BLUEGREEN ALLIANCE®

BUY CLEAN

A Tool to Create Good Jobs, Cut Pollution, and Renew American Manufacturing

EXECUTIVE SUMMARY

A key component of effectively dealing with the problem of climate change is reducing emissions from the industrial sector. In the United States, industry is responsible for 23% of greenhouse gas emissions, which rises to 30% when accounting for electricity use. Furthermore, U.S. industrial sector energy-related emissions are projected to increase by 23% through mid-century, presenting a long-term challenge of reaching the administration's goal to achieve net-zero emissions economy-wide by no later than 2050. Meanwhile, toxic air pollution from U.S. industry spells high cancer risks for a quarter million people who live near industrial facilities.[1] For example, decades of environmental injustice mean that predominantly Black neighborhoods, regardless of proximity to an industrial facility, bear twice as much cancer risk from air pollution as primarily white neighborhoods.

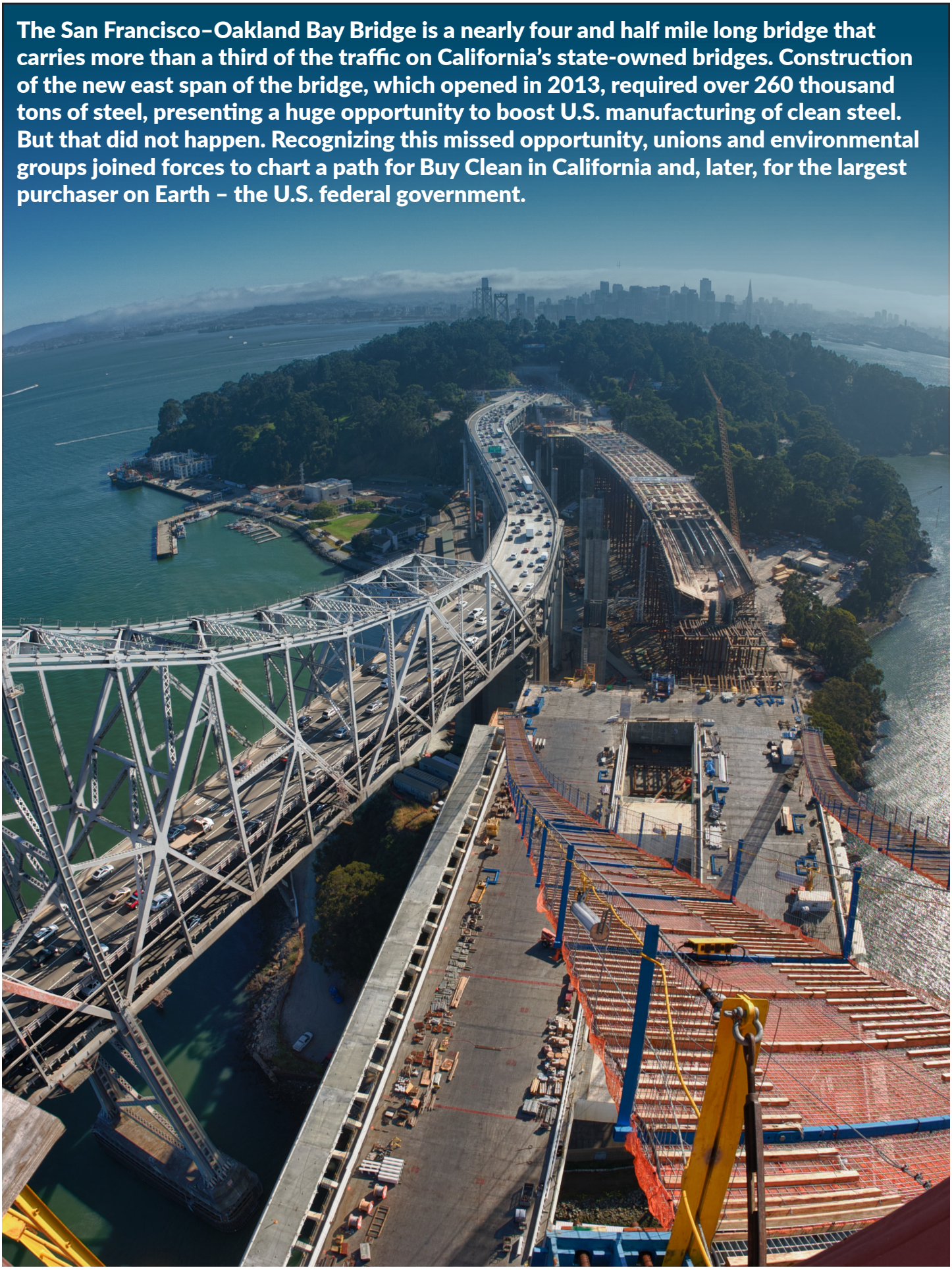
As a subset of the broader industrial sector, manufacturing is a major source of pollution yet also a key source of strong, family-sustaining jobs. Manufacturing employs over 12 million Americans; jobs that pay about 10 percent higher than comparable jobs in other sectors and with a higher unionization rate than the private sector as a whole. Unfortunately, deindustrialization has resulted in the loss of over 5 million manufacturing jobs since 1997, decimating local communities and increasing racial and gender inequities. Recent studies find that the loss of U.S. manufacturing jobs has been a major driver of the rise in U.S. income inequality since the 1980s.[2]

