DE-FOA-0002830: Request for Information on Barriers and Pathways to Integrating Onsite Clean Energy Technologies in the Industrial Sector

Submitted by:

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The National Insulation Association® (NIA) is a not-for-profit educational trade association representing merit and union contractors, distributors, laminators, fabricators, and manufacturers that provide thermal insulation, insulation accessories, and components to the commercial, mechanical, and industrial markets throughout the nation. Since 1953, the northern Virginia–based association has been the voice of the mechanical insulation industry and is dedicated to keeping the commercial and industrial sectors up-to-date on the latest industry trends and technologies.

C1.1 What level of interest is there from industrial energy users in installing onsite clean energy technologies, and what is driving that interest?

The level of interest is very high and is driven by the desire to meet GHG and, especially, carbon emission reduction goals as well as reducing energy costs. Adding new mechanical insulation systems to meet or surpass current commercial building codes is recommended but the industrial side does not have code guidance to follow and must rely on insulation systems inspections. The National Insulation Association created a consensus-based national program to certify insulation inspectors that could be ramped up with funding and program awareness.

C1.2 What types of onsite clean energy technologies do industrial energy users feel comfortable deploying, and why? Which technologies do industrial energy users not feel comfortable deploying, and why?

Mechanical insulation is a familiar, proven technology that many users have in their own homes and can easily translate insulation's benefits from a residential to industrial setting. It is a clean technology that prevents energy waste on existing or new systems with a readily available, product that will last the life of the system with proper inspection and maintenance.

C1.3 What primary factors are driving decisions about whether a clean energy technology is implemented at a manufacturing facility?

Frequently users look for the latest innovation and overlook existing solutions. Insulation is a known energy and carbon saver for small- to medium-sized plants and resulted in 5–6% overall reduction in CO_2 emission in one Georgia Pacific pulp and paper plant.[1] Return on Investment (ROI) is often cited as a deterrent for energy/carbon reduction technology deployment. A recently released study completed by ICF on pipe insulation

in industrial facilities saves more than $126 billion in energy costs based on an average capital cost of $3.77 billion. The average payback on this investment is about one year. For many industrial sectors, the payback is as little as six months.[2]

C1.4 How are manufacturers incorporating onsite clean energy technologies into their *shortterm* planning for a future decarbonized economy?

Once installed, insulation works immediately, and many projects have an ROI of less than a year. Quality insulation contractors are available nationwide to assist manufacturers meet both shortterm and longterm energy and emission goals.

C1.5 How are manufacturers incorporating onsite clean energy technologies into their *longterm* planning for a future decarbonized economy?

According to a recent independent ICF study, making pipe and mechanical insulation improvements to industrial facilities in eight major industrial sectors (Chemical, Food, Paper, Petroleum and Coal Products, Primary Meals, Nonmetallic Mineral Product, Transportation Equipment, and Plastics and Rubber Products) would save these sectors more than $126 billion in energy costs based on an average capital cost of $3.77 billion. The average payback on this investment is about one year. For many industrial sectors, the payback is as little as six months.[2]

C1.6 Provide any additional information relevant to the current state of uptake of onsite clean energy technologies by industry that does not fit in the previous sections in this category.

A mechanical insulation (MI) system is uniquely designed to address each plant's or facility's needs and challenges using a variety of MI materials and technologies. Each MI system is designed to operate under a given set of operating and environmental conditions, which vary by geographic regions, including humidity and temperature ranges, especially as they relate to process temperatures and indoor/outdoor facilities/spaces. It can be used in any type of plant or facility, any where in the country because it will be design for that building or system.

C2.1 How do industrial facilities expect their patterns of electricity and thermal energy use to change in coming years due to carbon reduction and renewable energy goals?

The ICF study, mentioned above, found that Energy savings from insulation upgrades can reduce natural gas use by 118 billion therms across the U.S. industrial sector and help reduce demand on the electric grid as electrification technologies roll out.[2]

C2.2 What aspects of manufacturing processes or facility operations face the greatest challenges or barriers to using onsite clean energy technologies?

C2.3 What industrial subsectors have the greatest opportunity for integrating the following onsite clean energy technologies? What are the barriers to integrating the following technologies?

- **Solar PV**
- **Solar thermal**
- **Wind power**
- **Bioenergy**
- **Geothermal**
- **Battery storage**
- **Thermal storage**

Insulation has the greatest opportunity for impact and should be included on this and all other improvement lists. As established in NIA's previous partnership with the DOE, the research found that 10–30% of insulation is missing after 1–3 years from installation and that the insulation is rarely replaced once it is taken off or damaged.[3] To take full advantage of this proven and readily available technology for all the industrial categories covered by this RFI, it is essential to begin thinking differently about mechanical insulation and for those facilities to adopt the mindset that insulating mechanical systems is necessary, not an option.

