

BEFORE THE
CALIFORNIA AIR RESOURCES BOARD

In Re:

PUBLIC HEARING TO CONSIDER THE PROPOSED AMENDMENTS TO THE
CALIFORNIA CAP ON GREENHOUSE GAS EMISSIONS AND MARKET-BASED
COMPLIANCE MECHANISMS

COMMENTS OF THE
NORTH AMERICAN INSULATION
MANUFACTURERS ASSOCIATION

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**COMMENTS OF THE NORTH AMERICAN
INSULATION MANUFACTURERS ASSOCIATION
ON THE CALIFORNIA AIR RESOURCES BOARD'S
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I. INTRODUCTION

The North American Insulation Manufacturers Association (“NAIMA”) greatly appreciates the opportunity to provide comments on the California Air Resources Board’s (“CARB”) Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms (“Proposed Amendments”). NAIMA is the association of North American manufacturers of fiber glass and rock and slag wool insulation products. The fiber glass and rock and slag wool industry is frequently referred to as the “Mineral Wool” industry. Thus, NAICS Code 327993 is entitled “Mineral Wool Manufacturing” but also includes all fiber glass manufacturing.¹ It is under this nomenclature that CARB is regulating the industry. There are no rock and slag wool manufacturers currently operating manufacturing facilities in the State of California, but, as described more fully below, there are four fiber glass insulation manufacturers operating manufacturing plants within the State of California. Therefore, when referring to NAIMA’s members in California, these comments will refer to the “Fiber Glass insulation industry.”

In the comments set forth herein, NAIMA strongly urges CARB to retain the original 100 percent assistance factor for the third phase and assign a 100 percent assistance factor beyond 2020 to the Mineral Wool industry in recognition that the Fiber Glass insulation industry in California is quite vulnerable to both international and domestic leakage. NAIMA supports specific provisions of the Proposed Amendments, including maintaining the current benchmark for the Mineral Wool industry and direct allocations of allowances to industrial facilities. NAIMA also advocates for retention of the original threshold limits (25,000 tons), and urges CARB not to include or combine indirect emissions from purchased electricity or other energy sources with the direct emissions from manufacturing plants in determining whether the established threshold limit has been met or exceeded. NAIMA’s comments support other provisions in the Proposed Amendments and seek clarification on certain provisions as described more fully below.

NAIMA requests that CARB give full consideration to NAIMA’s comments as NAIMA represents four key stakeholders – CertainTeed Corporation, Johns Manville, Knauf Insulation, and Owens Corning. Each of these companies has a manufacturing plant in the State of California which represents significant jobs in and financial benefits to the California economy.

¹ See, e.g., <https://www.census.gov/econ/isp/sampler.php?naicscode=327993&naicslevel=6>.

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NAIMA participated in the public comment process when CARB initially established the Cap-and-Trade Program. NAIMA appreciated the extensive dialogue and exchange of information throughout that process. NAIMA found that CARB was responsive to NAIMA's concerns and comments and ultimately awarded 100 percent assistance factors in recognition of the evident risk to the Fiber Glass insulation industry of domestic leakage. The factual scenario and geographic configuration of manufacturing facilities at or near California's border remains essentially the same as it was in 2011 and 2012, so California's recognition of a domestic leakage risk for the Fiber Glass insulation industry remains fully justified.

II. CARB SHOULD APPROPRIATELY RECOGNIZE THE POTENTIAL DOMESTIC LEAKAGE RISK FOR THE FIBER GLASS INSULATION INDUSTRY, RETAIN 100 PERCENT ASSISTANCE FACTORS FOR THE THIRD PHASE, AND ASSIGN A 100 PERCENT ASSISTANCE FACTOR BEYOND 2020

A. The Fiber Glass Insulation Industry Has a Strong Presence In the State of California

The Proposed Amendments are particularly relevant to NAIMA and its members because NAIMA's members have four (4) manufacturing plants located in California:²

- CertainTeed – Chowchilla, California
- Johns Manville – Willows, California
- Knauf Insulation – Shasta Lake, California
- Owens Corning – Santa Clara, California

In addition, virtually all of NAIMA's members' products are used or sold in California. More importantly, NAIMA's members provide important manufacturing jobs to the California economy. Specifically, Owens Corning operates a fiber glass building materials manufacturing facility in Santa Clara. According to public sources, Owens Corning's Santa Clara facility has an estimated 100 to 249 employees with an annual revenue of \$20 to \$50 million (www.manta.com/c/mmcntlv/owens-corning). Johns Manville operates a fiber glass manufacturing facility in Willows, California. According to public sources, Johns Manville's Willows facility employs between 250 and 499 employees and generates annual revenue of \$100 to \$500 million (www.manta.com/c/mmckzn/johns-manville). CertainTeed Corporation operates a fiber glass manufacturing facility in Chowchilla, California. According to public sources, CertainTeed's Chowchilla facility employs between 250 and 499 employees and generates annual revenue of \$100 to \$500 million (www.manta.com/c/mmjhsbb/certain-teed-corp). Knauf Insulation operates a fiber glass manufacturing facility in Shasta Lake, California. According to public sources, Knauf's Shasta Lake facility employs between 100 and 249 employees and generates annual revenue of \$20 to \$50 million (www.manta.com/c/mm0tt3b/knauf-fiberglass).

² UPF Corporation in Bakersfield is a maker of fiber glass filter media as well as thermal and acoustical aircraft and marine insulation. UPF operates a manufacturing plant in California. UPF is not currently a member of NAIMA.

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California is losing manufacturing jobs – in both traditional and high-tech industries – to other states and nations. One of the key reasons for this exodus from California is the State's existing regulatory requirements and concerns about the future regulatory climate.³ NAIMA's members have found California's regulatory environment to be challenging, time-consuming, complex, duplicative, and costly.

CARB's existing Cap-and-Trade Program and now its Proposed Amendments extending the Cap-and-Trade Program beyond 2020 with a specific proposal to ratchet down assistance factors while simultaneously lowering threshold limits is a perfect illustration of such costly regulation. As discussed in greater detail below, the Proposed Amendments afford the Fiber Glass insulation industry the much needed protection against domestic leakage. NAIMA strongly supports CARB's assignment of 100 percent assistance factors to the Fiber Glass insulation industry. This is prudent and wise because the California market could potentially be supplied with insulation products by manufacturing facilities in other bordering or nearby states, as well as Canada and Mexico, under the right market conditions.

With the inclusion of 100 percent assistance factors such a result is not likely to happen. As indicated above, fiber glass insulation is an important contributor to the California economy, through direct manufacturing, shipment of finished product to markets within California and other western states, and export of product to foreign markets. It also supports the insulation industry and installers, is a critical material for the construction industry, and a much-used material for do-it-yourself consumers. In addition, fiber glass insulation promotes energy efficiency, environmental preservation, and reduces pollutants, including greenhouse gases. Fiber glass is also the most thoroughly tested and researched insulation product on the market. It is the preferred product for more than 80 percent of the insulation market. Raising the cost of insulation products by raising the costs of doing business for fiber glass insulation manufacturers or by artificially reducing the supply of available insulating materials will reduce the ability of the State to meet its greenhouse gas emission reduction goals. If the cost to California insulation customers should rise, it would likely discourage insulation installation beyond code, particularly in the do-it-yourself market. The price increase could also occur as a result of increased transportation costs from out-of-state plants if regulations priced California products too high.

III. LOCATIONS OF NEARBY FIBER GLASS MANUFACTURING PLANTS SUPPORT CALIFORNIA'S DECISION TO ASSIGN 100 PERCENT ASSISTANCE FACTORS TO THE FIBER GLASS INSULATION INDUSTRY

CARB's effort to stop leakage is really an attempt to ensure that emission reductions within the State of California are not offset by emission increases in other jurisdictions by reducing industry flight from California. The following information and facts support CARB's allocation of 100 percent assistance factors to the Fiber Glass industry: 1) there is a demonstrated ability for

³ Ross C. Devol, Perry Wong, Armen Bedroussian, Candice Flor Hynek, and David Rice, "Manufacturing 2.0: A More Prosperous California," Milken Institute, June 2009, p. 9.

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existing insulation manufacturing facilities located throughout North America to increase or maintain fiber glass insulation production if production in California is reduced; 2) there is a potential for increased transportation-related emissions because of insulation products being shipped into the State of California that were previously manufactured and distributed within the State; and 3) because the lowest emitting plants in the industry are located in California⁴ and there is an absence of greenhouse gas regulations in other relevant jurisdictions outside California, transferring manufacturing to non-California jurisdictions would likely increase overall greenhouse gas emissions in the State and nation.