As a result, any strategy to reduce industrial sector emissions must also boost the important economic benefits of domestic manufacturing and enhance international competitiveness. One such policy tool is Buy Clean, which would use the government's vast purchasing power to create a large and stable market for the manufacture of low-carbon construction materials like steel, concrete, cement, and aluminum, which are among the biggest sources of industrial climate pollution. The BlueGreen Alliance (BGA) has been spearheading an effort to develop a comprehensive federal Buy Clean policy built on a three-pronged framework:

- Enhanced disclosure of the greenhouse gas emissions and air, water, and land pollution from the production of materials like steel, concrete, cement, and aluminum through widespread adoption of Environmental Product Declarations.
- Major direct investments in industrial facilities to reduce emissions as well as increased funding for research, development, and deployment in order to spur adoption of new emissions-reducing technologies and processes, and increase global competitiveness.
- Creation of procurement standards that drive manufacturers towards a cleaner and more globally competitive future while creating and retaining good jobs and incentivizing deep emissions reductions and adoption of strong labor practices.

Buy Clean is key to reforming the misaligned incentives that have prevented strong action to reduce industrial emissions. The Biden administration has recently taken major action to advance Buy Clean federally with Executive Order 14057, and a Buy Clean Task Force established in February 2022. The Inflation Reduction Act, which President Biden signed into law in August 2022, will complement Buy Clean by investing billions of dollars to directly help manufacturers reduce emissions and use environmental product declarations, while devoting billions to government purchases of low-emissions construction materials for public buildings and highways. The billions the federal government spends on public infrastructure could hold the key to reforming the status quo and creating markets for firms that innovate to reduce emissions and create good jobs. A federal Buy Clean policy that prioritizes transparency, invests in innovation, and ties public dollars to low-emissions materials holds the promise of transforming some of the most pollution-intensive and economically vital sectors in our economy, allowing us to confront climate change while rebuilding the middle class and advancing environmental justice.

This white paper details the interconnected problems of industrial emissions and deindustrialization, analyzes the scope of federal procurement,



The San Francisco–Oakland Bay Bridge is a nearly four and half mile long bridge that carries more than a third of the traffic on California's state-owned bridges. Construction of the new east span of the bridge, which opened in 2013, required over 260 thousand tons of steel, presenting a huge opportunity to boost U.S. manufacturing of clean steel. But that did not happen. Recognizing this missed opportunity, unions and environmental groups joined forces to chart a path for Buy Clean in California and, later, for the largest purchaser on Earth – the U.S. federal government.

and lays out a comprehensive vision for Buy Clean. Reducing industrial emissions while creating and retaining good jobs is not easy, but with a careful and thoughtful approach, Buy Clean will be an additional and effective policy tool for doing so.

INTRODUCTION

In September 2013, after nearly a dozen years of construction, the eastern section of the San Francisco-Oakland Bay Bridge finally opened to the public. This marked the completion of the most expensive public works project in California's history, coming in at $6.5 billion, despite original 1997 estimates of $250 million.[3] Cost overruns and quality issues plagued the bridge's construction, particularly the fabrication of the signature tower and roadway.

