of equipment it protects. And because such heat transfer is highly dependent on the temperature difference between the protected surface and its surroundings, small flaws in the industrial insulation can have a much greater impact on absolute heat loss than even large flaws or insufficient insulation in building exterior walls. Whereas building interiors operate at approximately 22 °C, typical industrial operating temperatures can range from below -160 °C to well above 600 °C.

In light of these extreme and widely varying operational temperatures, it is reasonable to expect that industry guidelines and standards would require more robust insulation performance than that required by typical building codes. Unfortunately, the opposite is true. For example, a comparison between building codes for a German passive house (350–500 mm insulation thickness, <3 W/m2 heat loss) and the German AGI (Arbeitsgemeinschaft Industriebau e.V.) industrial standard (100 mm insulation thickness, 150 W/m2 heat loss) indicates that industry standards allow for much higher heat losses than those considered acceptable for new buildings (Figure 1).

Outdated maximum heat loss rates

Insulation standards: a simple comparison of industry and building insulation standards illustrates why industry is losing not only energy but also money whilst producing tons of unnecessary CO_2

	Power plant	Building code	Passive house
Temperature	250°C – 640°C	18°C – 22°C	18°C – 22°C
Heat loss (AGI Q101)	150W/m2	< 10 W/m2	< 3 W/m2
Insulation thickness	100mm	100mm	350-500mm

Figure 1: German power plant and building code insulation specifications

In addition to heat losses resulting from outdated guidelines and standards, many industry heat losses are due to equipment that is either uninsulated or for which insulation is damaged.

Conservative estimates from the 2012 Ecofys report[3] indicate that the percentage of industrial equipment in such condition is 10%, 6%, and 2% for low-, middle-, and high-temperature surfaces, respectively—leading to very high energy losses (Figure 2, page 14).

(3) Ibid

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Comparison of heat loss reductions and savings delivered by Insulation Systems

Heat losses and savings in kWh/year of uninsulated and insulated pipes with a length of 10 m (calculated)

DN	100°C - Thickness: 70mm			300°C - Thickness: 170mm		
	Heat loss uninsulated	Heat loss insulated	Savings when insulated	Heat loss uninsulated	Heat loss insulated	Savings when insulated
32	13.800	1.500	12.300	**89.000**	4.600	**84.400**
50	18.700	1.800	16.900	**121.770**	5.270	**116.500**
100	32.700	2.600	30.100	**218.700**	7.200	**211.500**

Figure 2: Heat losses, savings, and temperature

So great is the impact of insufficient, missing, and/or damaged industrial insulation, in fact, that its remediation to merely cost-effective levels in the EU could reduce EU-wide energy consumption by the equivalent of 10 million households—matching the output of 15 coal-fired power plants. This fact alone suggests that industrial insulation may represent "low-hanging fruit" in the drive for reduced EU energy consumption and that responsible future energy initiatives, including legislation, should address its impacts.

Cost-effective remediation of insufficient, missing, and/or damaged industrial insulation could reduce EU-wide energy use by the equivalent of 10 million households.

And, of course, because energy consumption translates into CO_2 emissions in a fossil-fuel-based economy, its reduction necessarily helps to mitigate global warming.

Why Industrial Equipment Is Deficiently Insulated

Three main factors serve as the primary culprits for the observed deficiency of industrial insulation across the EU—insufficient equipment design criteria, lack of awareness and proper maintenance, and plant management barriers.

INSUFFICIENT EQUIPMENT DESIGN CRITERIA

Most industrial plants base their equipment design criteria only on safety rules, minimum process needs, and/or generic allowable surface temperature limits and do not take into account the impact of insulation decisions on ongoing energy costs. Consequently, the resulting equipment tends to be built and installed without regard for the positive long-term effect of insulation on its operational costs and energy losses. This design deficiency can only be addressed by involving insulation experts throughout the design process for both new equipment and turnaround projects.

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Most industrial equipment is designed without taking into account the impact of insulation on energy efficiency.

LACK OF AWARENESS AND PROPER MAINTENANCE

Before any problem can be addressed, it must first be recognised. With regard to the need for good industrial insulation, such recognition requires special tools that expose the effects of insulation flaws and allow industrial plant asset owners and decision makers to evaluate their impact on costs and operations. Some of these tools are technological; others are computational and designed to be used in support of a comprehensive protocol such as that employed by the TIPCHECK programme described in this report.

Before any problem can be addressed it must be recognised.

For low-temperature industrial processes, which may operate far below 0 °C (for example,-162 °C for LNG processing), insulation flaws are readily apparent to the naked eye, typically characterized by ice condensation on the unprotected surfaces. Similar flaws for high-temperature processes, on the other hand, are more difficult to detect and usually require special equipment to identify from a distance—such as a high-resolution thermal imaging camera, which exposes heat losses by displaying images captured in the infrared range of the electromagnetic spectrum (Image 1).

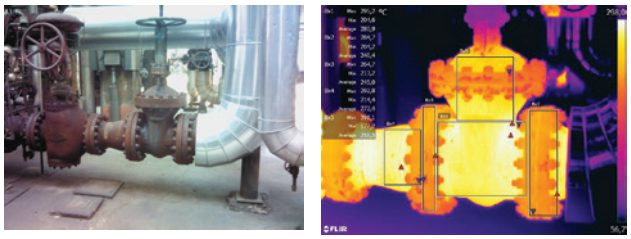

Image 1: Normal and thermal image of a process valve operating at 260 °C

This type of visualisation provides an easy-to-understand, qualitative picture of heat loss from uninsulated industrial surfaces. To be useful in addressing insulation deficiencies, however, it must be combined with a powerful computational tool such as the proprietary computer programme used by TIPCHECK-certified engineers for calculating thermal energy losses and the monetary benefits of proper equipment insulation.

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Sometimes, insulation deficiencies are due to poor equipment design, as noted above. In many cases, however, they result either from poor maintenance of existing insulation or from the failure to reinstall insulation that has been removed to perform mechanical maintenance on the industrial equipment. In either case, the plant management responsible for the equipment maintenance must be made aware of the deficiencies and their impacts before steps can be taken to address them.

In many cases, insulation deficiencies are due to failure to reinstall insulation after performing ordinary mechanical maintenance operations.

Unfortunately, industrial insulation experts (suppliers and installers) are somewhat handcuffed in their ability to offer proactive help in raising awareness among plant asset owners and decision makers, because they are not usually consulted unless they are called on to submit a bid for an approved project. And because such bids are often evaluated strictly on the price of the investment, rather than taking into account its resulting energy cost savings, the experts are restricted in their ability to recommend remediation to cost-effective, energy-reducing levels.

It is partly for this reason that EiiF created the TIPCHECK programme—to serve as a powerful tool that insulation experts can use to proactively raise awareness among industrial plant asset owners and decision makers. TIPCHECK allows insulation contractors and service providers to shift from a passive market model, in which they interact with clients only in response to project bids, to an active model, in which they serve as consultants. By becoming involved in the project planning process, they can help to ensure that cost-effective and energy efficient solutions are considered when insulating equipment.

