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via email to: Industrial-Decarb-RFI@ee.doe.gov

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The Aluminum Association (the 'Association') and its members appreciate that the Department of Energy (DOE) is focused on supporting US decarbonization efforts and that it is seeking input on the opportunities and challenges for decarbonizing the important industrial sector of the US economy as referenced in its January 27, 2022 Request for Information (RFI). Support for the decarbonization of the metals sector is particularly important given its out-sized contributions to economic growth and its hard-to-abate energy utilization profile.

The Association is the voice of the aluminum industry in the United States, representing aluminum producing companies and their workers that span the entire aluminum value chain from primary production to value-added products to recycling, as well as suppliers to the industry. Association member companies produce 70+ percent of the aluminum and aluminum products shipped in North America, and the U.S. aluminum industry across the value chain directly employs more than 166,000 workers and indirectly supports an additional 494,000 workers. Through its activity, the economic impact of the US aluminum industry adds \$172 billion to the economy annually.

Aluminum is foundational to modern societies and to the U.S. economy, and its unique physical properties – light weight, corrosion resistance, and infinite recyclability paired with the innovative application of alloys and manufacturing processes – make use of the metal an ideal solution for a wide range of decarbonization challenges in the 21st century. And beneficially, decarbonization of a material substrate like aluminum that is used in such a variety of manufactured goods across the economy can have a significant 'flywheel effect' that flows through the value chain in reducing the carbon footprint of downstream products as well. The Association therefore recommends that the DOE focus its manufacturing decarbonization efforts on materials like aluminum that have a proven record of enabling reduced carbon footprint in their application and use.

The North American aluminum industry is highly integrated between the US and Canada, and it has made tremendous progress to date in reducing its carbon emissions. A Life Cycle Assessment report released in January 2022 documents that the North American aluminum industry has decreased the carbon intensity of primary aluminum by 49% since 1991 and the carbon intensity of secondary aluminum by 60% since 1991. Incredible progress, to be sure,

but the continuous improvement ethic of the aluminum industry is already focused on additional opportunities for the future.

More broadly, a [report](#) released in April 2021 by the Association demonstrates positive environmental impact trendlines for the U.S. aluminum industry on virtually every measure over the past 25 years. The *U.S. Aluminum Industry Sector Snapshot* report focuses on seven key environmental issue areas: air, energy, greenhouse gas emissions, land management, water, waste and aluminum scrap usage. Positive environmental trends are attributable to both performance improvements by the U.S. aluminum industry in the primary sector and the addition of significantly more recycled material.

Importantly, aluminum producers have reduced environmental impact while increasing output – meeting growing domestic demand for the material while demonstrating a commitment to sustainability. Despite the impact of the COVID-19 pandemic, the Aluminum Association estimates that in 2021, the North American demand for aluminum was 26.3 billion pounds. This represents a 41 percent increase in demand from 2009, when North American demand was 18.7 billion pounds. With demand increasing, the aluminum industry continues to invest in technologies that decrease operational environmental impact and to embrace operational practices and corporate policies that drive energy efficiency, reliable and sustainable sourcing for raw materials, development of a next-generation workforce, and innovation for material applications.

Recognizing the industry’s significant progress to date, the opportunity now exists to build on it to further enhance the sustainability and production carbon profile of the US aluminum industry in a number of areas to support aggressive decarbonization. To help the DOE understand how it can best support the aluminum industry’s decarbonization, below are Association comments responsive to the RFI regarding key opportunities to decarbonize energy intensive industries like aluminum.

Aluminum Industry Decarbonization Pathways

In April 2021, the International Aluminium Institute (IAI) released its [GHG Pathways to 2050](#) report documenting the type and scale of changes needed across the global aluminum industry to reach IEA 2050 B2DS goals and in October 2021 released an [addendum](#) to the report modeling the scenarios needed for the global industry to reach a 2050 1.5 degree scenario. These reports provide a foundation and perspective in considering aluminum industry decarbonization policies and technologies. They recognize three key areas of focus –

- Electricity decarbonization in the primary aluminum sector
- Reduction of process emissions across all aluminum sectors
- Increase in aluminum recycling and resource use efficiency

Focus on each of these areas is important and the Association recommends that the DOE use the information contained in the report and its addendum to help shape DOE’s broad efforts to support industrial decarbonization of the US aluminum industry.

Scope of the Challenge

The first step in facing a challenge is understanding its scope and it is instructive to view US aluminum industry decarbonization through that lens. The IAI report referenced above notes that on a global scale, it will require “on the order of trillions of US dollars” for the aluminum

industry to decarbonize in alignment with 2050 goals. US primary and secondary aluminum production is approximately 6% of percent of global production and using two trillion US dollars as an approximation for the scale of global investment needed, an implied scoping estimate of \$120 billion (\$2 trillion x 6%) in investment will be needed to achieve US aluminum industry decarbonization. Across the next ~30 years to 2050, this means \$40 billion per decade will need to be invested in decarbonization without expectation of a direct financial return to the investing companies as that term is currently defined.