While several domestic steel mills on the west coast bid on the bridge project in 2006, the winning bid was awarded to an overseas firm 6,500 miles away called Shanghai Zhenhua Port Machinery Co. Ltd (ZPMC).[4] In 2002, years before winning the Bay Bridge project, ZPMC settled a lawsuit from the District Council of Ironworkers of California that alleged workers on a Port of Oakland project were paid as little as $0.57 an hour and performed work in violation of their temporary visa conditions.[5] As ZPMC began its construction of the tower and roadway, concerns about cracked welds came up repeatedly, which resulted in California spending an additional $250 million on cost overruns, incentive payments, and training of ZPMC welders, which lacked needed experience, as opposed to utilizing domestic union workers with proper training.[6] Further problems before and after the bridge opened included cracked steel deck sections,[7] fractured anchor rods,[8] corrosion, and broken bolts. Investigative reporting on the project found that experts believe the bridge will likely require "extraordinary and costly maintenance" in the years to come.[9]

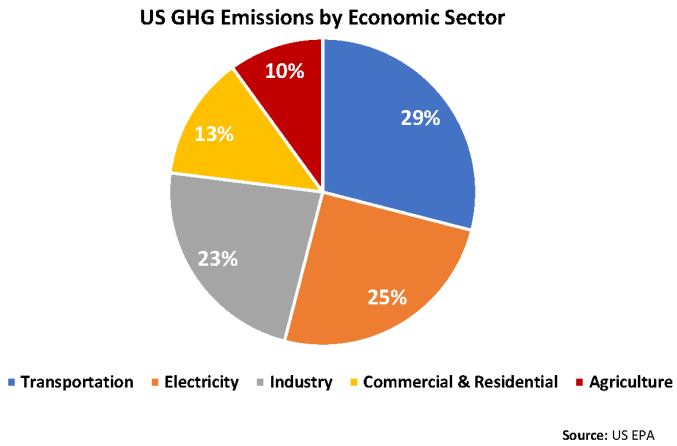
The decision to outsource the bridge's construction not only led to the use of non-union labor that undermined American workers, created safety issues, and cost taxpayers, but it also had significant climate impacts. Analysis by the BlueGreen Alliance found that an estimated 180,000 tons of carbon emissions would have been averted — equivalent to taking 38,000 cars off the road for a year — had the steel been procured from a U.S. supplier.[10] This is in part because the steel used by the company that ultimately won the bid used steel made in China, which was and remains significantly more carbon-intensive on average than steel produced in America, even before taking into account the transportation emissions generated by shipping that steel from China to the United States. This was but one of a number of frequent examples across the country of domestic manufacturers losing out to competitors overseas that do not have to abide by the same environmental, health, and labor standards and thereby led the BlueGreen Alliance to propose the idea of a Buy Clean policy, attaching climate considerations to public infrastructure procurement.

Since its inception, BGA has helped secure the passage of Buy Clean policies in California, Colorado, and Oregon. As necessary as these state programs are for kicking this process off, a federal policy, which would prioritize procurement of low emissions construction materials in federally funded infrastructure projects, would be far more impactful and create a multi-billion dollar market for the domestic companies making investments to reduce emissions. Addressing industrial emissions, which account for nearly a third of U.S. emissions, is a critical piece in meeting the scope and urgency of the climate crisis. yet, a series of misaligned incentives that include unfair trade policies and a lack of investment in domestic manufacturers have created barriers to achieving the deep reductions in climate pollution that are needed.

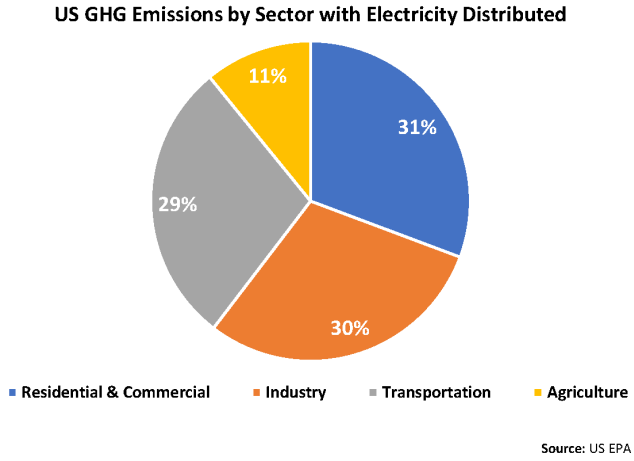
Buy Clean, particularly at a federal level, can help account for this barrier by creating a powerful incentive to reduce industrial emissions and enhance the competitiveness of domestic manufacturing. Unfair trade has enabled firms to offshore manufacturing workers along with the emissions associated with producing critical goods. Meanwhile, not enough support exists for firms to make the investments necessary to lower emissions and create good jobs in a globally competitive environment. The billions the federal government

spends on public infrastructure could help solve this puzzle by creating a market for firms that innovate and create good jobs. A federal Buy Clean policy that prioritizes transparency, investments in innovation, and ties public dollars to low-carbon materials holds the promise of transforming some of the most carbon-intensive sectors in our economy, allowing us to confront climate change while rebuilding the middle class and advancing environmental justice.