C3.1 Which types of facilities are more likely to have the resources required to implement onsite clean energy projects?

Mechanical insulation (MI) systems positively impact key unit operations equipment in industrial facilities and are essential to controlling process temperatures (-450–1,800°F). MI is a clean, proven, and green technology that can be used across multiple subsectors to save energy, no matter the source, thereby contributing to the decarbonization of the industrial sector. A properly specified and installed MI system on bare process lines and equipment can increase the efficiency of a process system by as much as 95% or more.

C3.2 What resources, such as cost/benefit analysis tools, vendors, consultants, education and training institutions, and technical assistance programs, are available to assist industrial energy users in evaluating different onsite clean energy technology options? What are their strengths and weaknesses?

While MI is an existing component in industrial facilities, these facilities frequently are under-insulated or insulated to outdated code minimums, instead of current or maximum efficiencies and carbon reduction levels.

To take full advantage of this proven and readily available technology for industrial facilities, it is essential to begin thinking differently about mechanical insulation and for those facilities to adopt the mindset that insulating mechanical systems is necessary, not an option. NIA is prepared to address the change in mindset and barriers listed below though education, training, consultants, and existing and new tools.

What are the barriers for industrial and process facilities to implement an aggressive and continuous MI system maintenance process that would increase energy savings and reduce carbon emissions every year for the life of the facility?

- Many decision makers lack detailed knowledge about MI systems, their benefits, and the risk of not maintaining them in an effective and timely manner as they work silently in the background.
- Every plant, facility, or company needs a MI "champion"—trained personnel in inspection and assessing insulation system technology.
- Good or best practices in one unit/plant need to be widely dispersed within and between organizations.
- Decision makers need motivation to allocate attention and resources. Financial modeling prescriptive to mechanical insulation should be considered as part of the decision process.
- Timely and effective insulation maintenance is an investment, not an expense, especially since the return on investment (ROI) is so quick and can help fund additional improvements. The real expense is the energy waste and the extra GHG and carbon emissions released due to neglected systems. The damage or cost caused by reduced focus on MI is often not identified in technical and/or financial terms until it is too late.
- There is usually pressure from competing and often more "glamorous" or widely accepted carbon-reducing initiatives. NIA proved that "Insulation Is Greener Than Trees" more than a decade ago in Christopher P. Crall's January 2009[4] article and the September/October 2021[5] updated version published in *Insulation Outlook* magazine.

Resources in these plants and facilities is another challenge. There are little-to-no job functions within industrial facilities that are exclusively dedicated to the MI systems, their function, and their maintenance. If there is anyone identified and responsible for this area, they have no formal education or training on thermal insulation. Unfortunately, insulation systems are not seen as a high priority or a technology that requires expertise.

How could these barriers be overcome? NIA suggests establishing a national education/training program and developing a job program to train new or existing personnel in understanding the inspection and assessment of MI systems. NIA has existing training programs, the Insulation Energy Appraisal Program™ and the Thermal Insulation Inspector Certification™, (see C3.4 for details on these two certification courses) that could readily be scaled up and is ready to work with DOE to deploy this training.

In addition, to further build upon the data point from previous research that 10–30% of insulation is missing or damaged after 1–3 years after installation, a system-wide insulation inspection and energy appraisal should be performed, at minimum, annually at each facility to determine the true energy reduction, environmental savings, and cost-benefit to the individual location. One potential solution would be to develop a hybrid

certification based on two existing NIA certification programs, which now focus on (1) inspection of new and existing facilities and (2) insulation energy appraisals.

On demand and portable training are needed to reach all locations. NIA can work with the DOE on providing adequate remote training to allow these locations to benefit. In fact, NIA's Education Center is launching in Q4 2022 and is a new concept in training and education for the insulation industry to meet the growing need for easily accessible on-demand training from a trusted industry source. There are 30 new topics in development, with the majority addressing technical topics.

C3.4 Of the resources described in the previous two responses, which are the most utilized by industrial energy users?

NIA's Insulation Energy Appraisal Program™ is a certification-level course established in 2000 that teaches future appraisers how to determine the optimal insulation thickness and corresponding energy and dollar savings for a project and gives facility managers a better understanding of their insulated systems' ROI. This course also trains appraisers to use 3E Plus®, a free online tool that allows users to calculate appropriate insulation thickness for any application. There are currently 131 Certified Insulation Energy Appraisers. NIA's Thermal Insulation Inspector Certification™ is a certification level course established in 2019 that trains inspectors to evaluate installation work and determine whether it is compliant with mechanical insulation specifications. There are currently 196 Certified Insulation Inspectors.