PLANT MANAGEMENT BARRIERS

According to the 2012 Ecofys report, some deficiencies in industrial insulation are due to plant management barriers. Typically, industrial insulation represents a relatively small part of the overall plant investment and is, therefore, perceived as being of lower priority than other investments. In addition, for some industrial processes, revenue losses caused by the downtime required to fix insulation flaws can easily overwhelm the energy cost savings that result from the fixes themselves.

And because energy efficiency does not constitute the core business of the plant, any investment in it is seen primarily as an expense to be minimised rather than a smart investment which, in most cases, pays for itself in a relatively short time span.

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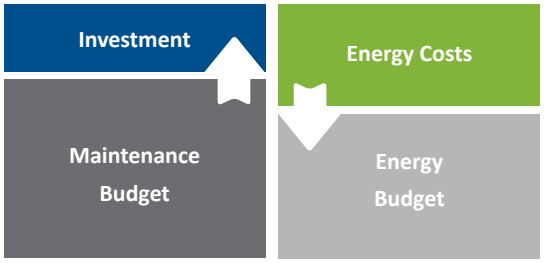
Insulation energy efficiency investments often become caught in an organizational gridlock between plant management departments.

It is also quite often the case that insulation investments become caught in an organizational gridlock between plant management departments. Although an energy manager might advocate for better insulation on the grounds that it will reduce energy costs, the investment itself might fall under the aegis of the maintenance manager—who serves as the primary point of contact with insulation contractors and whose budget must absorb the cost of the installation.

- **Split incentives**



Regardless of which type of barrier is responsible for the insulation deficiency, the first step in overcoming the issue involves educating the plant asset owners and decision makers by means of a detailed energy audit such as that represented by a TIPCHECK report.

How Industrial Insulation Can Help

In 2012, EU institutions adopted the Energy Efficiency Directive 2012/27/EU (EED), the purpose of which was to establish a common framework for promoting energy efficiency within the EU in order to meet its goal of a 20% reduction in energy use by 2020. The Juncker Commission has defined energy efficiency as one of the five main dimensions of the Energy Union[4] . And the ambition for the medium- and long-term is built on this policy framework and on the COP21 Paris agreement to stop global warming at a level of a temperature increase of 1,5 °C (compared to 1990 levels).

The 2012 Ecofys report indicates that remediating industrial insulation deficiencies to cost-effective levels across the EU could reduce industrial insulation related plant thermal losses by as much as 66% (620 PJ), thereby contributing to the 2020 and 2030 ambitions. In the process, the remediation effort could reduce European dependency on gas imports by as much as 12,5% and reduce annual CO_2 emissions by the equivalent of 18 million mid-sized cars running 12.500 km per year—thereby contributing cost-effectively to the EU 2020 and 2030 emissions reduction target.

Industrial insulation has the potential to contribute significantly to EU energy and emissions reduction goals and to reduce EU dependency on gas imports.

(4) "Energy Union and Climate Change Policy," http://ec.europa.eu/priorities/sites/beta-political/files/energy-union-1-year_en.pdf

About the TIPCHECK Programme

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In 2010, EiiF anticipated the need for a convenient, standardised method that industrial plant asset owners and decision makers could use to assess the potential benefits of remediating deficiencies in plant insulation. To meet this need, EiiF created an insulation auditing programme, called Technical Insulation Performance Check (TIPCHECK).

The TIPCHECK programme is a powerful tool that plant managers, energy managers, and CEOs can use to audit their industrial insulation systems and determine the economic benefits of remediating any problems that are identified and/or properly insulating new or retrofit projects. To grasp its scope and potential, it is necessary to understand what TIPCHECK is, how it works, and why it is important to European industry and society.

What TIPCHECK Is

The TIPCHECK programme was created to provide an affordable, non-intrusive, standardised energy auditing tool. Trained-and-certified engineers can use it to evaluate industrial insulation systems and make recommendations to plant management regarding cost-effective means of fixing insulation problems and/or ensuring that new or retrofit projects incorporate good insulation practices. Its primary purposes are to promote industrial efficiency and to help industrial plant asset owners and decision makers understand how insulation can provide energy and cost savings while contributing to a cleaner environment by reducing CO_2 emissions.

The TIPCHECK protocols are designed in accordance with the relevant and applicable energy auditing standards EN 16247 and ISO 50002. They also help to fulfil the requirements of energy management systems and regulations such as ISO 50001 and Energy Efficiency Directive Article 8.

In addition to providing specific recommendations based on thermal assessments, a TIPCHECK report can identify areas of improvement for process control and efficiency and safety risks attributable to high- and/or low-temperature surfaces.

How TIPCHECK Works

Structurally, the TIPCHECK programme consists of two main pieces—a training and certification programme and an energy auditing and reporting protocol. To maintain consistent reliability across TIPCHECK audits, they are subject to quality control by EiiF.

TRAINING AND CERTIFICATION PROGRAMME

Who Can Apply

At its core, TIPCHECK relies on a robust training programme that qualified engineers can undergo to obtain certification as TIPCHECK energy auditors. To be eligible for the programme, a candidate must possess an engineering degree and at least two years of experience in industrial insulation projects. And to maintain certification, the TIPCHECK engineer must participate in a refresher course at least once every three years.

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What Certification Requires

To become a certified TIPCHECK engineer, a candidate must meet minimum education requirements and successfully complete the TIPCHECK training programme. The training programme consists of four main sections—principles and guidelines, applicable insulation standards, use of the TIPCHECK calculator, and assessment and communication.

The TIPCHECK principles and guidelines are

TIPCHECK engineer certificate

designed to align with energy auditing and energy management standards like EN 16247, ISO 50001 and ISO 50002. The applicable insulation standards are those contained in EN ISO 12241, EN ISO 23993, VDI 2055, and VDI 4610. The TIPCHECK calculator is a proprietary software programme that EiiF created to ensure consistency in data analysis and evaluation across industries. And the assessment and communication training provides practical instruction for conducting and reporting on a TIPCHECK evaluation, including preparation and writing of the standard TIPCHECK report.

To date, TIPCHECK training has been conducted in England, France, and Germany and has provided training to more than 150 insulation experts from across Europe (and the world).

ENERGY AUDITING AND REPORTING PROTOCOL

Part of the power of TIPCHECK lies in its ability to apply a standardised protocol to any given industrial plant and to produce recommendations based on universal best practices for insulation engineering. A standard TIPCHECK energy audit consists of six basic steps:

1. Technical preparation (2 days)
2. Facility visit (1–2 days)
3. TIPCHECK execution (1–2 weeks)
4. Energy savings calculations
5. Creation of the TIPCHECK report (1–4 weeks)
6. Presentation of the TIPCHECK results

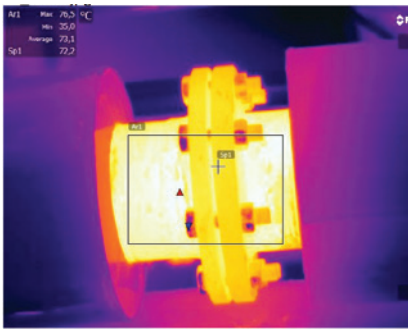
The first four steps involve data collection and analysis. The last two recognise that to produce effective results, data and conclusions from the audit must be presented in a consistent, understandable, and professional manner.