The Biden administration has recently taken major action to advance Buy Clean federally with Executive Order 14057, and a Buy Clean Task Force established in February 2022. The Inflation Reduction Act (IRA), signed into law by President Biden in August 2022, also includes important Buy Clean-related funding. This White Paper details how a federal Buy Clean policy should be structured to maximize its impact on reducing industrial pollution and supporting good union jobs. The paper also reviews the critical role of the industrial sector in climate change, how deindustrialization has destroyed good jobs and exacerbated the climate crisis, and lays out technological pathways for creating a cleaner industrial sector. As a leader in creating good jobs, a clean environment, and a fair and thriving economy, the BlueGreen Alliance sees Buy Clean as an important and innovative policy tool to achieve that mission.



Source: US EPA



Source: US EPA

THE PROBLEM

Climate Change, Environmental Injustice, & the Role of Industrial Emissions

Ahead of the United Nations (UN) 2021 Climate Change Conference (also known as COP26) in November 2021, the UN Intergovernmental Panel on Climate Change (IPCC) released the latest comprehensive assessment of climate science, the first part of the panel's Sixth Assessment Report. This latest report finds that temperatures are likely to rise by more than 1.5C above pre-industrial levels and that human activity is "unequivocally" the driver of warming global temperatures.[11] The report is another stark reminder to policymakers around the world that significant measures must be taken to tackle the climate crisis and prevent the worst of its potential calamities.

Confronting this crisis will require addressing emissions from the industrial sector, which represents a significant source of U.S. and global emissions. In 2019, the largest sources of greenhouse gas emissions by sector in the United States were transportation (29%), electricity production (25%), and industry (23%).[12] However, distributing electricity by end-use reveals that the industrial sector is the second largest source of emissions in the United States, responsible for 30% of emissions overall. Globally, after allocating electricity and heat emissions to final sectors, industry was the largest emitting sector, with nearly 40% of GHG emissions in 2019 per IEA.[13]

While industrial sector emissions may be large today, they have been growing and are projected to increase even further. Globally, industrial sector emissions increased at an average annual rate of 3.4% between 2000 and 2014, significantly faster than total carbon dioxide (CO2) emissions.[14] Industrial sector emissions are also growing at a faster rate than other sectors. Between 1990 and

2014, industrial sector emissions increased by 69%, while emissions from buildings, power, and transport increased by only 23%.[15] In the United States, energy-related industrial sector emissions are projected to increase by 23% through mid-century. Much of this growth is attributed to expanded output.[16]

While other economic sectors are projected to see flat or declining emissions, any resulting climate benefits would be offset by increases in industrial emissions under a business-as-usual scenario.[17] Reductions in the power and transportation sectors, for example, are projected to be offset by an increase in carbon emissions from industrial sources.[18] While emissions from a range of economic activities are included in the industrial sector, manufacturing accounts for the lion's share at roughly three-quarters of the sector's emissions. Within manufacturing, several key energy-intensive manufacturing sub-sectors are responsible for the majority of emissions.[19] The six largest sources of emissions, now and looking ahead, are: chemicals, petroleum refining, iron and steel, food products, paper products, and cement and lime production.[20]

In addition to the impact manufacturing has on climate change, it is also a significant source of air, water, and land pollution. In 2020, for example, manufacturing generated 89% (24.58 billion pounds) of all chemical waste in the United States.[21] Furthermore, in 2017, cement and concrete manufacturing generated 285 thousand tons of criteria air pollutants (ground-level ozone, particulate matter, lead, nitrogen dioxide, carbon monoxide, and sulfur dioxide) and over 40 thousand tons of hazardous waste.[22] That same year, the most recent data available, iron and steel manufacturing generated over 438 thousand tons of criteria air pollutants and 1.48 million tons of hazardous waste.[23]