For the record, all California fiber glass manufacturers confirm that the vast majority of products presently produced in California that are used in California or are shipped out of California could potentially be supplied from other fiber glass manufacturing plants located within the U.S., Canada, and Mexico if the right market conditions prevailed such as high in-state production costs. As the cost to produce the product in California goes up, the economies of supplying the California market shift so that at some point it becomes more cost-efficient to import insulation products from out of state than to continue to supply the California market from the California facilities. This fact makes CARB's allocation of 100 percent allowances all the more important and vital to achieving CARB's emission reduction goals.

Since California plants are the best performers, it provides yet another incentive for CARB to keep fiber glass plants operating, without production reduction, in California. In fact, a production cost incentive to move more production to California facilities would have a positive impact on greenhouse gas reductions and California jobs.

Finally, while other North American manufacturers present the most immediate threat to California fiber glass manufacturing, Chinese imports, which have proven to be inferior in performance capacity and substandard in materials content, also present a significant threat to California's fiber glass insulation market and to overall greenhouse gas emission reductions.

A. The Evolution of CARB's Position On Leakage Risk For Fiber Glass Insulation

In CARB's original Cap-and-Trade proposal, fiber glass insulation (mineral wool) was assigned a medium level of leakage risk, which equated to a 100 percent assistance factor in 2012–2014; a 75 percent assistance factor in 2015–2017; and a 50 percent assistance factor in 2018–2020. The other two glass sectors (flat glass and glass packaging) received 100 percent allowances for all three compliance periods. CARB justified that distinction based on the lack of foreign competition for fiber glass insulation while recognizing that the other two glass sectors had strong foreign competition.

NAIMA responded that while there was a lack of foreign competition for fiber glass insulation, CARB's purpose for preventing leakage, nonetheless, was to stop businesses from fleeing the

⁴ This statement is based on individual company's unique and specific knowledge of plant performance.

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State;⁵ it was equally plausible that leakage could occur within the United States. CARB had not conducted a domestic leakage analysis.⁶ With the aid of a map showing all fiber glass and rock and slag wool manufacturing plants in North America, NAIMA was able to effectively demonstrate that, with two fiber glass manufacturing facilities at California's border in Arizona and two additional fiber glass plants in nearby Utah, domestic leakage was a far more immediate and realistic leakage threat than foreign leakage. NAIMA further demonstrated that the industry could easily transfer production eastward and easily maintain national production levels even with the closure of all California manufacturing plants.

In a meeting with Chair Mary Nichols, Chair Nichols informed NAIMA that CARB agreed with NAIMA and that 100 percent assistance factors would be assigned to the Fiber Glass insulation industry for all three compliance periods.

NAIMA is now facing new amendments to the Cap-and-Trade Program and an expansion to the Program beyond 2020. The facts that were so persuasive to Chair Nichols are still in place, and it is as equally important in 2016 as it was in 2012 for the Fiber Glass insulation industry (Mineral Wool Manufacturing) to be afforded 100 percent assistance factors for the final phase of the original Program and in 2020 and beyond. In fact, given CARB's goal of strengthening reductions, the facts are even more compelling now.

B. U.S. Domestic Insulation Production Still Presents A Genuine Leakage Threat For California

NAIMA respectfully requests CARB to recognize that if the California fiber glass operations are not economically viable as a result of AB 32 and the Proposed Amendments, some of NAIMA's California members might close their plants or significantly reduce capacity. The fiber glass insulation production capacity in other jurisdictions will be able to adequately supply the California market, thereby increasing emissions in those jurisdictions and overall greenhouse gas concentrations, including in California. This fact is particularly relevant at the present moment because industry product resources are not fully utilized.

Any demand previously fulfilled by a California plant can be easily and economically supplied from other U.S. plants were production costs to change significantly. This industry does not

⁵ AB 32 mandates that CARB minimize leakage "to the extent feasible." *See* California Health and Safety Code § 38562(B)(8). CARB's technical appendices on leakage and allowance allocation seem to focus on international leakage (relocation of industry from California to other countries). But the statutory definition of leakage is not restricted to the international context; rather, it includes any situation where "a reduction in GHG emissions within the state [] is offset by an increase in GHG emissions outside the state." Cal. Health & Safety Code 38505(J). The main body of CARB's "Initial Statement of Reasons" (or "ISOR") for the Cap-and-Trade Program defines leakage in similar terms: "If production shifts outside of California to a region not subject to GHG emissions-reduction requirements, emissions could remain unchanged or even increase."

⁶ During NAIMA's meeting, CARB acknowledged the limits of its analytical approach using only international leakage. In the context of trade exposure, for example, the Agency admits that its methodology "may not be sufficient to accurately quantify the degree of exposure to competition for many sectors." *See* ISOR App. K at page K-27.

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have to look to offshore facilities to supply the California market. In addition to the increase in greenhouse gas emissions per ton of fiber glass insulation produced at these plants located outside California, the transportation needed to get that material to California markets would have a further negative impact on greenhouse gas emissions.

Aislantes Minerales, S.A. de C.V.
1. San Luis Potosí, Mexico

Armstrong Ceilings
2. Millwood, WV

CertainTeed Corp.
3. Athens, GA
4. Chowchilla, CA
5. Kansas City, KS
6. Ottawa, Ontario
7. Redcliff, Alberta
8. Sherman, TX
9. Tilsonburg, Ontario

Hollingsworth & Vose
10. Corvallis, OR

Industrial Insulation Group, LLC
11. Phenix City, AL

Johns Manville
12. Berlin, NJ
13. Cleburne, TX
14. Defiance, OH
15. Defiance, OH
16. Innisfail, Alberta
17. McPherson, KS
18. Richmond, IN
19. Waterville, OH
20. Willows, CA
21. Winder, GA

Knauf Insulation
22. Albion, MI
23. Inwood, WV
24. Kingman, AZ
25. Lanett, AL
26. Shasta Lake, CA
27. Shelbyville, IN
28. Winnsboro, SC

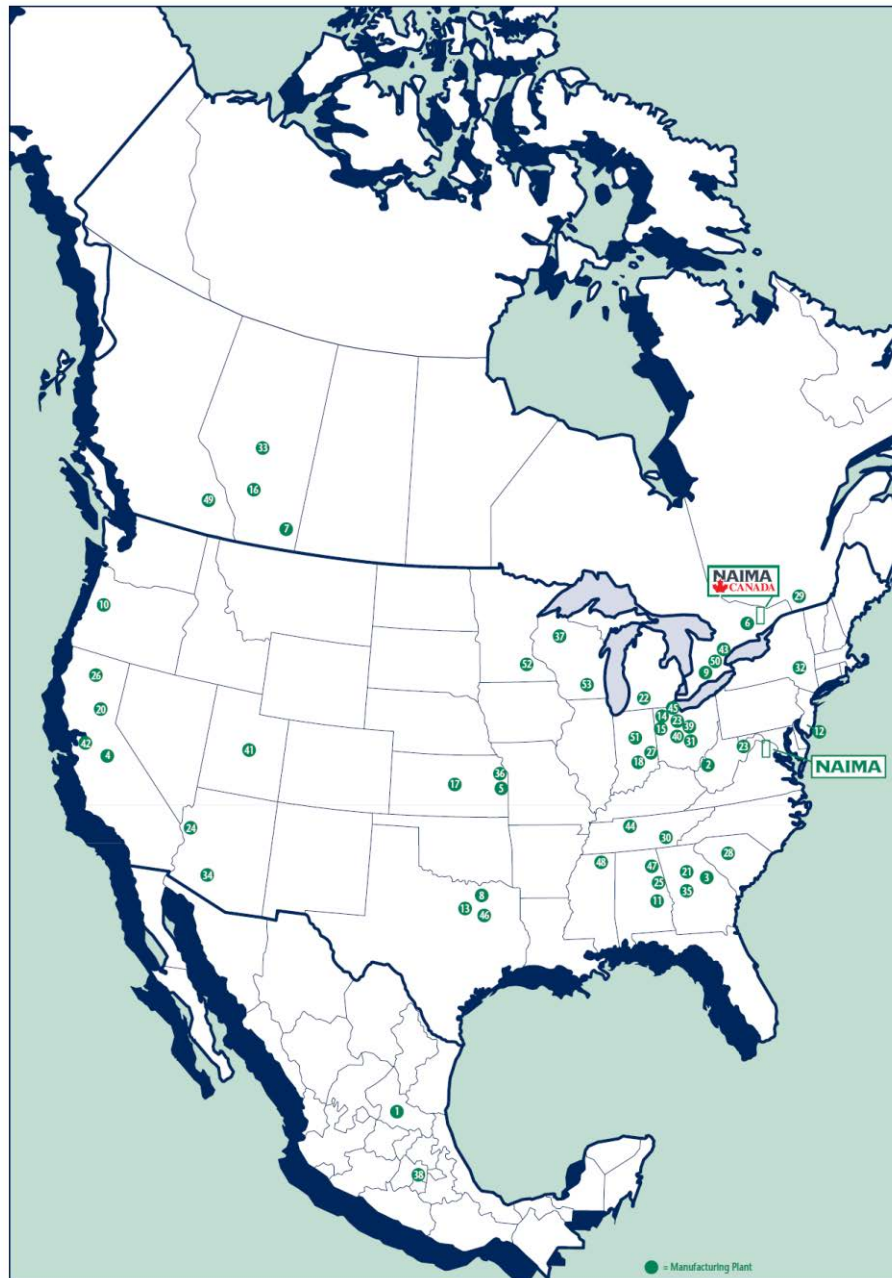
Owens Corning
29. Candiach, Quebec
30. Cleveland, TN
31. Columbus, OH
32. Delmar, NY
33. Edmonton, Alberta
34. Eloy, AZ
35. Fairburn, GA
36. Kansas City, KS
37. Ladysmith, WI
38. Mexico City, Mexico
39. Mount Vernon, OH
40. Newark, OH
41. Nephi, UT
42. Santa Clara, CA
43. Scarborough, Ontario
44. Springfield, TN
45. Tiffin, OH
46. Waxahachie, TX