1 Technical Preparation

In the technical preparation step, the TIPCHECK engineer meets with the client representative—typically a facility manager, maintenance manager, or energy manager—to identify the targets of the potential TIPCHECK energy audit, define its scope, and discuss other important matters regarding the audit. The ability to establish relationships and work closely with one or more representatives on the client side is critical to the overall success of the TIPCHECK audit.

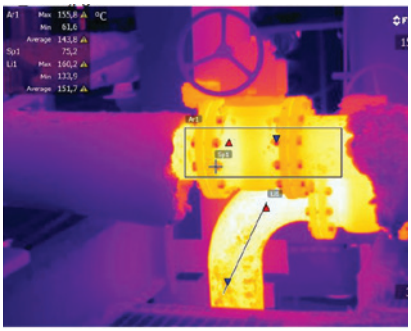
2 Facility Visit

The facility visit consists of a walk-through of the industrial plant during which the TIPCHECK engineer assesses the current state of the equipment insulation and makes note of areas that represent the likeliest and largest savings potentials. The primary focus of the visit involves identifying pieces of equipment such as pipes, vessels, valves, ducts, and flanges that are either uninsulated or under-insulated, especially due to damage. Depending on the agreed-upon scope of the project, the TIPCHECK engineer may also identify instances of corrosion under insulation (CUI) and suggest process efficiency improvements.



3 TIPCHECK Execution

The TIPCHECK execution step serves as the data collection step in the process. In this step, the TIPCHECK engineer performs a thorough onsite analysis of the equipment that was identified in the facility visit and obtains all of the measurements required to perform the TIPCHECK energy savings calculations and create the TIPCHECK report.



It is important to note that the TIPCHECK execution step is entirely non-intrusive and can be conducted while plant operations are fully underway; consequently, the TIPCHECK audit does not result in lost revenue due to operational downtime.

4 Energy Savings Calculations

When the all of the necessary measurements have been collected, the TIPCHECK engineer performs a thorough analysis of the data in order to calculate the extent of the current thermal losses and the savings—both in energy and monetary terms—that can be realised by remediating the issues with the current insulation. This step is aided greatly by a proprietary TIPCHECK computer programme that EiiF created to ensure that the results are accurate, reasonable, and computed according to standardised procedures that represent best engineering practice.

In addition to computing energy losses from obviously non-insulated equipment surfaces, the TIPCHECK computer programme contains an innovative function that helps the TIPCHECK engineer to identify insulation issues that may be hidden beneath cladding that shows no outward signs of damage. This ability to "work backward" from measured cladding surface temperatures can reveal unseen problems such as rotten or damaged insulation material or thermal conductivity bridging due to water ingress and corrosion—and allow the TIPCHECK engineer to recommend a tailored, cost-effective solution to the problems.

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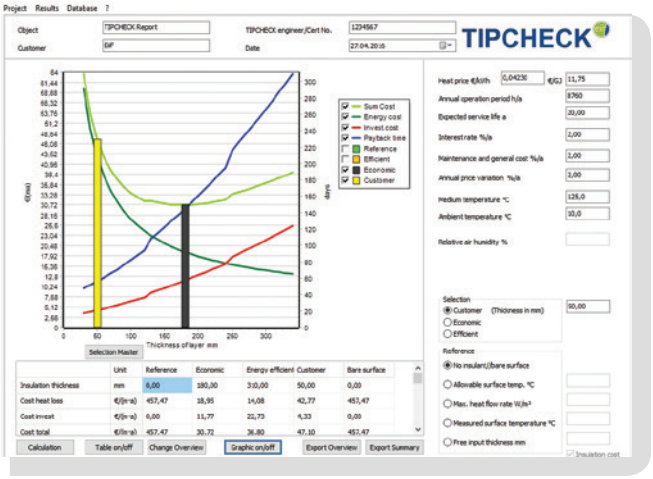
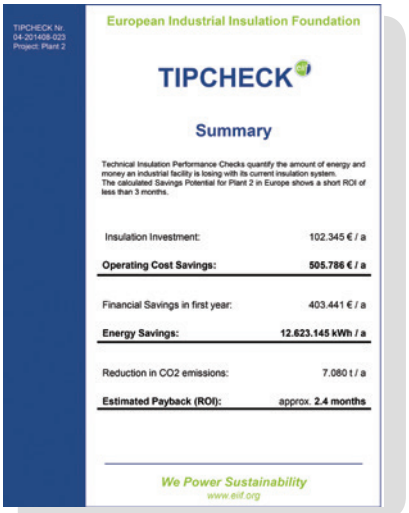


The EiiF software calculates the cost-effectiveness of insulation solutions



5 Creation of the TIPCHECK Report

One of the most important features of the TIPCHECK audit is the tailored report that the engineer creates to communicate the audit results to the client. This report is designed to consistently identify thermal losses (and the associated CO_2 emissions) due to the current insulation and to reveal the energy and CO_2 savings potential of both "cost-effective" and "energy-efficient" insulation levels[5]. In addition to providing background information and a detailed description of the audit methodologies, the TIPCHECK report offers specific recommendations as well as a plan and implementation schedule for any proposed actions. The report may also include additional issues, such as worker safety risks from the current insulation levels, but the main body of the report focuses solely on the energy savings and CO_2 reduction potential of recommended actions.

6 Presentation of the Results

The final step in the TIPCHECK protocol involves the presentation of results to the client. This allows the TIPCHECK engineer to personally describe the details of the data collection and analysis steps and to discuss the results and conclusions face-to-face with the clients—which provides the best opportunity to answer questions that may arise.

QUALITY CONTROL

EiiF is vitally interested in maintaining the quality and integrity of TIPCHECK reports. To do so, EiiF conducts random quality checks on TIPCHECK reports—and any client can request such a quality check—in which case, the TIPCHECK engineer who created the report is obliged to provide EiiF with the information necessary to evaluate its quality.

(5) "Cost-effective" insulation levels are defined as those for which the insulation minimizes the total costs of insulation and heat loss. "Energy-efficient" levels are those which result in 25% less heat loss than the cost-effective levels.

The Impact of TIPCHECK

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The survey findings presented in this report confirm the effectiveness of the TIPCHECK programme in helping to mitigate industrial thermal energy losses due to deficient equipment insulation. And because each instance of mitigation produces operational cost savings and corresponding CO_2 emissions reductions, the programme may be seen as benefiting not only the industrial plants where it is applied but also European society in the large.

These benefits are of particular importance to three audiences with diverse needs and responsibilities: EU policy makers, industrial plant asset owners and decision makers, and industrial insulation stakeholders.