C4.1 What educational and training resources do industrial energy users need to accelerate the adoption of onsite clean energy technologies?

Resources in industrial plants and facilities are a challenge. There are little-to-no job functions within industrial facilities that are exclusively dedicated to mechanical insulation systems, their function, and their maintenance. If there is anyone identified and responsible for this area, they have no formal education or training on thermal insulation. Unfortunately, insulation systems are not seen as a high priority or a technology that requires expertise.

How could these barriers be overcome? NIA suggests establishing a national education/training program and developing a job program to train new or existing personnel in understanding the inspection and assessment of MI systems. NIA currently has training programs available such as the *Insulation Energy Appraisal Program,* which utilizes the *3E Plus* software program, which calculates appropriate insulation thickness for various applications, and *Thermal Insulation Inspection Program.*

In addition, numerous resources reside on NIA's website, www.insulation.org, including the Mechanical Insulation Design Guide and numerous, simple calculators including Energy Calculator for Equipment (Vertical Flat Surfaces), Energy Calculator for Horizontal Piping, Mechanical Insulation Financial Calculator, Estimate Time to

Freezing for Water in an Insulated Pipe Calculator, Personnel Protection Calculator for Horizontal Piping, Temperature Drop Calculator for Air Ducts, and Temperature Drop Calculator for Hydronic Piping,

Research has shown that 10–30% of insulation is missing or damaged after 1–3 years after installation, a system-wide insulation inspection and energy appraisal should be performed, at minimum, annually at each facility to determine the true energy reduction, environmental savings, and cost-benefit to the individual location. One potential solution would be to develop a hybrid certification based on two existing NIA certification programs, which now focus on (1) inspection of new and existing facilities and (2) insulation energy appraisals.

C4.2 What software and analysis tools do industrial energy users need to accelerate the adoption of onsite clean energy technologies?

Ensuring that the industrial facility's onsite clean energy technologies include mechanical insulation is essential. This includes adopting a mechanical insulation maintenance program. Having at least one NIA Certified Thermal Insulation Inspector and Certified Insulation Energy Appraiser is an essential tool/resource for analyzing a facility's mechanical insulation system and determining if maintenance and repairs are necessary. Appraisers are trained to use various calculators as well as the previously mentioned 3E Plus software program.

C4.3 What other forms of technical assistance may industrial energy users need to accelerate the adoption of onsite clean energy technologies?

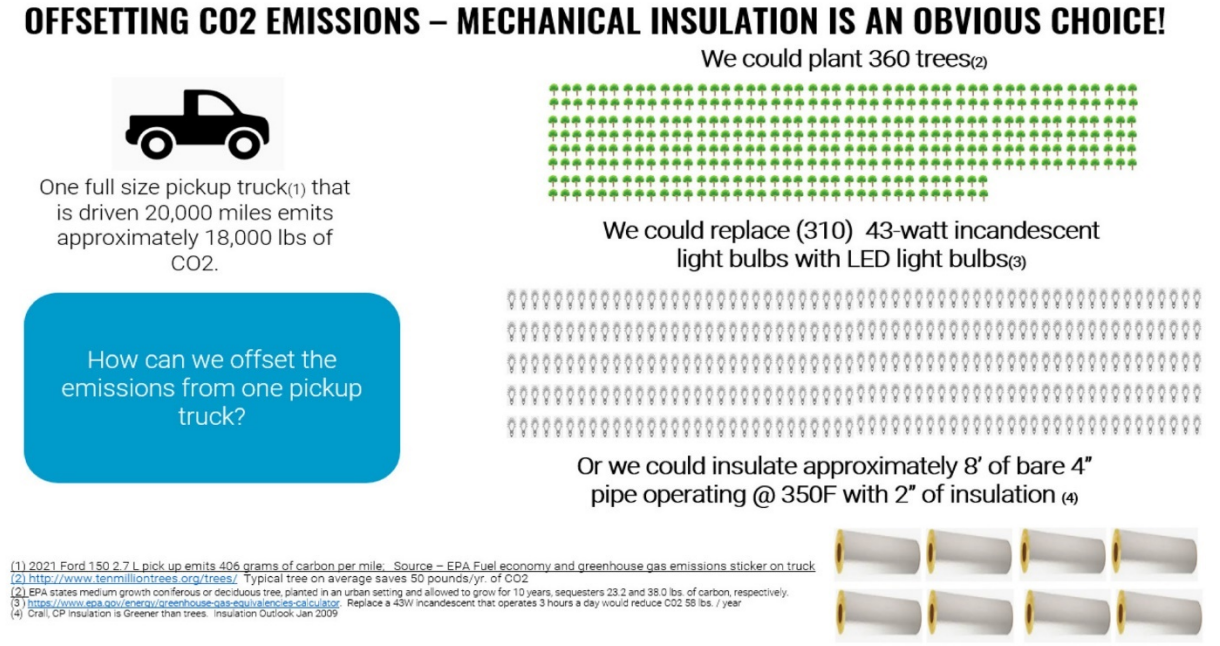
For mechanical insulation systems, consulting with NIA insulation contractors and manufacturers, NIA Certified Thermal Insulation Inspectors, and Certified Insulation Energy Appraisers will ensure that industrial energy users, and their facilities, are functioning efficiently.