Rock Wool Manufacturing Co.
47. Leeds, AL

Roxul Inc.
48. Byhalia, Mississippi
49. Grand Forks, British Columbia
50. Milton, Ontario

Thermafiber, Inc.
51. Wabash, IN

USG Interiors, LLC
52. Red Wing, MN
53. Walworth, WI



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A close look at the map of fiber glass manufacturing capacity in North America effectively illustrates why fiber glass companies should be afforded 100 percent assistance factors for the third compliance period and all compliance periods beyond 2020. NAIMA again points out two manufacturing plants right at California's border in Arizona. Two additional plants in Utah also could relatively easily take up the work of supplying the California market. There are also four insulation manufacturing plants in Western Canada.

The fiber glass insulation plants in the states bordering California are far more relevant to assessing the potential for leakage in this industry than 20 plants in Europe or 10 plants in Asia. If CARB is serious about preventing leakage from the State of California, it must carefully weigh the manufacturing potential, as illustrated on the above map of U.S. fiber glass and mineral wool insulation manufacturers. The presence of those 40-plus plants are the most effective argument for giving fiber glass plants 100 percent assistance factors for the third compliance period and beyond 2020.⁷

The Fiber Glass insulation industry in California does face some competition from plants in Canada and Mexico. There have been some efforts by Chinese manufacturers to supply the U.S. market. However, the insulation produced was inferior to U.S.-produced product, and to date, China has not caught on as a source of supply for the U.S. market. A reduction of production in California could prompt a renewed effort on the part of Chinese manufacturers to supply this market. Aside from the economic impact of such a development, it could lead to even greater transportation-related greenhouse gas emissions in California and beyond.

C. Fiber Glass Companies Can Make Up For Production Reductions In California Plants

NAIMA has analyzed the fiber glass industry's capacity to compensate for the reduction in production or closure of 1 or more of California's fiber glass insulation manufacturing plants. Such reduction of production or plant closures could be likely triggered by the serious deleterious impacts from CARB's implementation of the proposed Cap-and-Trade Program.

First, to effectively assess the ability of North American fiber glass and mineral wool insulation manufacturers to satisfy any gap in the production of fiber glass insulation created by the closure of or reduction in output from California's fiber glass insulation plants, it is necessary to assess the current production of California manufacturing facilities.

The following chart identifies the number of production lines available at the California fiber glass facilities:

⁷ It is acknowledged that not all of these plants could produce the specific products being currently manufactured in the California plants.

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Company	Plant Locations	Number of Lines
CertainTeed	Chowchilla, CA	2
Johns Manville	Willows, CA	2
Knauf	Shasta Lake, CA	1
Owens Corning	Santa Clara, CA	2

The cumulative potential production capacity for the four California plants is estimated at 519,743 tons of fiber per year. The average utilization of this capacity in 2015 is estimated at 85 percent.

The CertainTeed, Johns Manville, Knauf, and Owens Corning facilities are producing residential and commercial insulation products that are used throughout the United States.

If any of the California plants were to reduce production or close due to the increased regulatory burden from the Proposed Amendments, fiber glass production facilities operating in the western part of North America could increase their production to serve the California market. These plants currently produce residential and commercial insulation products that are largely equivalent to those manufactured at California plants; there is no reason why they would not be able to serve the California market if production costs became too high in California. In addition, as the chart below demonstrates, these western U.S. plants have sufficient capacity to meet the demands of its current market plus demands west of its operation:

Company	Plant Locations	Number of Lines
CertainTeed	Redcliff, Alberta	1
Johns Manville	Innisfail, Alberta	3
Knauf	Kingman, AZ	1
Owens Corning	Eloy, AZ	1
Owens Corning	Nephi, UT	2
Owens Corning	Edmonton, Alberta	2

The cumulative potential production capacity of these western North American manufacturing plants is estimated at 352,840 tons of fiber per year. The average utilization of this capacity in 2015 is estimated at 58 percent.

Many of these western North American manufacturers are currently underutilized because of the residential and commercial building downturn; therefore, these plants have existing capacity to help meet the increased demand occasioned by the reduced production or closure of one or more California plants. In addition, consistent with the westward migration of products described above, any challenge to meet market demands from these western manufacturing facilities could be met by those manufacturing in the middle region of the United States and Mexico:

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Company	Plant Locations	Number of Lines
CertainTeed	Kansas City, KS	4
Johns Manville	Cleburne, TX	3
Johns Manville	McPherson, KS	2
Johns Manville	Richmond, IN	2
Knauf	Albion, MI	4
Knauf	Shelbyville, IN	6
Owens Corning	Kansas City, KS	3
Owens Corning	Mexico City, Mexico	1
Owens Corning	Waxahachie, TX	3

The cumulative potential production capacity of these middle North American manufacturing plants is estimated at 1,235,878 tons of fiber per year. The average utilization of this capacity in 2015 is estimated at 88 percent.

As these charts demonstrate, the further east on the U.S. map, the greater the fiber glass insulation capacity. As illustrated above, the number of plants and the capacity of those plants are significantly greater. These simple geographic facts demonstrate that the current manufacturing capacity within the United States can, with a slight shift westward, accommodate the market demands created by the closure of three of the four California plants.

To further illustrate this point and bring it home, consider the chart below that lists the eastern manufacturing plants that also have the ability to meet any market demands created by the closure of California plants and the demand placed on plants in closer proximity to the California market:

Company	Plant Locations	Number of Lines
CertainTeed	Athens, GA	3
CertainTeed	Ottawa, Ontario	3
Johns Manville	Berlin, NJ	1
Johns Manville	Defiance, OH	13
Johns Manville	Winder, GA	2
Knauf	Inwood, WV	2
Knauf	Lanett, AL	3
Owens Corning	Delmar, NY	2
Owens Corning	Fairburn, GA	3
Owens Corning	Lakeland, FL	2
Owens Corning	Mount Vernon, OH	3
Owens Corning	Newark, OH	3
Owens Corning	Guelph, Ontario	2

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The cumulative potential production capacity of these eastern North American plants is estimated at 1,094,938 tons of fiber per year. The average utilization of this capacity in 2015 is estimated at 77 percent.

The total cumulative capacity⁸ for North America is estimated at 3,203,399 tons of fiber per year. A significant volume of capacity for mineral wool (rock and slag wool) insulation is not represented in this number. It is estimated that mineral wool has cumulative capacity for North America of 258,700 tons per year. The total utilization of this capacity in 2015 is estimated at 60 percent. The numbers speak for themselves, and it is plainly evident that any market gap caused by closure of California's plants could be quickly and easily satisfied by existing operations.

It is also worth noting that fiber glass insulation can readily be transported into California from other jurisdictions. Insulation can be shipped economically by truck or by rail (using intermodal trailers). It does not require any special infrastructure, and there are no hard and fast limits on shipping distances. In fact, some manufacturers have in the past and currently do ship products to Australia and Europe. Again, all out-of-state supplies, whether by rail, truck, or ship, would create additional transportation-related emissions in California and beyond.

The above series of charts tell a story of an industry and its ability to supply and meet the North American insulation market demands.

D. Domestic Leakage Analysis

The Brattle Group prepared an independent analysis of CARB's Domestic and International Leakage Studies. Key components of their analysis, as it relates to fiber glass production in California, are set forth below. The Brattle Group Report in its entirety is attached hereto and incorporated as part of NAIMA's comments.

The RFF study examined 49 industries and used a mixture of industry and plant-level data in California and other states to explore changes in output, employment, and value added resulting from energy price increases.⁹

According to Table 2a, fiber glass manufacturing has the fourth highest electricity cost share (2.64%) of the 49 industries (average of 0.99%).¹⁰ Table 2a also

⁸ Specific facilities that produce fibers for the production of ceiling tiles, fire proofing products, or specialized insulation production – for example, automotive, aerospace, and battery separators – are not included in this total capacity calculation. This capacity specifically relates to building insulation in residential, commercial, and industrial applications.