Importance to EU Policy Makers

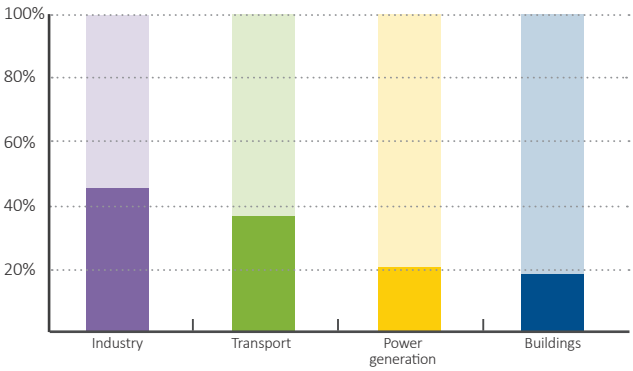
In tackling the important issues facing the EU with regard to a sustainable-energy strategy and the reduction of greenhouse gas emissions, EU policy makers must actively pursue all reasonable means (aligned with the Energy Union) of reducing EU-wide energy use and increasing energy security. In this respect the industrial sector has begun to draw legislative attention.

As an example, Article 8 of the EED requires Member States to promote the availability of high quality energy audits carried out in an independent manner by accredited experts and according to qualification criteria. Furthermore the audits shall be proportionate, and sufficiently representative (see Annex VI of Article 8).

To fully satisfy the drawing of a reliable picture of overall energy performance the insulation focused TIPCHECKs can team up with more general energy audits.

Audits by themselves, however, do not save energy. To be useful in accomplishing that goal, they might need to be paired with regulatory efforts that require industry to take remedial actions based on recommendations that arise from the audits. In the absence of such efforts, the potential for energy savings and emissions reductions could remain unrealised.

These unrealised energy savings are of particular concern given that the EU currently imports 53% of the energy it consumes (at a cost of more than € 1 billion/day) and includes several Member States



Two-thirds of the economic potential to improve energy efficiency remains untapped in the period to 2035 (IEA WEO 2012)

Realised energy efficiency potential

Unrealised energy efficiency potential

which are entirely dependent on a single non-EU state for their energy supplies, rendering them highly vulnerable to external political and energy shocks. An evaluation performed by Ecofys in 2014 indicated that EU-wide remediation of industrial insulation problems could reduce EU dependency on gas imports, for example from Russia, by as much as 12.5%[6] .

(6) http://www.eiif.org/awm/downloads/Ecofys_GasInFocus_calculations.pdf

These estimates suggest that EU policy makers must take a bold stance with regard to energy reduction in the industrial sector. And the success of the TIPCHECK programme, as demonstrated by the results surveyed in this report, suggests that this bold stance should include standardised audits in the mould of the TIPCHECK programme and should require action on the part of industry in response to the conclusions and recommendations of such audits, especially as they relate to industrial insulation.

Such actions would not only reduce energy use but could also contribute significantly to the EU efforts to reduce CO_2 emissions and meet overall environmental goals in a cost-effective manner with reasonable payback times. Figure 4, for example, shows the potential impact that industrial insulation solutions could generate in eight major countries and economies of the EU.

EUs dependency on gas imports

Industrial Insulation could cost-effectively reduce the EU's energy consumption by 0,5% - 1% = 460 PJ – 620 PJ

Figure 3: Possible reduction in gas imports due to industrial insulation remediation

	Annual cost-effective savings potential		... in idustry		... in fossil fuel-fired power generation		Households equivalents	Cars equivalents	Initial investment	Energy savings potential	Annual savings
FR	51 PJ	3.8 Mt CO_2	45 PJ	3.4 Mt CO_2	6 PJ	0.4 Mt CO_2	750.000	1.9 M	€ 100 M	75%	€ 420 M
DE	106 PJ	8.7 Mt CO_2	80 PJ	6.3 Mt Mt CO_2	26 PJ	2.4 Mt CO_2	1.500.000	4.3 M	€ 180 M	75%	€ 750M
IT	65 PJ	4.5 Mt CO_2	48 PJ	3.3 Mt CO_2	17 PJ	1.2 Mt CO_2	1.500.000	2.2 M	€ 90 M	75%	€ 500 M
PL	40 PJ	3.4 Mt CO_2	27 PJ	2.2 Mt CO_2	13 PJ	1.2 Mt CO_2	600.000	1.7 M	€ 35 M	75%	€ 200 M
ES	49 PJ	3.4 Mt CO_2	40 PJ	2.8 Mt CO_2	9 PJ	0.6 Mt CO_2	1.200.000	1.7 M	€ 75 M	70%	€ 400 M
SE	16 PJ	1.4 Mt CO_2	15 PJ	1.3 Mt CO_2	1 PJ	0.1 Mt CO_2	200.000	0.7 M	€ 35 M	70%	€ 150 M
UK	65 PJ	4.7 Mt CO_2	46 PJ	3.2 Mt CO_2	19 PJ	1.5 Mt CO_2	900.000	2.3 M	€ 100 M	75%	€ 450 M
NL	31 PJ	2.1 Mt CO_2	24 PJ	1.6 Mt CO_2	7 PJ	0.5 Mt CO_2	500.000	1.0 M	€ 50 M	75%	€ 225 M

Figure 4: Potential Industrial insulation energy savings in eight EU countries, ECOFYS 2013 - 2015

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Importance to Asset Owners and Decision Makers

Industrial plant asset owners and decision makers are driven largely by cost-and-profitability considerations, but they must also take into account the regulatory requirements that apply in the region in which they operate. Historically, decisions regarding the insulation of new or existing equipment have been based on satisfying minimum criteria for worker safety or process control, rather than with an eye toward energy efficiency and the operational cost savings and emissions reductions that can result from properly insulated equipment.

Proper industrial insulation can provide operational cost savings that far outweigh its required capital investment.

The findings of the survey presented in this report illustrate the cost-effectiveness of proper industrial insulation, and its ability to provide operational cost savings that far outweigh its capital investment and that leads to rapid payback. They also highlight the ability of industrial insulation to reduce plant CO_2 emissions, thereby helping industry to meet regulatory requirements and contribute to overall EU emissions reduction goals.

The TIPCHECK programme has been so successful, in fact, that:

- Three out of four (75%) industrial clients who commissioned a TIPCHECK audit have either acted already or plan to act in the near future (for example, at the next turnaround) on the conclusions and recommendations of their TIPCHECK report by investing in insulation to remediate existing insulation deficiencies.
- Based on cost savings from a reduction in energy loss, investments in industrial insulation paid back after only one or two years, and some investments paid back in less than one year, resulting in a TIPCHECK-identified cost saving potential for industry of at least € 23,5 million.
- Based on the observed implementation rate (55% of TIPCHECK clients have implemented 100% of the identified potential, 13% have implemented parts of the potential, and 14% are considering implementation), the TIPCHECK programme has already resulted in EU-wide annual energy savings of more than 500.000 MWh/year (1,8 PJ/year) and CO_2 reductions of more than 370.000 t CO_2 — equivalent to the annual greenhouse gas emissions of almost 80.000 cars.

These results demonstrate the ability of the TIPCHECK programme to produce a significant impact on the cost savings and profitability of industrial plants. But it is important to note that the programme also helps industrial plants to contribute to the auditing requirements of EED Article 8 and ISO 50001.