This pollution has a disproportionate effect on communities of color. The average exposure to industrial air toxins among African Americans earning less than $15,000 per year is 47% higher than that of whites earning less than $15,000.[24] Communities of color are not only more likely to be exposed to industrial air pollution, but also less likely to reap the economic benefits of good manufacturing jobs. One study found that African Americans and Hispanics in communities neighboring industrial facilities receive 32.6% of the pollution exposure from those facilities, but just 21.3% of total jobs.[25]

Because increased manufacturing output is crucial in the creation and retention of good, family-supporting jobs for American workers, ensuring that production becomes more energy efficient and has less associated GHG emissions is key to addressing the climate crisis and must be a central component of our strategy moving forward, but a holistic approach rooted in environmental justice that incorporates broader pollution reduction is needed. This broader approach will help address climate change and support improved public health outcomes for workers and communities that live near manufacturing facilities.

Manufacturing supports good jobs and a strong, fair economy

While reducing industrial emissions will not be easy, it also presents a massive opportunity to remake our economy and protect the next generation of good jobs across the country. According to the U.S. Bureau of Labor Statistics (BLS), the industrial sector, which BLS defines as the goods-producing sector, employs over 20 million people, representing nearly 15% of the nation's workforce.[26]

Manufacturing plays a core role in industrial jobs, employing over 12 million people[27] and contributing $2 trillion a year[28] to the gross domestic product (GDP). Manufacturing also has a massive multiplier effect that drives broader job growth with each full-time job in manufacturing creating 3.4 equivalent jobs in nonmanufacturing industries.[29] Research by the Economic Policy Institute has found that the average wage in manufacturing is 10% above than comparable jobs in other sectors and the higher share of manufacturing workers who receive benefits raises that premium to 13%.[30] The sector is also a key driver of innovation as manufacturing firms fund most domestic corporate research and development.[31]

Manufacturing is also a key source of good union jobs, with 8.5% of manufacturing workers represented by a union in 2020 compared to 6.3% of private sector employees.[32] Unionization is a key pathway to quality jobs and family-sustaining wages. Union jobs on the whole pay better, have better benefits, and are safer than non-union jobs.[33] Workers who are members of, or are represented by a union, earn significantly more than those who are not across all relevant industries and occupations, with especially pronounced benefits for lower-paid workers. For example, on average, union members earn a premium of 15% higher wages than non-union workers in the utilities sector, and 45% higher wages in the construction sector.[34]

Unionization is also a key tool for increasing racial and gender equity. Research has shown that through the collective bargaining power of unions,[35] workers are able to get more and better benefits such as health insurance and pensions, and are able to fight for more enforcement of the labor protections they have a right to under the law, like enforcement of safety and health regulations, and overtime. And research has shown that union members earn higher wages across the board than non-union workers,[36] and the difference is most pronounced for workers of color and women. White union members earn on average 17% more than their non-union counterparts. Female union members earn 28%, Black union members earn 28% more, and Latino union members earn 40% more in wages than non-union Latino workers.

Manufacturing hit hard by effects of unfair trade policies

Despite the various economic benefits of manufacturing, the nation has lost nearly 5 million manufacturing jobs since 1997.[37] Much of the decline owes to trade agreements since the 1990s that have pitted American workers against manufacturers in countries with lax environmental and labor standards. For example, the North American Free Trade Agreement (NAFTA) in 1994, China's entry into the World Trade Organization (WTO) in 2001, and the U.S.-Korea Free Trade Agreement (UKFTA) in 2007 are estimated to have reduced annual wages for the median full-time American worker without a four-year college degree by $1,800.[38] While this economy-wide impact on wages is significant, workers directly displaced by increased trade have seen wage losses as high as $11,987 per year.[39] In 2021, the U.S. imported over $326 billion of manufactured goods like steel, cement, copper, and other key materials.[40]

Trade with China has had a particularly significant impact on U.S. manufacturing capacity since the U.S. Congress voted to support "free trade" with China without requiring a common baseline for workers' rights and environmental protections. Consequently, the decision pitted U.S. manufacturing against manufacturing in China, where wages, labor protections, and environmental standards were all far lower than in the United States. The predictable result of this uneven playing field was the unprecedented outsourcing of U.S. manufacturing to China. From 2001 to 2018, the growing trade deficit with China was responsible for the loss of 3.7 million jobs, including 2.8 million in manufacturing.[41] Another study found that up to one-quarter of the decline in manufacturing jobs between 2001-2007 was the result of Chinese import competition following the United States granting Permanent Normal Trade Relations to China.[42]