⁹ Output was measured as value of shipments, which is actually a dollar value and therefore affected by price as well as production quantity. This introduces a potential “identification” problem associated with the lack of an estimated elasticity of demand.

¹⁰ Electricity cost share is average share of electricity in value of shipments in 1989. As the authors explain, “[u]nder the standard assumption that in the long run, plants earn zero economic profits (i.e., accounting for opportunity costs), this share is equal to the cost share.” (p. 9) In the text describing the results reported in Table 2a,

reports the estimated elasticity of the manufacturing outcome measures with respect to electricity price. Elasticity measures the degree of responsiveness of one variable to a one percent change in another variable. According to Table 2a, a 1.0% increase in electricity price would cause a 1.42% drop in the output of fiber glass facilities (measured by value of shipments), a 1.1% decline in employment and a 1.45% fall in value added (the value of shipments minus the cost of input materials). These adverse production results from electricity price increases are the second only to Automobile Manufacturing among the 49 industries studied.

Like the Domestic Study, the econometric study of international leakage also shows the relative sensitivity of fiber glass manufacturing production to energy price increases. In Table 9, the fiber glass industry is the 11th most sensitive (out of 51 industries displayed and 98 industries studied) to energy prices as measured by the elasticity of production (50th percentile of coefficient values). Table 10 shows that the fiber glass industry would experience the 7th largest percentage production decline (out of 51 industries displayed) from a \$10/ton CO₂ price, assuming the 50th percentile value on coefficient estimates.

Considered individually and together, the Domestic Study and the International Study indicate that fiber glass insulation manufacturing in California is very sensitive to energy price increases and thus prone to emissions leakage. Table 5 of the Domestic Study and Table 10 of the International Study show the output impacts of a \$10/ton CO₂ price. While fiber glass manufacturing (mineral wool) is the 6th and 7th most affected industry in the tables individually, only two industries are more affected according to *both* studies: paperboard mills (NAICS 322130) and iron and steel mills and ferroalloy (NAICS 331111). This underscores the high potential for emissions leakage arising from shifting fiber glass production outside of California as a result of CO₂ prices that affect production costs.

IV. U.S. DEPARTMENT OF COMMERCE IDENTIFIES FIBER GLASS INSULATION AS GREEN MANUFACTURER AND GREEN PRODUCTS

The U.S. Department of Commerce issued a report, "Measuring the Green Economy," that defined green products and jobs "as those whose predominant function serves one or both of these two goals:

- Conserve Energy and Other Natural Resources . . .
- Reduce Pollution."¹¹

the authors mistakenly identify mineral wool manufacturing as having the highest electricity cost share (p. 13), but industrial gases, other inorganic chemicals, and cement have higher reported shares in the Table 2a.

¹¹ "Measuring the Green Economy," U.S. Department of Commerce, Economics and Statistics Administration, April 2010, p. 5.

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Given these criteria, insulation materials are identified as green products because they both save energy and reduce pollution.¹² The fiber glass industry is also specifically identified by the Department of Commerce as among the manufacturing codes that are deemed green:

- 3279931111 Loose fiber (blowing and pouring) (shipped as such) and granulated fiber, mineral wool for thermal and acoustical envelope insulation (for insulating homes and commercial and industrial buildings)
- 3279931211 Building batts, blankets, and rolls in thermal resistance (R) values R19 or more, mineral wool for thermal and acoustical envelope insulation (for insulating homes and commercial and industrial buildings)
- 3279931311 Building batts, blankets, and rolls in thermal resistance (R) values R11 to R18.9, mineral wool for thermal and acoustical envelope insulation (for insulating homes and commercial and industrial buildings)
- 3279931321 Building batts, blankets, and rolls in thermal resistance (R) values R10.9 or less, mineral wool for thermal and acoustical envelope insulation (for insulating homes and commercial and industrial buildings)
- 3279931411 Acoustical (wall and ceiling) sold as acoustical insulation, mineral wool for thermal and acoustical envelope insulation (for homes and commercial and industrial buildings)

V. ENVIRONMENTAL BENEFITS OF INSULATION

In issuing its final regulations, it is important for CARB to recognize that improving the energy efficiency in new and existing buildings can deliver significant reductions in greenhouse gas emissions, thus promoting the ultimate goal of AB 32. Insulation is the most cost-effective means of improving energy efficiency in buildings. It is, therefore, the most cost-effective means of reducing greenhouse gas emissions. This fact was confirmed in studies conducted by the Harvard School of Public Health in 2002 and 2003.¹³ These Harvard studies were recently

¹² "Measuring the Green Economy," U.S. Department of Commerce, Economics and Statistics Administration, April 2010, p. 8.

¹³ Jonathan I. Levy, Yurika Nishioka and John D. Spengler, "The public health benefits of insulation retrofits in existing housing in the United States," *Environmental Health: A Global Access Science Source*, April 2003, pp.1-16 and Yurika Nishioka, Jonathan I. Levy, Gregory A. Norris, Andrew Wilson, Patrick Hofstetter, and John D. Spengler, "Integrating Risk Assessment and Life Cycle Assessment: A Case Study of Insulation," *Risk Analysis*, Vol. 22, No. 5, 2002, pp. 1003-1017. The findings by the Harvard School of Public Health demonstrated the dramatic correlation between the benefits of increased insulation and reduction of air emissions. These Harvard researchers stated that the "magnitude of the economic and public health benefits indicates that creative public policies to encourage" increased insulation "may be warranted." Jonathan I. Levy, Yurika Nishioka and John D. Spengler, "The public health benefits of insulation retrofits in existing housing in the United States," *Environmental Health: A Global Access Science Source*, April 2003, p.14. The Harvard researchers concluded that "[t]his approach

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updated by Boston University. The findings included specific reductions in greenhouse gases in addition to criteria pollutants.

The Boston University update focused on how much energy could be saved if all single-family homes across the continental United States in 2013 were insulated to the levels mandated by the 2012 International Energy Conservation Code. With that premise, Boston University determined that 37 TWh of electricity would be saved every year; this is a 3.4 percent reduction in residential electricity consumption. A similar analysis was performed for natural gas consumption, LPG/propane, and fuel oil consumption. The increased insulation reduced natural gas consumption by 360 billion standard cubic feet every year. LPG/propane consumption was reduced by 490 million gallons annually and fuel oil was reduced by 480 million gallons a year.

More importantly, Boston University calculated the energy savings into annual reductions of pollutants. Specifically, reductions in electricity consumption would result in annual reductions of 80 million tons of CO₂, 68,000 tons of NO_x, and 120,000 tons of SO₂. Reduction in direct residential combustion would result in annual reduction of 30 million tons of CO₂, 25,000 tons of NO_x, 10,000 tons of SO₂, 1,200 tons of VOCs, and 600 tons of primary PM_{2.5}.¹⁴

Figure 3 from the article effectively illustrates the breadth of the pollution reduction achieved through increased insulation:

allows us to quantify the benefits of energy efficiency on a national scale not seen before, which takes us far beyond energy savings and energy security. Now it is clear that improving energy efficiency not only helps us as a nation, but also has an immediate, positive impact on us, as individuals, and our families." NAIMA "Harvard Study Findings," NAIMA-036, September 2003.

¹⁴ Jonathan I. Levy, May K. Woo, Stefani L. Penn, Mohammad Omari, Yann Tambouret, Chloe S. Kim and Saravanan Arunachalam, "Carbon reduction and health co-benefits from US residential energy efficiency measures," *Environmental Research Letter*, 11(2016)034017, p. 4.