Importance to Industrial Insulation Stakeholders

In typical practice, insulation experts do not interact with industrial plant asset owners and decision makers except in response to a call for bids to insulate an approved industrial project—for example, to insulate a retrofitted storage tank and its associated piping. And because such bids are often evaluated on price alone, the experts are not often provided with the opportunity to apply their expertise to the improvement of plant operations and profitability—especially since they are usually considered subcontractors rather than consultants.

The TIPCHECK programme provides a powerful tool that insulation experts can use to proactively engage clients.

For these experts, the TIPCHECK programme provides a powerful tool that they can use to proactively engage potential clients with regard to the cost- and emissions savings that result from proper industrial insulation. The TIPCHECK audit allows them to offer their clients a standardised protocol, based on industry standards, to assess thermal losses and make consistent recommendations based on industry best practices.

The results of the TIPCHECK audits reviewed in this survey highlight two significant conclusions for insulation stakeholders:

- The total amount invested in TIPCHECK-related insulation solutions was € 20 million.
- In three out of four cases (75%), successful TIPCHECK services led to investments in insulation solutions, most of which are by far greater than the investment in the TIPCHECK audit itself.

These results suggest that the TIPCHECK programme is not only economically viable for insulation stakeholders but may be seen as a key to profitability—and that the TIPCHECK programme may be considered an integral part of smart business practice for insulation suppliers and installers. In doing so, they provide their clients with a valuable service and realise the benefits of responsible business practices that fall under the umbrella of “doing well by doing good.”

About This Report

This report summarises the results of approximately 180 TIPCHECK audits conducted between 2010 and 2015 at industrial plants in 11 European countries, in Brazil and Singapore. These audits were conducted by more than 30 TIPCHECK-certified engineers, representing approximately one third of the engineers who have obtained certification in the TIPCHECK programme.

Summary Facts and Figures

Number of plants inspected: 180

Plant locations (countries): Austria, Belgium, Brazil, Finland, France, Germany, Italy, Lithuania, Singapore, Spain, Switzerland, The Netherlands, United Kingdom.

Industry sectors: Chemical and petrochemical, Paper, pulp and print, Refinery and petro refinery, Power plant, Food, Chemical - Pharmaceutical, Consumer Goods, HVAC -Building equipment, LPG storage, Non-specified, Iron and steel, Wood and wood products, Construction, Machinery, Non-metallic minerals.

Inspected items: Valves, flanges, tanks, boilers, heat exchangers, pipes, drums, ducts, turbines, vessels (and other pieces of equipment).

Temperature ranges: -162 °C to 900 °C

Most often inspected temperature range: 100–350 °C

Nationality of TIPCHECK engineers: Belgian, British, Dutch, German, Italian, Spanish.

Data Quality

To ensure the quality of this survey, the results of each TIPCHECK report were signed and certified by the TIPCHECK engineer who conducted the audit. In addition, five of the 180 collected TIPCHECK reports used for the overall evaluation were excluded from the calculation of energy savings, CO_2 emission reduction potentials and cost savings, because their relevant figures for these calculations were not 100% assured at the time of publication of this report. In most cases, feedback from the client was still missing or not provided for confidentiality reasons.

Energy Prices and Savings Calculations

Because energy prices are often considered proprietary company information, they were not always provided by the TIPCHECK clients. In some cases, clients provided overall energy savings but not an equivalent in cost savings, or vice versa. In cases where energy savings were provided without a corresponding cost-savings figure (or vice versa), an average price of 30 €/MWh was used to determine the cost savings associated with the TIPCHECK-related action(s).

TIPCHECK Survey Findings

The findings of this survey may be generally organized into two groups:

- Energy/cost savings and CO_2 reduction potential
- Effectiveness of the TIPCHECK audits

Of course, these two groups cannot be completely decoupled—since each depends on the other—but their individual findings speak to separate benefits of the TIPCHECK programme indicated by the survey results.

Energy/Cost Savings and CO_2 Reduction Potential

The energy/cost savings and CO_2 reduction potential for the 175 TIPCHECK audits used to calculate the survey results depend strongly on the industrial sector and type of process inspected in the TIPCHECK audit, as well as the size and scope of the audit itself. A significant number of the TIPCHECK audits evaluated in this survey were carried out in the pioneering phase of the TIPCHECK programme, and some current audits are still carried out as pilot studies to demonstrate the potential of the programme. Consequently, per-project cost savings resulting from these 175 audits range from a few hundred euros (on the very low end) to more than € 7 million (on the high end)[7].

The major survey findings with regard to energy/cost savings and CO_2 reduction potential are as follows.

1. The energy savings potential for TIPCHECK clients was 759.804 MWh, corresponding to an energy cost savings of € 23.560.444[8].
2. The CO_2 reduction potential is 523.924 t CO_2, equivalent to the emissions of 110.300 cars[9]. (Because the specific energy sources could not be precisely verified in all cases, the CO_2 emission saving potential was calculated on the basis of the energy savings potential of 759.804 MWh.)
3. The TIPCHECK programme is currently responsible for EU-wide annual energy savings of more than 500.000 MWh/year and CO_2 reductions of more than 370.000 t CO_2–equivalent to the annual greenhouse gas emissions of almost 80.000 cars[10].

(7) Cost-effective insulation savings vary widely depending on factors such as plant size and production processes. In a refinery, for example, the savings can range from a few hundred thousand euros to millions of euros. In a small plant, like a family-owned brewery, the cost savings are on the order of tens of thousands of euros. In addition, the regular quality and maintenance control of the system impacts the need for tailored TIPCHECK audits. Often, large differences exist even between plants with similar production processes and within the same company. Also, the scope and size of the agreed-upon TIPCHECK audit necessarily impacts the size of the TIPCHECK result.

(8) The cost saving potential was calculated based on an average payback time of 1,5 years.

(9) Equivalent greenhous gas emissions were calculated using the Greenhouse Gas Equivalencies Calculator from the United States Environmental Protection Agency (EPA): epa.gov/energy/greenhouse-gas-equivalencies-calculator.

(10) The equivalent greenhous gas emissions were calculated using the Greenhouse Gas Equivalencies Calculator from the United States Environmental Protection Agency: epa.gov/energy/greenhouse-gas-equivalencies-calculator

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Effectiveness of the TIPCHECK Audits

To be considered effective in the large, the TIPCHECK programme must be evaluated not only on the basis of its potential effect on energy/cost savings and emissions reductions but also on its tendency to produce real-world actions and results on the part of the TIPCHECK clients. With respect to this evaluation, the major findings of this survey are as follows.

1. Of the 175 TIPCHECK clients included in this report, 97 (55%) implemented all of the recommendations in their respective TIPCHECK reports, 13% implemented parts of the recommendations, and 18% decided not to implement any of the recommendations. At the date of publication of this report, 14% of the TIPCHECK clients are still considering their implementation plans.
2. Because 68% (55% + 13%) of the TIPCHECK clients chose to implement all or part their TIPCHECK report recommendations, it is reasonable to estimate that at least half (50%) of the clients who are still considering implementation (14%) will eventually implement at least part of their report recommendations. It is likely, therefore, that an additional 7% of TIPCHECK clients will realise the identified potentials—for example, at the next turnaround of the plant. Consequently, it may be concluded that the total implementation rate is about 75%—which is to say that three out of four clients take action to implement identified saving potentials after a TIPCHECK audit.
3. Based on the implementation rates cited above, the industrial insulation contract volume realised in practice for the TIPCHECK audits included in this survey was about € 20 million[11].
4. Based on the calculated energy and cost savings of 759.804 MWh and € 23.560.444 [12] , respectively, and the observation that payback times for industrial insulation improvements are typically between one and two years, the business opportunities for the insulation industry can be estimated as a contract volume of about € 35 million at a 100% implementation rate.