C4.4 What types of stakeholder engagement efforts may help to accelerate the adoption of onsite clean energy technologies?

There needs to be an awareness campaign to reach the industrial sector decision-makers, stakeholders, and influencers at each industrial facility to understand the importance and value of mechanical insulation's role in decarbonization and energy efficiency, thereby adopting this essential carbon-reducing and energy-saving technology. A recent article in *Insulation Outlook* magazine, "A Carbon Message Everyone Should Copy" [ii]provides two highly relevant examples.

First, the article outlines how the EPA sticker on a new truck showed that the truck emits 406 grams of carbon per mile. By calculating what the truck emits in a year (using 20,000 miles/year as a baseline), and then using the EPA's Greenhouse Gas Equivalencies Calculator[iii] to get comparative values for other strategies for offsetting emissions. Against these figures, an estimate of the length of pipe that needed to be

insulated to offset these emissions was created. Offsetting CO_2 Emissions summarizes the shocking results.



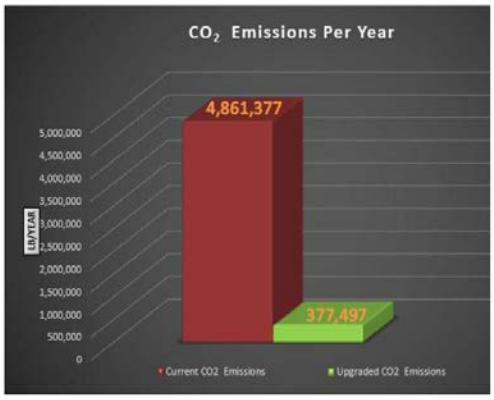
Secondly, here is a case study of how one facility was convinced to install insulation upgrades. The company has an aging facility with complex piping systems supporting hot processes.

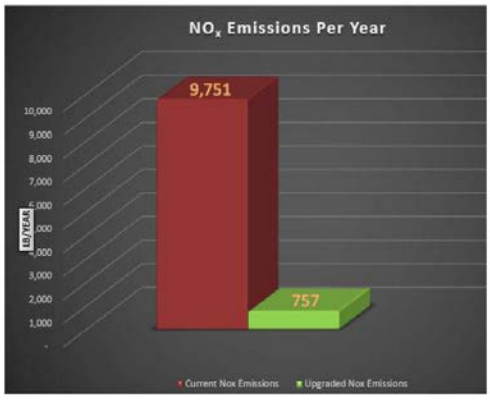
The appraisal team identified 2,300 locations of missing and damaged insulation, all of which they cataloged in NAIMA's 3E Plus® software. The customer wanted to insulate pretzel process lines, heat lines running continuously at 125°F to 140°F, and a steam station. (See Insulation Energy Appraisal Results and Reduced GHG Emissions.)

Insulation Energy Appraisal Results

Parameter Measured	Result
Estimated Savings from Upgrading Insulation on Identified Items	$93,761 per year
Cost to Operate the Identified Items as Currently Insulated	$101,651 per year
Cost to Operate the Identified Items if Upgraded	$7,890 per year
Reduction in Heat Flow	28,060,191 kBTU per year
Reduction in CO_2 Emissions	4,492,880 pounds per year
Reduction in NO_x Emissions	8,994 pounds per year

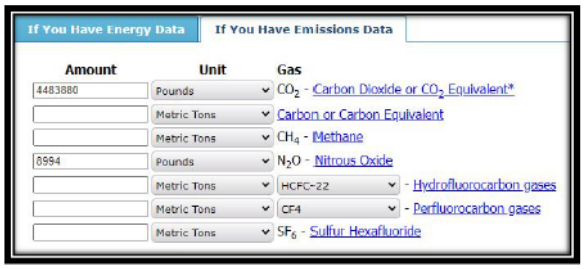
REDUCED GHG EMISSIONS





Use of the EPA's GHG Equivalencies Calculator (see below) helped to demonstrate the value of the insulation upgrades. This is another example of the value of a marketing and awareness campaign.