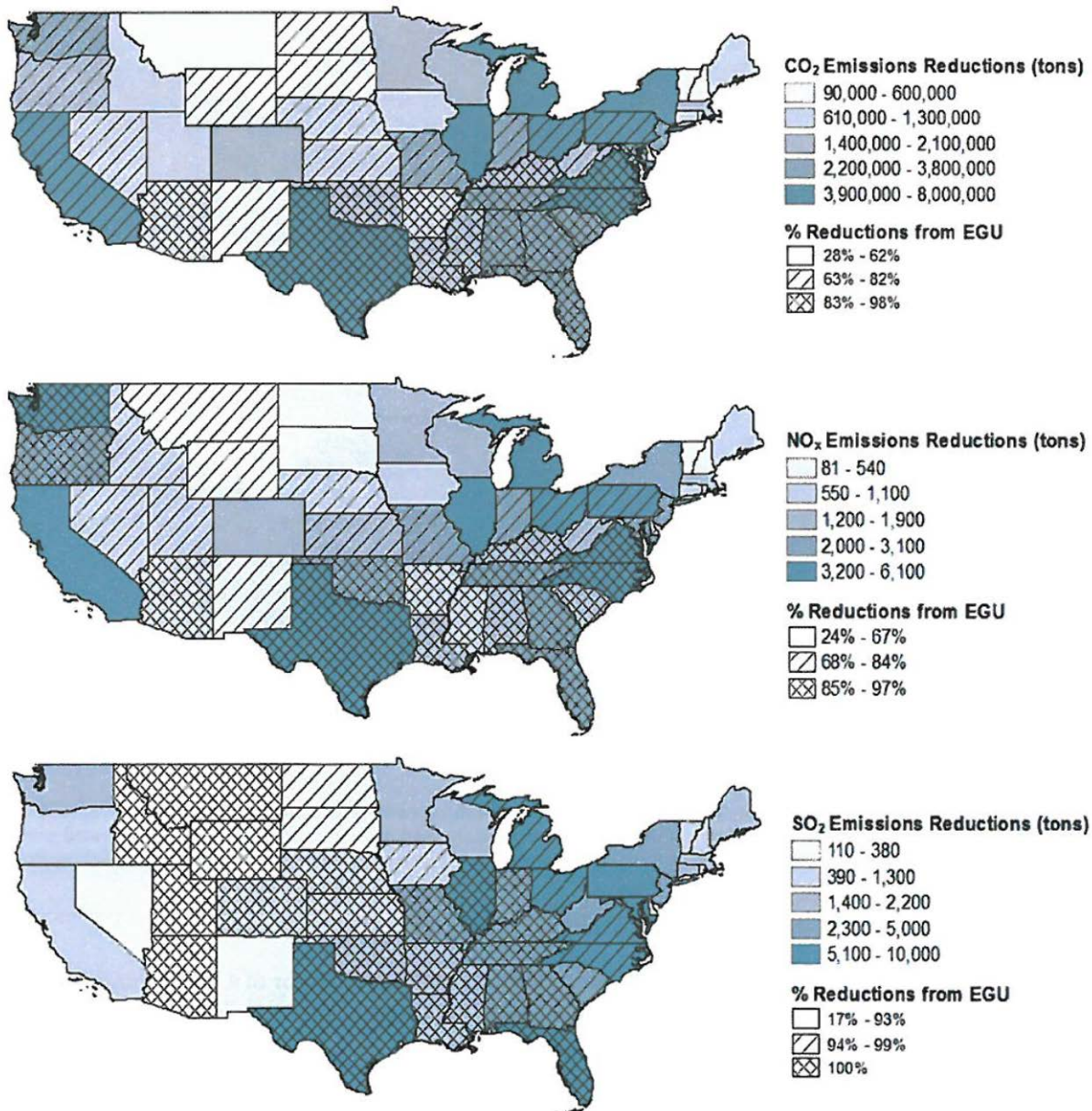


Figure 3. Annual reduction in emissions associated with increased residential insulation and the fraction of the reduction from EGUs versus residential combustion sources.

Boston University also looked at building new homes with increased insulation to 2012 levels. Here again, improving the energy efficiency in new homes provided sizable reductions in pollutants. Table 3 and Table 4 from the article illustrate the magnitude of pollution reduction that can be achieved through insulation¹⁵:

¹⁵ Jonathan I. Levy, May K. Woo, Yann Tambouret, “Energy savings and emission reductions associated with increased insulation in new homes in the United States,” *Building and Environment*, 96 (2016) 72-79, p. 77.

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Table 3

Annual residential combustion emission reductions associated with increasing residential insulation for new homes to IECC 2012 levels, by state. All values are rounded to two significant figures.

State	NO _x (pounds)	SO ₂ (pounds)	PM _{2.5} (pounds)	CO ₂ (tons)
AL	910	5.8	4.1	580
AR	1800	11	7.9	1100
AZ	1200	7.8	5.6	790
CO	3200	20	15	2000
CT	530	120	34	290
FL	260	1.6	1.1	150
GA	3600	48	16	2100
ID	1100	6.9	4.9	690
IN	2800	30	200	1700
KS	3200	55	510	1900
KY	1200	7.5	5.4	750
LA	720	4.5	3.3	460
ME	1500	380	96	830
MI	2400	23	120	1500
MN	5600	76	590	3500
MO	5500	86	740	3400
MS	600	3.8	2.7	380
NC	5900	50	24	3300
ND	2200	27	190	1400
NE	610	8.6	70	370
NH	550	140	35	300
NJ	6100	230	36	3800
NM	1200	7.4	5.3	740
NV	2300	14	10	1400
NY	4300	170	26	2700
OH	2400	25	160	1500
OK	3400	21	15	2100
OR	650	6.1	31	410
PA	4600	210	29	2800
SC	2500	22	10	1400
SD	1200	16	120	770
TN	2300	15	11	1500
TX	9500	60	43	6000
UT	4000	25	18	2500
VT	400	98	24	220
WI	3300	32	180	2000
WV	500	11	2.5	300
WY	750	4.7	3.4	470
Total	95,000	2100	3400	58,000

Table 4

Annual power plant emission reductions associated with increasing residential insulation for new homes to IECC 2012 levels, by state. All values are rounded to two significant figures.

State	SO ₂ (pounds)	NO _x (pounds)	CO ₂ (tons)
AL	38,000	19,000	12,000
AR	30,000	20,000	11,000
AZ	2200	7700	5200
CO	4200	6100	3200
CT	300	300	200
FL	32,000	16,000	10,000
GA	110,000	57,000	36,000
ID	1100	2500	1000
IN	18,000	7000	3700
KS	23,000	21,000	9800
KY	43,000	21,000	14,000
LA	16,000	11,000	5900
ME	600	600	400
MI	12,000	4500	2400
MN	41,000	24,000	13,000
MO	50,000	33,000	17,000
MS	22,000	11,000	7100
NC	180,000	89,000	57,000
ND	15,000	8800	4800
NE	4400	2600	1400
NH	300	300	200
NJ	30,000	12,000	6600
NM	2100	4200	2300
NV	4000	13,000	8700
NY	5400	4700	3100
OH	13,000	4900	2600
OK	51,000	49,000	22,000
OR	1400	2800	1100
PA	25,000	10,000	5300
SC	94,000	47,000	30,000
SD	8800	5600	3000
TN	98,000	49,000	32,000
TX	130,000	86,000	66,000
UT	3500	8500	3200
VT	200	200	100
WI	14,000	6900	3800
WV	13,000	5100	2700
WY	800	1300	600
Total	1,100,000	670,000	410,000

Both the Harvard School of Public Health and Boston University updates confirm that insulation’s most significant environmental attribute is saving energy which, in turn, delivers significant pollution reductions.

Indeed, both energy efficiency and insulation products are resources. In fact, energy efficiency, including insulation, has been deemed the greatest untapped resource available to address the current energy crisis and climate change.¹⁶ Unlike other energy efficiency measures, such as energy efficient appliances or energy saving light bulbs, insulation, once installed, requires no additional energy to save energy.

Fiber glass insulation also has consistently high recycled content. Since 1992, NAIMA has conducted an annual survey of member companies to determine the volume of glass cullet used by NAIMA’s members. The most recent survey showed that in 2015, NAIMA’s member companies in the United States used more than 1.7 billion pounds of recycled glass. The data for Canadian facilities showed that in 2015, 373 million pounds of recycled glass was used in the

¹⁶ “Transforming Energy Efficiency,” www.duke-energy.com/docs/CGI - Fact-Sheet.doc, September 27, 2007.

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production of fiber glass insulation. That is a total of 2 billion pounds of recycled glass used in 2015.

Since 1992, when NAIMA started collecting recycled data, 52 billion pounds of recycled material have been diverted from the waste stream. These numbers place fiber glass insulation as the second largest user of glass cullet in North America. Fiber glass insulation manufacturers are also the highest users of mixed bottle cullet (a mix of flint, amber, and green) and, as such, are responsible for recycling more of this material than any other source.

By using glass cullet, raw materials (sand, soda ash, etc.) use will be reduced, energy in producing the raw materials will be decreased, and the life of the furnaces will increase up to 30 percent due to decreased melting temperatures and a less corrosive batch. Reports have shown that compared to 100 percent raw materials, using 30 percent glass cullet reduces silica use by 60 percent, soda ash by 40 percent, and saves 10 percent in energy costs.¹⁷

NAIMA's members are committed to continued use of clean cullet. CARB should ensure its final regulations promote, rather than discourage, the Fiber Glass insulation industry and its green products.

VI. NAIMA SUPPORTS NO ADDITIONAL CHANGES TO THE BENCHMARK FOR
MINERAL WOOL MANUFACTURING

CARB has identified specific industry sectors that will be considered for changes to their benchmarks. CARB stated that "no additional sectors will be considered for changes to their benchmarks." NAIMA supports CARB's decision to not change the Mineral Wool Manufacturing benchmark.