(11) The € 20 million investments initiated were calculated based on the implementation rate (100% realised by 55% of all TIPCHECKs and partly realised by 13% of all TIPCHECKs) and based on the average payback time of 1,5 years.

(12) Based on an average payback time of 1,5 years.

Case studies

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Case studies demonstrate the effectiveness of the TIPCHECK Programme

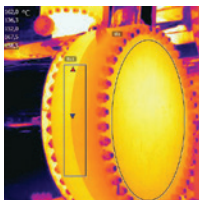
The following examples illustrate the effectiveness of the TIPCHECK audit when applied to specific, real-world industrial situations. They include:

- Coking-oven By-products Plant—Ghent, Belgium
- Sugar Beet Processing Plant—Vierverlaten, The Netherlands
- Oil Storage Tank Roof—Italy
- Chemical Plant—Italy
- Fibreglass Plant—Oschatz, Germany
- Meat Processing Plant—Germany

Each case study summarizes the situation addressed by the TIPCHECK audit, provides information regarding the personnel involved in the audit, and presents details of the case.

Case Study 1
Coking-oven By-products Plant

SUMMARY



At a coking-oven by-products plant in Ghent, Belgium, the plant manager noticed that process efficiency was being compromised by an unidentified heat loss, leading to higher-than-necessary energy bills. A TIPCHECK audit revealed the heat loss to be caused primarily by the heat exchanger and pipe network. Implementation of insulation recommendations from the TIPCHECK report reduced ongoing energy losses, and the associated investment paid back in less than eight months.

PROJECT INFORMATION

Client Details

Company: ArcelorMittal

Facility Purpose and Location: Coking-oven by-products plant, Ghent, Belgium

Project Contact (Role): Johan van de Vijver (Plant Manager)

Quote: "This survey had shown us that there was an issue and that it could be solved relatively easily. We really hadn't considered that the valves and flanges could be an area of key heat loss, but the TIPCHECK images and calculations showed the impact of leaving this area uninsulated."

CASE DETAILS

Key Facts and Challenges

- The coking-oven by-products plant uses steam to clean coking-oven gases for use elsewhere onsite—an energy-intensive process that operates at temperatures as high as 180 °C.
- Unidentified heat losses were causing process inefficiencies, leading to rising energy bills.

Key Findings

- The TIPCHECK audit included 37 thermographic images of 79 different pieces of equipment—leading to the conclusion that the largest heat losses were from the heat exchanger and associated pipe work.
- Insulation of the valves and flanges in the areas of largest heat loss had the potential to reduce plant energy costs by more than € 28.000 per year.

Payback

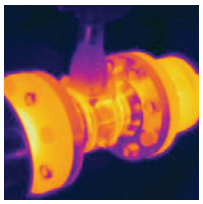
The payback period of this project was eight months.

Results

The client implemented the recommendations of the TIPCHECK-certified engineering team and monitored year-to-year energy use to determine the effect of the insulation investment. Actual energy cost reduction slightly exceeded the reduction predicted by the team. As a result, the client has requested the team to conduct similar TIPCHECK audits on other areas of the coking-oven plant.

Case Study 2
Sugar Beet Processing Plant

SUMMARY



At a sugar beet processing plant in Vierverlaten, Netherlands, the team leader of the mechanical engineering department sought ways to reduce energy losses in line with its Total Productive Maintenance (TPM) programme, one goal of which is to reduce energy use. A TIPCHECK audit identified critical heat-loss spots in the process and outlined three different remediation scenarios with payback periods of two, four, and six years, respectively. Based on the report, the client was able to prioritise planned remediation efforts to coincide with scheduled plant downtime.

PROJECT INFORMATION

Client Details

Company: Suiker Unie

Facility Purpose and Location: Sugar beet processing plant, Vierverlaten, Netherlands

Project Contact (Role): Lukas Rietsema (Mechanical Engineering Team Leader)

Quote: "We were keen to understand the return on investment we would achieve from the recommendations of the study. With our factory operating 150 days a year, we will be carrying out the necessary works during the quiet periods over the next year, starting with the simplest to remedy."

CASE DETAILS

Key Facts and Challenges

- The plant produces granulated sugar from sugar beets. Process by-products include: molasses, beet pulp for animal feed, and lime fertilizer for agriculture. The fermentation of residual sugars in the sugar-beet wash water produces gas that is used as an energy source in the plant.
- Rising energy prices prompted a close look at energy use and potential heat losses in the plant, which were determined to be as high as € 800.000.

Key Findings

- The TIPCHECK audit included thermographic images taken in 198 different positions, covering 419 different pieces of equipment, including three boilers, evaporation and cooking pans, heat exchangers, pumps, and valves.
- TIPCHECK calculations showed that an insulation investment of € 84.000 could save as much as € 37.000 per year.

Payback

The payback period of this project was slightly more than two years.

Results

Based on the TIPCHECK audit report, the client was able to prioritise insulation subprojects and plan a strategy to implement many of the recommended remediation actions during the upcoming plant downtime periods (approximately 200 days per year).

Peter Stulen

TIPCHECK Engineer Details

Company: Hertel

Name (Role): Peter Stulen (Head of Plant Integrity)

TIPCHECK Certification: Senior TIPCHECK engineer, Level 2 Certified Thermographer

"From the images in the by-products plant, we quickly identified that the largest heat loss was from the heat exchanger and piping. Our experience in the process engineering sector led us to consider valves and flanges as an area of potential for heat loss—which was confirmed by the thermal images." (Case study 1)

"Planning where to take the thermographic image within the factory is key to being able to validate the results and heat loss. And when analysing the images, we use two approaches—a qualitative approach, to locate all areas where there are hot and cold spots, and a quantitative analysis where we are able to determine real temperatures around the equipment." (Case study 2)

Case Study 3
Oil Storage Tank Roof

SUMMARY

At an oil refinery, the roof on a large oil storage tank needed replacement due, in part, to damage from corrosion under damaged insulation. The owner was considering installing the new roof without insulation, and accepting the resulting heat losses, in order to alleviate future problems with corrosion. A TIPCHECK audit revealed the magnitude and cost of the heat losses, and the insulation firm that performed the audit was able to recommend a technical solution that allowed the new roof to be insulated without a recurrence of the corrosion problems.

PROJECT INFORMATION

Client Details

Company: Confidential/Not disclosed

Facility Purpose and Location: Refinery, Italy

Project Contact (Role): Confidential/Not disclosed

CASE DETAILS

Key Facts and Challenges

- Tank operating temperature was 60 °C
- The roof of the oil storage tank was equipped with very old and damaged insulation, and the sheet of the roof was heavily corroded.
- The status of the roof required that it be demolished and fully replaced.
- In order to avoid corrosion problems in the future, the owner was considering replacing the roof without insulation accepting the heat loss.