As a point of comparison, US aluminum producers are proud to have invested or committed over \$4 billion in the last decade to invest in growing its manufacturing base through both expansions of existing facilities and new facility projects, all of which had expected direct financial return justifying the investments.

The blunt conclusion from these approximations is that US aluminum companies are being tasked with spending ten times more (\$40 billion vs \$4 billion) per decade to fund non-return seeking decarbonization projects than they have invested in return seeking projects across similar timeframes. Therein lies the reason that DOE support, and indeed, an all of government approach to support for aluminum industry decarbonization is critical. Industry simply cannot fund the scope of these investments on their own without governmental support.

To that end, the Association is supportive of the broad approach to industrial decarbonization presented in the February 15, 2022 announcement from the White House to [Advance a Cleaner Industrial Sector to Reduce Emissions and Reinvigorate American Manufacturing](#) which includes a focus on low-carbon production of aluminum. Much of this announcement focused on actions that the DOE can take to enable that focus and the Association looks forward to continued engagement with all governmental stakeholders in that effort.

DOE Support for Aluminum Industry Decarbonization

The Association encourages DOE to consider broad and strong support for the US aluminum industry. Simply put, the US aluminum industry competes globally with market-based and non-market-based countries whose aluminum industry decarbonization efforts are supported by their governments across all levels of research, development, piloting, implementation, and commercial scale deployment. Competing on this uneven playing field risks the future of the US aluminum industry in a sustainable world.

Therefore, the Association believes that the United States government must develop a comprehensive policy with long-term federal investment to enable innovations not just in early technology development, but through all aspects of bringing the technology to market, through to commercialization and deployment. We encourage the DOE to invest in advancing recycling technologies and support building the next generation US aluminum smelter. This can be achieved by: 1) ensuring a reliable and affordable supply of renewable energy; 2) facilitating access to supporting infrastructure such as ports and railways; 3) providing grants or forgivable loans for capital investment in next generation smelting and recycling technologies; 4) supporting R&D development and capital for implementation of successful projects, and 5) investments in domestic recycling infrastructure to maximize the recovery of post-consumer aluminum scrap.

Other countries have provided such support that is helping ensure the future of their domestic aluminum industries. Several recent examples are instructive here:

- Canada - At its technical center outside Pittsburgh, PA, Alcoa developed and piloted an inert anode technology for primary aluminum production called Elysis that can eliminate direct carbon emissions from the production of primary aluminum, and instead produce oxygen. To bring the technology to commercial scale, it formed a joint venture with Rio Tinto and solicited government support. Given the significant environmental benefits, the Canadian and Quebec governments have contributed over \$120 million in funding to support proving the technology at commercial scale. That testing occurred at a Rio Tinto Canadian smelter and has now progressed to commercial scale testing at the same facility. Should the Elysis technology be proven out at an industrial scale, it will be a game changer for the primary aluminum industry.
- Norway – Norway has a multi-stage support structure for decarbonization projects that runs from the R&D level to capital investment with percentage-based support throughout the life of a project. The final support level, during the capital phase, is designed to help offset the financial burden of the changes needed to support decarbonization. The government will contribute up to 40% of the project capital with the intent to bring the financial performance of the new project in line with traditional methods – lowering the risk of investing in new, decarbonizing, technologies.
- Switzerland – The Swiss government is currently in consultation on revisions to its CO2 Act that would provide funding instruments for assisting with decarbonization of its industrial and other economic sectors. Once approved, it could be used to enhance aluminum industry decarbonization efforts such as those already being pursued by Novelis, which has signed a long-term collaboration agreement to start the Net Zero Lab, a joint research and development laboratory to advance carbon neutral solutions for aluminum manufacturing. The lab will focus on identifying and implementing innovative solutions to neutralize the carbon footprint of Novelis' manufacturing operations and neighboring communities, starting at the Novelis Sierre facility. The aim is to reach carbon neutrality for scope 1 and 2 emissions at the facility by 2030.

A model in another metals industry for the DOE to consider that is relevant here is the Steel Upgrading and Emissions Reduction (SUPER) Act that has been introduced in Congress (HR 4599). This bill would direct the DOE to provide significant financial and technical support for the US steel industry to shift towards GHG emission-free production and allow it to take the lead on developing breakthrough technologies in order to stay competitive, create more high-paying jobs, and continue growing the US economy. A similar opportunity exists in aluminum and even without the enactment of formal legislation, the DOE can provide that broad support for the industry's decarbonization solutions.

Further, given the potential for Elysis and other decarbonization technologies in the aluminum industry to significantly reduce GHG emissions, the Association requests that the DOE consider opportunities for the existing Loan Program Office to financially support deployment of these technologies at scale.