VII. NAIMA SUPPORTS CARB'S TWO-YEAR EXTENSION OF AN EXEMPTION OF
RECYCLING PROGRAM FROM CARB'S PROPOSED AMENDMENTS

A limited exemption from a compliance obligation for emissions from the direct combustion of municipal solid waste in a waste-to-waste energy facility has been added by CARB for the 2016 and 2017 data years. CARB staff believes that it is appropriate to extend this limited exemption for two years as these options are further assessed. NAIMA supports CARB's recommendation as CalRecycle needs additional time to evaluate the treatment of end-of-life management options.

¹⁷ Berkeley National Laboratory, *Energy Efficiency Improvement and Cost Saving Opportunities for the Glass Industry: An Energy Star Guide for Energy and Plant Managers*, March 2008, pp. 67-68.

VIII. NAIMA SUPPORTS DIRECT ALLOCATION OF ALLOWANCES TO INDUSTRIAL FACILITIES

Because of delays related to the California Public Utilities Commission's ("CPUC") processing requirements, CPUC has requested that CARB directly allocate allowances to industrial covered entities to cover the carbon cost associated with their purchased electricity. CARB supports this request because having a single agency distribute this value will ensure that allocation is done in a timely manner and consistent with the regulation. NAIMA supports CARB's consolidation of these responsibilities in to a single agency.

IX. NAIMA SUPPORTS RETENTION OF ORIGINAL THRESHOLD

NAIMA strongly urges CARB to preserve the original regulatory threshold limit of 25,000 tons of greenhouse gas emissions. NAIMA's members are reporting indirect energy used by their facilities. NAIMA urges CARB to not consider indirect emissions as part of the total emissions used to determine whether the threshold has been met or exceeded. Such a measure would be extremely burdensome to NAIMA's companies and could lead to increased production costs. It would also not reflect the energy efficiency savings from the use of fiber glass products in the insulation industry. If CARB is truly committed to stopping leakage from California, it will provide assurances to industry that indirect emissions will not be used to calculate total emissions.

X. NAIMA OPPOSES CARB'S PROPOSAL TO REDUCE THE PROGRAM CAP ON GHG EMISSIONS 3.5 PERCENT A YEAR FROM 2021 TO 2030 – THIS RATCHETING DOWN IMPOSES BURDENS ON MANUFACTURERS

CARB has a statutory obligation to prevent leakage. The proposed ratcheting down will ultimately result in loss of business in California. NAIMA urges CARB to limit or abandon the ratcheting down of the Cap-and-Trade Program cap.

XI. CLARIFICATIONS

NAIMA makes the following requests for clarification in the final regulations:

1. NAIMA requests CARB to state whether purchased electricity will impact the benchmark.
2. NAIMA requests that the calculation method used to determine all aspects of the benchmark be disclosed in advance.
3. NAIMA requests clarification on whether CARB will allow carrying over of surplus allowances.

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4. NAIMA requests confirmation that opt-in entities can effectively opt-out.
5. NAIMA requests clarification on compliance schedule.

XII. CONCLUSION

As demonstrated throughout NAIMA's comments and the attached Brattle Group Report, fiber glass insulation manufacturing is vulnerable to both international and domestic leakage. NAIMA strongly urges CARB to retain the original 100 percent assistance factor for the third phase of CARB's Cap-and-Trade Program and to assign a 100 percent assistance factor for 2020 and beyond.

Attachment



Fiber Glass Insulation Manufacturing in California

A Case Study in Leakage Potential


PREPARED FOR

North American Insulation Manufacturers Association

PREPARED BY

Marc Chupka
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Charles Gibbons

September 19, 2016



This report was prepared for the North American Insulation Manufacturers Association. All results and any errors are the responsibility of the authors and do not represent the opinion of The Brattle Group or its clients.

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Executive Summary

Manufacturing fiber glass insulation in California is energy intensive and subject to substantial competition from production in neighboring states, Canada and Mexico. The competition for geographic market share is especially robust given the excess production capacity that plagues the industry since the downturn of housing construction that began about a decade ago and that has not yet fully recovered. Despite the fact that the new housing downturn was especially severe in the Western U.S., the four California fiber glass insulation manufacturing plants remained operating in California, though some plants in nearby states have not. Any production cost increases specific to California will reduce the competitiveness of these plants.

The California Air Resources Board (CARB) implemented a CO₂ cap-and-trade program that raises energy prices. To offset the potential for emissions leakage – when manufacturing declines in California, but increases elsewhere to offset the apparent reduction in emissions – the CARB program allocates some emission allowances to specific industries deemed particularly prone to experience leakage as a result of the energy price increases. The fiber glass manufacturing sector has qualified for maximum assistance since the inception of the program.

Recently, CARB has sponsored two studies of manufacturing industries to improve the understanding of leakage potential, one focused on domestic leakage (production shifting to other states) and another on international leakage (production shifting to other countries). These studies use statistical techniques to assess industry leakage potential, including the broad category (Mineral Wool Manufacturing) that includes fiber glass insulation production. Both studies confirm that energy cost increases for the fiber glass insulation manufacturing industry would pose substantial leakage risk as production would likely decline in California and rise in other states or countries to satisfy product demand. These findings support the continued maximum assistance for the industry.

I. Introduction

California has long been on the leading edge of environmental protection in the U.S. and the policy that emerged from The Global Warming Solutions Act of 2006 (Assembly Bill 32 or AB32) has continued that tradition. Under AB32, the California Air Resources Board (CARB) has implemented a CO₂ “cap-and-trade” system that places a price on CO₂ emissions, providing a market incentive to reduce fossil fuel use by raising energy prices, including the natural gas and electricity consumed by manufacturing processes.

Because the AB32 program applies only to California, the statute tasked CARB with designing measures that would reduce “leakage” to the extent feasible. Leakage refers to a reduction in emissions of greenhouse gases within California that is offset by an increase in emissions of greenhouse gases outside the state. For example, if a California manufacturing facility closes in response to CO₂ price-related energy cost increases, but an identical facility opens in an adjacent state or another country to serve the demand once supplied by the California plant, then overall CO₂ emissions remain unchanged, but economic activity and jobs in California decline. This production shift may even increase overall emissions if the plant that displaces California production is not as efficient or uses more carbon-intensive fuel.

For the early compliance periods, CARB designated various industries as being more or less prone to leakage through a scoring process that accounted for an industry’s emissions intensity and exposure to international trade.¹ These metrics, while generally considered useful, have some limitations. First of all, for a state-level policy such as AB32, leakage to other states is frequently as likely as international leakage and has similar environmental consequences. Secondly, the exposure to “domestic” leakage is a function of relative costs, geographic market boundaries, and broad inter-industry trends in the U.S. economy that may not be well captured by simple factors such as energy or emissions intensity. Finally, the scoring system itself used thresholds and cutoffs that struck some observers as arbitrary. CARB uses the scoring system to derive “Assistance Factors” (AFs) that translate into direct allowance allocations to those industries deemed most vulnerable to leakage. Facilities that produce fiber glass insulation products are

¹ See <https://www.arb.ca.gov/cc/capandtrade/allowanceallocation/allowanceallocation.htm> for sources on Allowance Allocation for Industrial Assistance, especially Appendix K and Appendix B.

among the industries that have received 100% assistance factors for the initial compliance periods due to the potential for leakage.

CARB has begun a process to consider additional information beyond that used in the metric-based approach and, to that end, sponsored two multi-industry econometric studies to examine international and domestic leakage potential. These studies were released in May 2016 and CARB is now considering how to utilize the results of the studies to derive assistance factors for the post-2020 compliance periods.

The North American Insulation Manufacturers Association (NAIMA) has engaged The Brattle Group to assess the potential for leakage in the California fiber glass insulation industry as a result of the implementation of AB32. This report summarizes our findings on relevant conditions in the fiber glass insulation market and our review of the Domestic and International Leakage studies.

II. Industry Description

Fiber glass insulation takes several forms, the most common and recognizable being the batts and rolls used in residential and commercial construction, along with loose fill for attic applications and other more specialized products. The Census Bureau classifies the manufacture of fiber glass insulation under the broader NAICS category of Mineral Wool Producers (327993).