Key Findings

- The TIPCHECK audit found out that without insulation the energy loss would have been approximately € 430.000 per year (9.500 MWh/year).
- An insulation of only 30 mm thickness on the roof, applied with a technical solution to avoid future corrosion under insulation (CUI) problems, could reduce the energy loss by 80%.

Payback

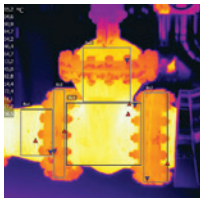
The payback period of this project was less than two years.

Results

The owner decided to insulate the new roof.

Case Study 4
Chemical Plant

SUMMARY



A large chemical plant in Italy contained hundreds of uninsulated or under-insulated parts, such as valves and flanges, which needed to be evaluated individually in order to assess the associated heat losses. The standardised TIPCHECK methodology revealed in detail the amount of heat lost from each instance of missing or damaged insulation and allowed the TIPCHECK auditor to present specific remediation recommendations and their projected results. In response to the TIPCHECK results, the client acted immediately to implement recommended measures.

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PROJECT INFORMATION

Client Details

Company: Confidential/Not disclosed

Facility Purpose and Location: Chemical plant, Italy

Project Contact (Role): Confidential/Not disclosed

CASE DETAILS

Key Facts and Challenges

- The plant had a large number of flanges and valves uninsulated and several parts of the equipment was only partly insulated and/or covered with old and damaged insulation.
- The large number of single items to be inspected and the evaluation of the saving potential of equipment with old insulation and/or un-insulated parts presented a great challenge.

Key Findings

- 650 m of piping were uninsulated or covered with damaged insulation
- 300 flanges, 160 valves, and 3 tanks were un-insulated
- The process temperature range was from 75 °C to 150 °C
- TIPCHECK recommended actions to save annually: 11.100 MWh, approximately € 200.000 and 2.240 t CO_2

Payback

The payback period of this project was less than one year.

Results

Flanges and valves are very often not insulated, mainly for operational and maintenance reasons. Yet, based on the TIPCHECK report and the energy, cost and CO_2 saving potential, the client decided to proceed with the full implementation of the TIPCHECK recommendations. The client recognized that new insulation techniques allow to insulate while fulfilling operational and maintenance needs presenting today a great opportunity to save energy and by this reduce production costs.

Michele Mannucci

TIPCHECK Engineer Details

Company: Termisol Termica

Name (Role): Michele Mannucci (Technical Director)

TIPCHECK Certification: Senior TIPCHECK engineer, Level 2 Certified Thermographer

"The surface of the roof of the tank was as big as a football pitch and the temperature inside was 60 °C. The challenge was to find the right technical solution to insulate and avoid returning CUI problems which had damaged the roof before. We found the right balance helping the client to save energy and money and preserve the newly refurbished roof of the tank."
(Case study 3)

"The complexity of this project was due to the size of the plant and the need to assess the status of the insulation in hundreds of single parts. The TIPCHECK standardised methodology helped us to do this precisely and effectively. Our client was very positively surprised when we presented the audit results highlighting his saving potential and the short payback time and he decided to proceed without further delays."
(Case study 4)

Case Study 5
Fibreglass Plant

SUMMARY

At a fibreglass plant in Oschatz, Germany, a continuous furnace uses hot air to melt glass in order to create a solid mat composite that is used in automotive and marine construction and to make glass fibre complexes and fabrics. Increasing energy expenditures prompted the plant management to commission a TIPCHECK audit. The audit revealed that oil in the air had penetrated and deteriorated the roof insulation, leading to the increasing energy losses, and that insulation between elements of the steel framework had deteriorated. In addition, the framework itself had never been insulated, contributing to the high heat losses. Implementation of recommendations in the TIPCHECK report resulted in energy savings even higher than those estimated in the report.

PROJECT INFORMATION

Client Details

Company: P-D Glasseiden GmbH

Facility Purpose and Location: Fibreglass plant, Oschatz, Germany

Project Contact (Role): Mathias Winkler (Energy Manager)

CASE DETAILS

Key Facts and Challenges

- Energy costs for the melting process were increasing greatly.
- The roof insulation had deteriorated and its cover was damaged.
- The steel framework in the vicinity of the melting operation had never been insulated.

Key Findings

- The roof insulation had been penetrated and damaged by oil in the plant air, resulting in a deterioration of its effectiveness by a factor or two.
- The cassette insulation between elements of the steel framework had deteriorated due to direct thermal load.
- TIPCHECK recommended actions could save annually: 442.4 MWh for an area of 200 m^2

Payback

The payback period of this project was about 1,5 years.

Results

Based on the recommendations of the TIPCHECK report, the client replaced the roof insulation and installed and sealed a new cover seam. The client also insulated the steel framework and applied an additional layer of insulation to the cassettes between the steel frames. Subsequent calculations of energy savings by the client confirmed—and actually exceeded—those estimated in the TIPCHECK report.

Tino Leonhardt

TIPCHECK Engineer Details

Company: G+H Insulation

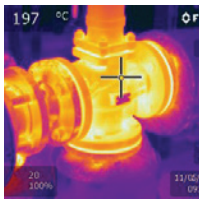
Name (Role): Tino Leonhardt (Project Engineer)

TIPCHECK Certification: TIPCHECK engineer, Thermographer

"The Energy Manager, Mathias Winkler, asked us to perform a TIPCHECK audit on the fibre glass ovens, because they operate at a relatively high temperature (180 °C). We found high temperatures and associated heat losses on some surfaces and outer parts, where the insulation was either damaged or missing. Our tailor-made insulation solution was able to reduce the identified heat losses to an acceptable minimum."

Case Study 6
Meat Processing Plant

SUMMARY



At a meat processing plant in Germany, plant management commissioned a TIPCHECK audit to determine the potential energy savings that might result from insulating lines conveying hot media throughout the plant. The TIPCHECK report concluded that insulating the lines to meet an applicable energy savings ordinance could pay back in less than two years.

PROJECT INFORMATION

Client Details

Company: Confidential / Nos disclosed

Facility Purpose and Location: Meat processing plant, Germany

CASE DETAILS

Key Facts and Challenges

- Plant operations take place indoors, with a reasonably steady mean ambient operating temperature of 18 °C and relative humidity of approximately 40%.
- Hot media processing temperatures range from 75 °C to 175 °C.
- Only uninsulated components were included in the TIPCHECK audit.

Key Findings

- Insulation of the hot media lines to a thickness that satisfies the applicable Energy Saving Ordinance ENEV 2014 would result in annual fuel cost savings of nearly € 9.000.
- Based on a total insulation cost of slightly over € 16.000, the insulation investment would pay back in less than two years.

Payback

The payback period of this project was 1,79 years.

Results

The client decided to proceed with the recommended implementation of the tailored insulation solutions following the TIPCHECK findings and similar TIPCHECK and remediation projects were carried out subsequently at all of their German sites.