GHG EQUIVALENCIES CALCULATOR



One of the key comparisons is how the proposed insulation project was equivalent to the carbon sequestered by ***4,000 acres of forest***.

C6.1 In what ways will widespread deployment of onsite clean energy resources impact the industrial workforce?

In addition to being a proven technology with decades of supporting data, mechanical products and systems are an ever-emerging technology—not only because it is underutilized but also because manufacturers' products are continuously evolving and improving, e.g., smart jackets, anti-corrosion coatings, nanotechnology, higher

efficiency, thin insulations, and easier-application solutions. There are new products developing due to new technologies and the need for insulation systems at extreme temperature range, especially LNG and hot petro-chem processing.

Another benefit of these products is that they are applied by people, and increasing their use also increases jobs. NIA estimated this maintenance work would create more than 27,000 jobs per year for insulation contractors, of which 90–95% are small businesses, in all 50 states. Those 27,000 jobs support other industry channels with job opportunities of more than 13,000, bringing the total job creation opportunity to 40,000. NIA also noted that 95% of the materials required for these opportunities are made in the United States, with most of the balance made in Canada.[6]

Green Jobs: Insulation installers/contractors do not need a college degree, are taught on the job, and frequently are paid more starting out than other trades. According to the BLS, the median annual wage for those with a bachelor's degree is $67,140. The annual wages for many construction trades are not far behind, and in many cases are even higher. Mechanical insulation workers, for example, have an average annual salary of $56,570, according to May 2014 data from the BLS.[7] NIA is made up of member companies across the nation who represent the insulation manufacturers, distributors, fabricators, and contractors and most have stayed in the industry for decades, not years.

C6.2 What workforce development opportunities would facilitate the industrial sector's ability to adapt to increased reliance on onsite clean energy resources?

Looking at the existing DOE Industrial Assessment Centers (IACs), we suggest making the program even more robust with specific attention to mechanical insulation training. A hybrid course for inspection and appraisal of mechanical insulation systems would benefit the facility and support the creation of a dedicated new "green" management role for personnel specific to decarbonization through mechanical insulation systems and technologies. In addition, expand the IAC's mission to include larger facilities and expand the IAC program to identify not only the savings in energy and emissions but also to identify the specific needs in personnel training and partner with industry to assist in conducting this training. In exchange for receiving the training, the facility would need to commit to performing the recommendations within 24 months and all data would need to be captured and reported.

NIA is ready to work alongside the DOE in working with the IACs to expand their scope and ensure that the reporting is acted upon.

C6.3 What equity and environmental and energy justice considerations should DOE incorporate into onsite clean energy resource deployment activities?

Have a minimum of one Certified Insulation Energy Appraiser in each industrial facility and in partnership with NIA, develop a series of learning modules for industrial facilities.

- The impact of mechanical insulation on industrial facilities

- Energy efficiency opportunities and the impact on the reduction of carbon emissions, including why mechanical insulation is often overlooked;
- The ease of determining ROI, etc. on energy efficiency-related topics (3E Plus® software/appraisal program);
- An overview of insulation systems for maintenance and/or retrofit projects;
- Where insulation is normally found in industrial facilities; and
- Why it is important to properly and timely repair or replacement damaged insulation.

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[1] *https://insulation.org/io/articles/georgia-pacific-reaps-benefits-by-insulating-its-steam-lines*. Accessed February 23, 2022.

[2] https://www.prweb.com/releases/independent_study_confirms_insulation_upgrades_are_keys_to_significant_energy_savings_and_emission_reductions_in_existing_buildings/prweb18896255.htm#! Accessed September 23, 2022.

[3] *https://insulation.org/wp-content/uploads/2016/10/About-Insulation-By-Numbers.pdf*. Accessed February 22, 2022.

[4] *https://insulation.org/io/articles/insulation-greener-than-trees*. Accessed February 22, 2022.

[5] *https://insulation.org/io/articles/insulation-still-greener-than-trees*. Accessed February 22, 2022.

[6] *https://insulation.org/io/wp-content/uploads/sites/3/2022/02/Carbon-Article.pdf*. Accessed February 23, 2022.

[7] *https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator*. Accessed February 23, 2022.

8 *https://insulation.org/wp-content/uploads/2016/10/About-Insulation-By-Numbers.pdf*. Accessed February 22, 2022.

9 *https://insulation.org/about-insulation/benefits-of-insulation*. Accessed February 22, 2022.