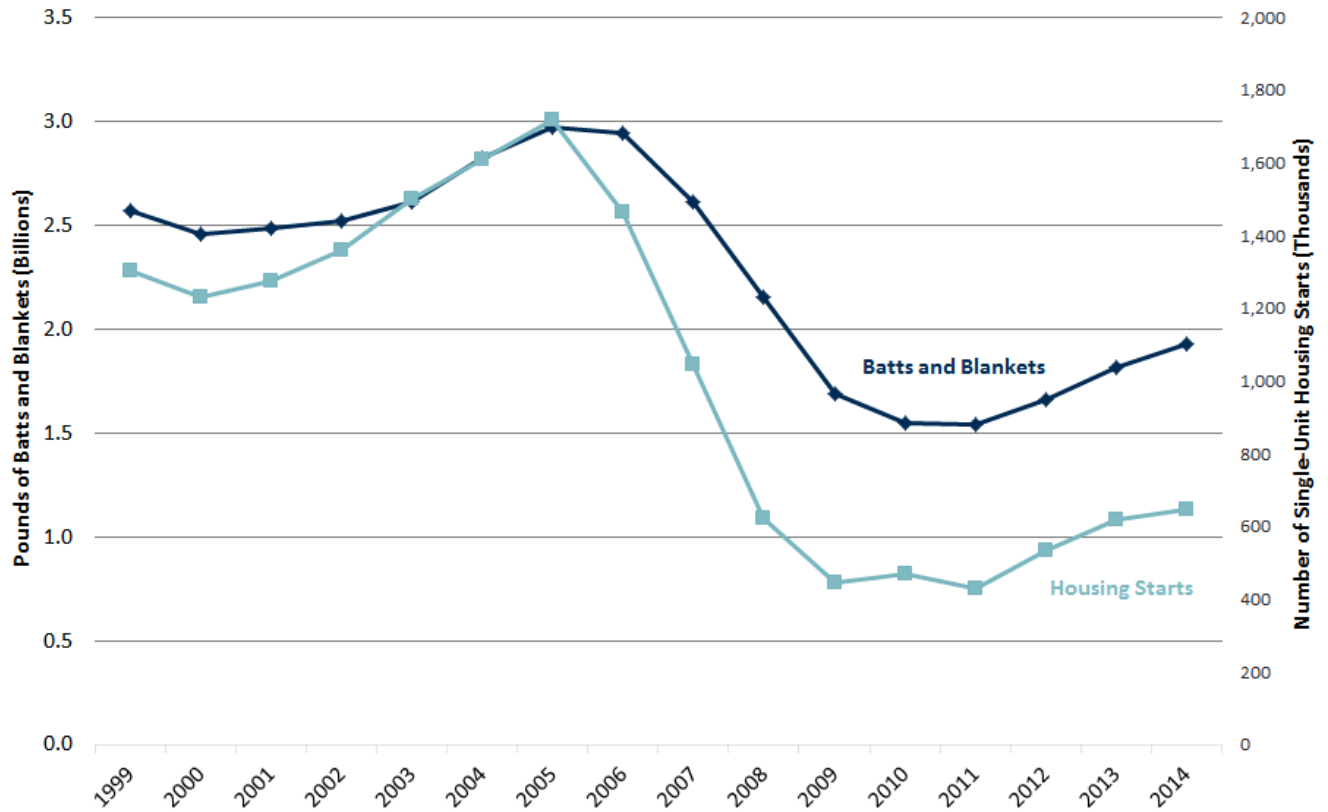
A. PRODUCT DEMAND REMAINS WELL BELOW 2005 PEAK

The demand for fiber glass insulation is strongly dependent on residential construction activity, which peaked in 2005: in 2005, 1,716,000 single-family units began construction and 2.97 billion pounds of fiber glass batts and blankets were shipped.² Both measures have rebounded somewhat from their 2011 lows, but U.S. fiber glass insulation demand was still about 35% below its 2005 peak in 2014, as shown in Figure 1. The result of this decline is that U.S. demand remains well below the productive capacity of North American fiber glass insulation manufacturing plants. If housing starts were to grow in the coming years at 4% per year, a rate approximately double the

² Housing starts data from Department of Commerce; fiber glass insulation shipment data from Fiber Economics Bureau, annual summary reports. The shipment figures include fiber glass product shipped and utilized in the U.S., regardless of origin.

rate of expected gross domestic product (GDP) growth, it would take over two decades before U.S. housing starts attained the 2005 peak levels.³

Figure1: Fiber Glass Batts and Blanket Shipments and Housing Starts 1999-2014



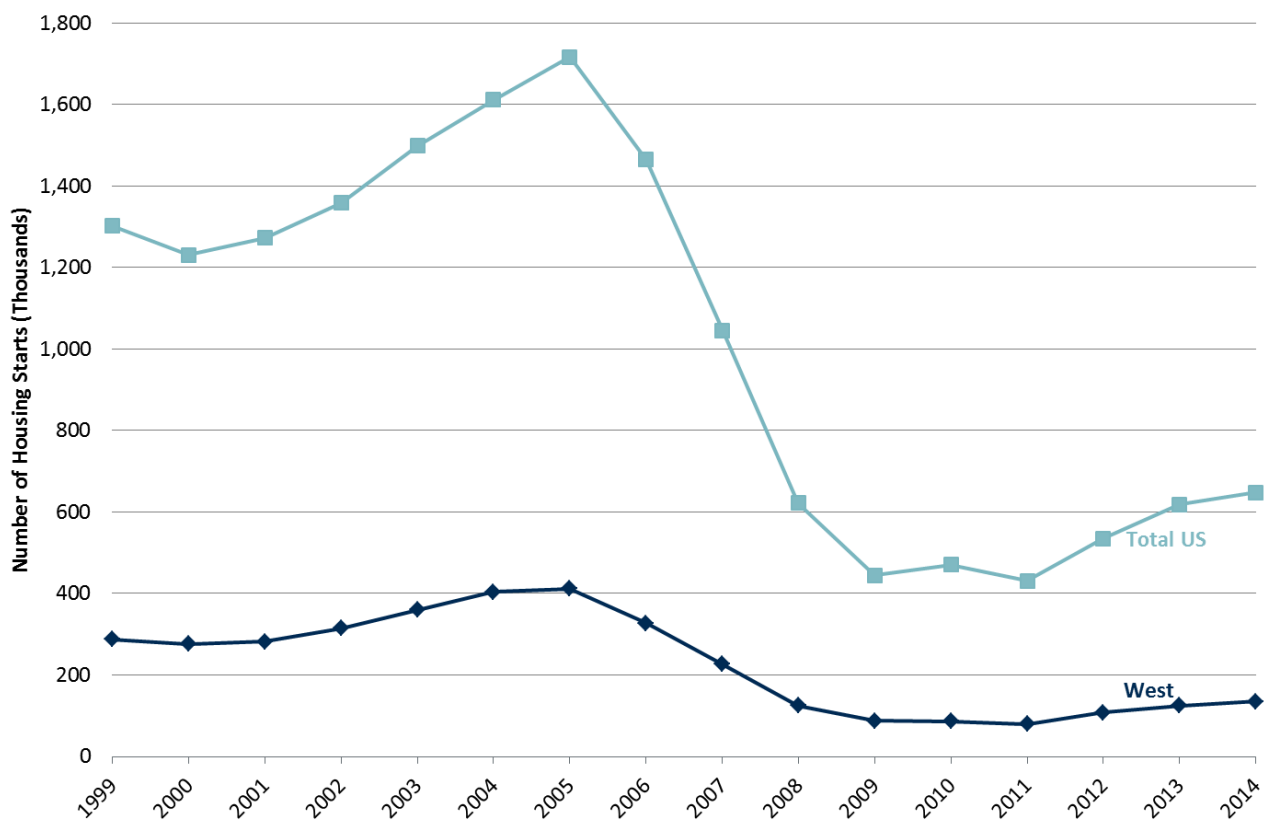
Sources: Fiber Economics Bureau, Annual Reports; and U.S. Department of Commerce

³ The Congressional Budget Office expects real GDP growth to be between 1.9% to 2.4% between 2016 and 2018, with real GDP growth below 2% between 2019 and 2026.

B. EXCESS MANUFACTURING CAPACITY WILL PERSIST

The four fiber glass manufacturing plants in California have continued to operate through the overall construction bust cycle, even though western states such as Arizona and Nevada were hit especially hard.⁴ As shown in Figure 2, the western states' housing recovery has been somewhat slower than that for the rest of the country. Overall, western state housing starts fell by over 80% between the peak in 2005 and the trough of 2011 and, in 2014, had only recovered to 33% of the level observed in 2005. Western states annual housing starts increased by about 20,000 per year between 2011 and 2014; at that rate of increase, it would take almost 15 years before housing starts attained their 2005 level.

Figure 2: U.S. and Western States Housing Starts 1999-2014



Source: U.S. Department of Commerce

⁴ The four plants located in California are the Knauf plant in Shasta Lake, the Herman Manville plant near Willows, the Owens Corning plant in Santa Clara, and the CertainTeed plant in Chowchilla.