Holger Fürst

TIPCHECK Engineer Details

Company: KAEFER

Name (Role): Holger Fürst (Project Leader)

TIPCHECK Certification: TIPCHECK engineer, Thermographer

"The Energy Manager asked us to perform a TIPCHECK audit. We started with one plant and found very cost-attractive energy savings potentials for uninsulated flanges, valves, and manholes in the vessel park. Similar TIPCHECK projects were carried out subsequently at all of their production sites in Germany. In addition to the TIPCHECK audits, our thermographic studies of already insulated and covered surfaces helped the client to fulfill their safety requirements of limited surface temperatures."

Conclusions

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This survey of TIPCHECK audits conducted between 2010 and 2015 indicates that the programme has been very successful with regard to reducing energy consumption and its associated CO_2 emissions at industrial plants. The majority of TIPCHECK clients tend to act on the recommendations contained in the TIPCHECK reports, resulting in a substantial investment in insulation solutions and in operational cost savings that pay back the investment after only one or two years. The energy-use reductions also result in CO_2 emissions savings that contribute to the ability of industrial plants to meet emissions regulatory requirements and support the fight against global warming.

The major findings of this report can be summarised as follows.

- The annual energy savings potential identified by nearly 180 TIPCHECK audits was more than
- 750.000 MWh/year (2,7 PJ/year), resulting in an estimated CO_2 emission reduction potential of more than 500.000 t CO_2—equivalent to the annual greenhouse gas emissions of almost 110.000 cars.
- Based on cost savings from a reduction in energy loss, investments in industrial insulation paid back after only one or two years, and some investments paid back in less than one year, resulting in a TIPCHECK-identified cost saving potential for industry of at least € 23,5 million.
- Three out of four (75%) industrial clients who commissioned a TIPCHECK audit have either acted already or plan to act in the near future (for example, at the next turnaround) on the conclusions and recommendations of their TIPCHECK report by investing in insulation to remediate existing insulation deficiencies.
- Based on the observed implementation rate (55% of TIPCHECK clients have implemented 100% of the identified potential, 13% have implemented parts of the potential, and 14% are considering implementation), the TIPCHECK programme has already resulted in EU-wide annual energy savings of more than 500.000 MWh/year (1,8 PJ/year) and CO_2 reductions of more than 370.000 t CO_2—equivalent to the annual greenhouse gas emissions of almost 80.000 cars.
- Implemented insulation improvements resulting from the first 119 realised TIPCHECK audits (68% of all TIPCHECKs to date) are estimated to represent at least € 20 million in insulation business.

These findings suggest that the TIPCHECK programme may present a substantial opportunity for the insulation industry to contribute to overall EU energy-use and CO_2 emissions reduction goals. Its results tend to translate into real-world actions that reduce industrial plant operating costs and emissions; consequently, it provides insulation stakeholders with the ability to proactively help their clients save energy and meet regulatory standards.

The energy savings associated with the TIPCHECK audits included in this report amounts to approximately 2,7 PJ, which corresponds to only 0,4% of the 620 PJ energy savings potential identified in the Ecofys report published in 2012. It is important to note, however, that these audits were conducted by only one third of the currently certified TIPCHECK engineers, at an average rate of slightly more than one audit per engineer per year. It is also significant that most of the reported TIPCHECK audits did not analyse entire plants but only certain parts of them—for example, the roof top of a tank or a few heat exchangers, valves, or flanges.

Recommendations

The 2012 Ecofys report suggests that EU-wide remediation efforts of industrial insulation deficiencies to cost-effective levels could help the EU to meet its 2020 and 2030 energy reduction goals by reducing energy consumption equivalent to 10 million households or 15 coal-fired power plants. But it also identified barriers to realising those remediation efforts, some of which involve a lack of awareness on the part of industrial plant asset owners and decision makers. The TIPCHECK programme provides an effective tool for overcoming such barriers and could be used—in conjunction with responsible legislation regarding energy audits and their follow-up actions—to contribute substantially to EU energy and emissions reductions goals in the years ahead.

In particular, the TIPCHECK programme can help to raise awareness of the issues in two primary ways—1) by prompting positive and proactive marketing efforts in the insulation industry, and 2) by supporting political actions aimed toward realisation of the potential energy and emissions savings to be achieved through proper use of industrial insulation.

The insulation industry should intensify its proactive marketing efforts for TIPCHECK services and take steps to increase the number of certified TIPCHECK engineers. For example, the TIPCHECK audits included in this study involved only 30 engineers. If ten times that number (300) were to actively pursue the selling of insulation appraisal services in their respective markets, the total potential energy savings identified in the 2012 Ecofys report (620 PJ) could be realised within the next ten years, which would deliver 1% energy savings potential, helping the EU to achieve its 2030 energy targets.

A strong political support for awareness programmes is needed to convince industry of the benefits of remediating recommendations from energy audits in general and the TIPCHECK audit in particular. For example, the inclusion of energy efficiency chapters in all the Best Available Techniques (BAT) Reference (BREF) documents, and supporting Best Available Techniques with short paybacks would help to raise awareness on both the supplier and client sides of the insulation market—and would prompt insulation contractors/service providers to invest in TIPCHECK engineer qualification and services and for insulation clients to invest in sustainable insulation systems.

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Abbreviations

AGI:	Arbeitsgemeinschaft Industriebau e.V. (German cross cutting technology network developing guidelines for building and civil engineering)
BAT:	Best Available Techniques
BREF:	Best Available Techniques Reference Document
CO_2:	Carbon dioxide
CUI:	Corrosion Under Insulation
DN:	Diameter Nominal
EED:	Energy Efficiency Directive
EiiF:	European Industrial Insulation Foundation
EN:	European Standard
EU:	European Union
GHG:	Greenhouse Gas
ISO:	International Organization for Standardization
MWh:	Megawatt hour
PJ:	Petajoule
TIPCHECK:	Technical Insulation Performance Check

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About EiiF

The European Industrial Insulation Foundation (EiiF) formed in 2009 to meet the need for a neutral, not-for-profit institution to promote insulation as a means to achieve industrial profitability and sustainability. From the initial group of 12 founding partners, EiiF has grown to include more than 60 leading industrial insulation companies, which range in size from large global firms to small- and medium-sized companies.

The fundamental mission of EiiF is to encourage the deployment of sustainable insulation systems in industry and to thereby contribute to a reduction in overall energy consumption and CO_2 emissions—while coincidentally improving worker health and safety, as well as industrial process control. To that end, its primary task is to advocate the use of sustainable industrial insulation solutions to governmental policymakers and industry decision makers; however, it also takes a proactive role in the education and training of insulation engineers and industrial plant management personnel, especially with respect to the importance of industrial insulation and its benefits to plant profitability.

Notes


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We Power Sustainability

The European Industrial Insulation Foundation (EiiF) is a non-profit foundation registered in Switzerland in 2009. The Foundation has been set up to promote and establish the use of industrial insulation as a widely understood and accepted means of achieving sustainability. Since its foundation, the EiiF has established itself as a resource for governments and industries that need to reduce CO_2 emissions and save energy.

For more information: www.eiif.org