Broadly, the DOE should also consider a renewable electricity TVA/BPA-type program that provides long-term renewable electricity to large industrial consumers at a competitive cost in order to provide the certainty needed for US primary aluminum production to invest and grow in a decarbonizing world.

Even before decarbonization came into focus, as an energy intensive industry the aluminum industry has long had significant focus on reducing the amount of energy needed to produce its products due to the high cost of energy use as a percentage of total production cost. That focus has only intensified recently but unfortunately much of the easier to implement and less costly improvements in this area are already in place and technology and cost constraints now hinder

much of the future improvement. Thus, the need for industry assistance in making further progress.

The Association also supports the creation of the proposed new Manufacturing Institute focused on industrial decarbonization and more information about that support can be found in the Association's comments of September 7, 2021 responsive to the new MI RFI. In order to enable rapid development and deployment in the most relevant areas of decarbonization, the MI program direction should come from the private sector, with aligned funding from the public sector. Further, the DOE will only be able to achieve its decarbonization goals for the institute if it prioritizes practical application of technology to the industry rather than solely on academic research.

In primary aluminum production, the commercialization of inert anode technology discussed above presents a significant opportunity for decarbonization and the Association encourages the DOE to support those efforts at the investment level required to truly enable the technology to be deployed at an industrial scale. In the near-term, while new technologies are being deployed, support of existing smelters for incremental decarbonization improvements should be provided to enable continued production.

In secondary aluminum production, natural gas continues to be utilized almost exclusively for remelting. At this time, the use of this fossil fuel resource is the accepted method by which aluminum is melted today. However, in order to meet decarbonization objectives in this area, the following breakthrough technology development opportunities should be prioritized:

- Large scale electrical melting coupled with renewable electricity inputs
- Combustion of hydrogen or other low or non-GHG emitting fuel as a replacement for existing natural gas use
- Carbon capture and use applications for existing natural gas combustion that are economic, scalable, and ideally able to use the stripped carbon on-site in the production of value-added products or electricity
- Mechanisms which provide the opportunity for carbon offsets to be utilized with an emphasis on their transparency and durability. An example would be cost-effective and scalable development of direct air capture technology that could be utilized to offset facility emissions

Incremental improvement in secondary aluminum production and fabrication that continues to use natural gas can also be realized through technology development in:

- Alternatives for non-natural gas use in non-melting applications such as homogenizing, heat treating, and annealing
- Improved systems for utilization of waste heat (advanced regenerative heating systems)
- Better refractories for improved thermal efficiency
- Higher efficiency burner systems
- Smart burner control and management systems

The potential for increasing scrap utilization as a means of decarbonization has already been identified and embraced by the aluminum industry as every additional pound of scrap utilized avoids production of primary aluminum with a higher carbon footprint. Therefore, DOE support for technologies which facilitate increased aluminum scrap utilization through the existing DOE REMADE Institute and/or other means will be critical in helping the industry meet its goals.

As an example of how aluminum recycling and resource use efficiency can play a significant role in decarbonization of the industry, a recent Association [study](#) showed that each percentage increase in the end-of-life recycling rate of aluminum cans will reduce the can's cradle-to-grave carbon footprint by 1.02 kg CO₂e per 1,000 cans.

There exists significant opportunity for the DOE to help develop and advance technologies in this area, including:

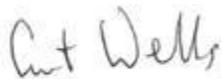
- Increased collection of post-consumer aluminum through enhancements in the US recycling infrastructure
- Better and faster aluminum sorting and segregation technology to allow highest value recycled use of alloys and alloy families
- Enhanced sorting and segregation of aluminum for recycling at building demolition and in automobile scrap recovery operations
- Maximizing recovery of aluminum in co-mingled environments such as shredder outputs and incinerator bottom ash
- Support for aluminum customer enhancements to allow increased use of aluminum alloys such as in product design, re-tooling, stamping, and other further fabrication processes
- Elimination/minimization of metal losses during remelting and recovery
- Minimization of pre-consumer scrap generated during aluminum fabrication activities

The Aluminum Association also appreciates DOE's recognition that workforce training is going to be an important component of deploying any new decarbonization technologies. As we continue in our decarbonization and modernization efforts, existing skills gaps are only going to get wider if we do not devote resources to retraining and retaining our workforces. While our industry is embracing this challenge, it is an expensive endeavor and starts from a young age. The resources of the government will be instrumental in achieving this goal.

In sum, the Association is committed to growing US domestic primary and secondary aluminum production inside the framework of decarbonization and asks that DOE and the larger US government consider ways such as those provided in this document that it can support and enhance that effort. Given that commitment, the Association and its member companies look forward to participating with DOE in the development and implementation of new technologies that can broadly support decarbonization and growth of the US aluminum industry overall.

On behalf of the Association and its member companies, we appreciate the opportunity to provide these comments to the DOE. For further dialogue and/or questions regarding them, please contact me at cwells@aluminum.org, 703-358-2976, or 804-385-6351.

Sincerely,



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