The fact that the California plants remained open during the housing construction downturn is consistent with the conclusion that they operate relatively efficiently, including in their consumption of energy. Other advantages may be proximity to raw materials (*e.g.*, cullet, sand, borax, *etc.*) or to transportation services. Whatever the source of this advantage, it would be eroded with an increase in effective energy prices specific to California. Moreover, production capacity outside of California is nearby: there are two fiber glass insulation manufacturing plants in Arizona and two in Utah. Both Arizona plants were closed for production earlier in the decade (2010 and 2012) but the closures were not permanent.⁵ Because fiber glass production levels in nearby states remain well below capacity, the California plants remain especially vulnerable to cost increases that would not affect neighboring states.

III. The Domestic and International Leakage Studies

CARB commissioned two studies to explore more granular treatment of leakage risks. Resources for the Future (RFF) produced a study for CARB entitled *Employment and Output Leakage under California's Cap-and-Trade Program* (Domestic Study). This study attempted to quantify the output, employment, and value added impacts of energy price increases for 46 California industries, including Mineral Wool (NAICS 327993). Researchers at the University of California Berkeley, Northwestern University, and the University of Texas at Austin produced *Measuring Leakage Risk* (International Study), which examined 98 industries. Since the only facilities that produce mineral wool products in California are fiber glass insulation manufacturers, we describe the result of the studies in terms of fiber glass manufacturing, while the studies themselves report results for mineral wool.⁶

Both the International and Domestic Leakage studies represent ambitious attempts to explore the impact of California energy price changes on manufacturing output levels and both reflect methodological and data limitations that hinder interpretation of specific industry results. Much of the underlying data is not publicly available and the methods and results have not been

⁵ <http://archive.azcentral.com/community/pinal/articles/20101203arizona-elyo-plant-closing.html> and <http://www.reviewjournal.com/business/economy/fiberglass-plant-closure-costs-90-jobs-kingman>

⁶ Mineral wool batts can effectively substitute for fiber glass in many residential construction applications, which makes for potentially even greater excess in fiber-based insulation production capacity.

exposed to rigorous peer review. In particular, the specific 6-digit NAICS industry findings display dispersion with unknown statistical properties and some anomalous outcomes. Thus, the studies themselves provide limited guidance to CARB regarding the appropriate weight to assign to their results for determining assistance factors for individual industries.⁷ Despite the shortcomings of the studies, both studies support the overall premise that leakage risks are highly correlated with emission intensity and trade exposure, as previously assumed, and both studies show the fiber glass manufacturing industry faces substantial leakage risk.

A. THE DOMESTIC LEAKAGE STUDY

The RFF study examined 49 industries and used a mixture of industry and plant-level data in California and other states to explore changes in output, employment, and value added resulting from energy price increases.⁸ The study attempts to account for changes in electricity and natural gas prices, as both might explain changes in production levels experienced by California facilities.

Table 2a of the study reports the estimated short-run effects of electricity price changes on manufacturing facility outcomes. In this context, short-run refers to impacts felt within the same year, *i.e.*, contemporaneous changes. According to Table 2a, fiber glass manufacturing has the fourth highest electricity cost share (2.64%) of the 49 industries (average of 0.99%).⁹ Table 2a also reports the estimated elasticity of the manufacturing outcome measures with respect to electricity price. Elasticity measures the degree of responsiveness of one variable to a one percent change in another variable. According to Table 2a, a 1.0% increase in electricity price would cause a 1.42% drop in the output of fiber glass facilities (measured by value of shipments),

⁷ “The imprecision of our estimates makes it difficult to estimate leakage potential for any particular industry with any degree of precision.” International Study, p. 41-42.

⁸ Output was measured as value of shipments, which is actually a dollar value and therefore affected by price as well as production quantity. This introduces a potential “identification” problem associated with the lack of an estimated elasticity of demand.

⁹ Electricity cost share is average share of electricity in value of shipments in 1989. As the authors explain, “[u]nder the standard assumption that in the long run, plants earn zero economic profits (*i.e.*, accounting for opportunity costs), this share is equal to the cost share.” (p. 9) In the text describing the results reported in Table 2a, the authors mistakenly identify mineral wool manufacturing as having the highest electricity cost share (p. 13), but industrial gases, other inorganic chemicals, and cement have higher reported shares in the Table 2a.

a 1.1% decline in employment and a 1.45% fall in value added (the value of shipments minus the cost of input materials). These adverse production results from electricity price increases are the second only to Automobile Manufacturing among the 49 industries studied.

Table 2b displays the same measures of elasticity with respect to changes in natural gas prices. Although fiber glass insulation has the 7th highest natural gas cost share, the impact of a 1.0% increase in natural gas prices reduces output by 0.07%, which is also the 49 industry average. A 1.0% increase in natural gas prices has no discernable impact on employment and a 0.16% reduction in value added. These results appear to be far less reliable, however, since the elasticity measures are not statistically significant (in the case of fiber glass as well as the majority of other industries) and many of the statistically significant responses have the opposite sign from expected. Also worth noting in this regard is that 3 of the 4 plants in California use electricity to run their furnaces, which implies that electricity prices are more important than natural gas prices for California production facilities.

Tables 3a and 3b display the study's long-run elasticities with respect to electricity and natural gas prices, which are much smaller than the short-run elasticities reported in Tables 2a and 2b. This reflects the underlying theory that, over longer timescales, industries can vary other inputs and make investments in efficiency in response to energy price increases, which minimize the impact of the price increases on long-run output and employment. In relative terms, however, the long-run elasticity of fiber glass manufacturing output with respect to electricity is in the most responsive cohort with several other industries and the estimate is statistically significant. The corresponding long-run results for natural gas show virtually no statistical significance for any industry, although the impacts on fiber glass manufacturing relative to other industries are similar to those shown in the short-run for natural gas. The authors of the Domestic Study express caution in interpreting these long-run elasticity measures.

The study then uses the estimated elasticities to simulate the impact of a California CO₂ emissions price of \$10/ton, which raise both electricity and natural gas prices for manufacturing facilities in California but not elsewhere. In the short-run simulations (Table 5 of the study), the \$10/ton CO₂ price reduced fiber glass manufacturing output (value of shipments) by 10.37% - which ranked 6th out of 49 industries in terms of negative output impact. The same \$10/ton CO₂ price would reduce fiber glass manufacturing employment by 7.49% (8th most negative employment impact) and cause a decline in value added of 11.3% (4th most negative impact on value added). This reflects the relative impact of the short-run elasticity results and suggests a

strong exposure to domestic leakage. As before, the long-run impacts are less reliable, and although slightly positive, are not statistically different from zero.

B. THE INTERNATIONAL LEAKAGE STUDY

The International Study used data on 98 industries and explored a wide array of econometric specifications – almost 600 by the authors’ count – to derive estimates of industry responsiveness to domestic energy price changes. Instead of reporting the coefficient results for so many equations, they reported the points along the distributions of elasticities estimated under the equations. Although we question the statistical properties of the mean estimates of 600 regression coefficients that apply to specific industries, the overall results are generally intuitive:

Whereas the point estimates for any given industry may be quite noisy, the general pattern is clear. Estimated impacts on production and trade flows, in percentage terms, are generally small among industries with low energy intensities. Estimated elasticities are larger in absolute value among the most energy-intensive industries. (p. 31)

Figure 3 of the study (p. 23) shows energy intensity in terms of energy cost shares of 32 industries, where mineral wool manufacturing is the 8th highest energy cost share of those displayed. Like the Domestic Study, the econometric study of international leakage also shows the relative sensitivity of fiber glass manufacturing production to energy price increases. In Table 9, the fiber glass industry is the 11th most sensitive (out of 51 industries displayed and 98 industries studied) to energy prices as measured by the elasticity of production (50th percentile of coefficient values). Table 10 shows that the fiber glass industry would experience the 7th largest percentage production decline (out of 51 industries displayed) from a \$10/ton CO₂ price, assuming the 50th percentile value on coefficient estimates.

C. CONCLUSIONS BASED ON THE LEAKAGE STUDIES

Considered individually and together, the Domestic Study and the International Study indicate that fiber glass insulation manufacturing in California is very sensitive to energy price increases and thus prone to emissions leakage. Table 5 of the Domestic Study and Table 10 of the International Study show the output impacts of a \$10/ton CO₂ price. While fiber glass manufacturing (mineral wool) is the 6th and 7th most affected industry in the tables individually, only two industries are more affected according to *both* studies: paperboard mills (NAICS 322130) and iron and steel mills and ferroalloy (NAICS 331111). This underscores the high

potential for emissions leakage arising from shifting fiber glass production outside of California as a result of CO₂ prices that affect production costs.

The prolonged downturn in U.S. housing construction activity and investment suggests that excess production capacity will persist in the domestic fiber glass insulation manufacturing industry for a decade or more, likely exacerbating the leakage risks identified in the econometric studies. Given the statutory mandate to counteract emissions leakage to the extent feasible, the fiber glass manufacturing industry should receive the maximum assistance factors under the law.

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