The loss of manufacturing jobs in the United States has also exacerbated both income inequality in general and racial inequities as cities with the largest declines in manufacturing also saw increases in the racial wage gap. An International Monetary Fund report estimates that since the 1980s, one-quarter of the increase in income inequality in the U.S. is attributable to manufacturing decline.[43] The impact of the U.S.-China trade deficit was felt disproportionately by manufacturing workers of color who suffered over a third of the job loss between 2001 and 2011.[44] The decline in manufacturing jobs since 1960 has resulted in a 13.3% decline in Black male wages, an increase of the poverty rate of eight percentage points for Black women, and one-third of the increase in wage inequality among Black men is due to manufacturing decline.[45] Across the Midwest, which experienced a 21.2% drop in manufacturing employment from 1990 to 2019,[46]

half of the Black population lives in economically distressed zip codes as calculated by the Economic Innovation Group's Distressed Communities Index.[47] Furthermore, Black and Latinx manufacturing workers who did lose their jobs from trade were less likely than their white counterparts to find other employment, as 21.2% of black workers and 21.8% of Latinx workers that lost their job remain unemployed, according to Trade Adjustment Assistance (TAA) data, while just 14.3% of white workers remain unemployed.[48]

The COVID-19 pandemic has created shortages across the economy and highlighted how the loss of American industrial capacity and our reliance on an offshored just-in-time production system has eroded the resiliency of our supply chains. The Department of Defense has called attention to the national security implications of diminished manufacturing capabilities, identifying reshoring manufacturing as a critical strategy in the agency's most recent industrial capabilities report.[49] In addition to the national security and economic implications, industries such as steel and aluminum will remain foundational to our infrastructure as well as a range of clean energy technologies, from electric vehicles to solar and offshore wind projects.

The steel and aluminum industries offer a more granular view of how trade has impacted American manufacturing. Domestic steel and aluminum producers have suffered from oversupply driven by massive financial subsidies received by foreign manufacturers of these products. From 2010 to 2017, over 13,000 jobs in the aluminum industry were lost as 18 out of 23 domestic smelters shut down production. Notwithstanding, China, India, and the Middle East significantly increased production.[50] In the steel industry, countries including China, India, Brazil, Korea, and Turkey have used various subsidies to protect domestic steel producers to the point that the Organisation for Economic Co-operation and Development (OECD) has calculated that global excess capacity in the steel industry is nearly six times the productive capacity of the entire U.S. steel industry, which has contracted by 5.5 million metric tons since 2000.[51]

The shift in steel production away from the United States not only has an economic impact, but also exacerbates climate change. Steel produced in the United States is among the cleanest in the world when it comes to carbon emissions.

Steel-making Processes

Steelmaking is generally produced through either the integrated blast furnace (BF)/basic oxygen furnace (BOF) process or the electric arc furnace (EAF) process. BF/BOF steelmaking starts with heating coke (although this is increasingly being replaced with natural gas), iron ore, and limestone in a blast furnace to create pig iron.[52] Pig iron is then fed into a basic oxygen furnace where recycled steel or direct reduced iron (DRI) is added with the pig iron and injected with oxygen to reduce the carbon content and reduce impurities. This process is the main source of primary steel production. Globally, the BF/BOF process is the predominant mode of making steel and accounts for nearly 70 percent of the world's steel production.[53]

EAF production generally uses steel scrap as the primary input. However, this feedstock can vary by country and can be a key source of carbon emissions. In India and Mexico, steelmakers use a substantial amount of DRI (around 40 percent of feedstock). In China, a significant amount of pig iron (around 45 percent of feedstock) is used, often produced using coal. Since the process of producing DRI and pig iron is highly energy-intensive, steel produced by EAF mills in China, India, and Mexico use much more energy than EAF facilities elsewhere. In the US, the EAF process accounts for nearly two-thirds of steel production.[54]

The EAF process has a lower emissions intensity, primarily because of the lower energy intensity needed to process steel scrap. Because the EAF process is dependent on electricity, the fuel source for the electrical grid plays a key role. In the case of countries like India, Mexico, and China where large shares of the EAF feedstock are pig iron or DRI, the energy intensity is much higher. It should also be noted that the embodied energy and carbon in recycled steel scrap are usually not included in the energy and emissions intensities calculation for EAF steel.[55]

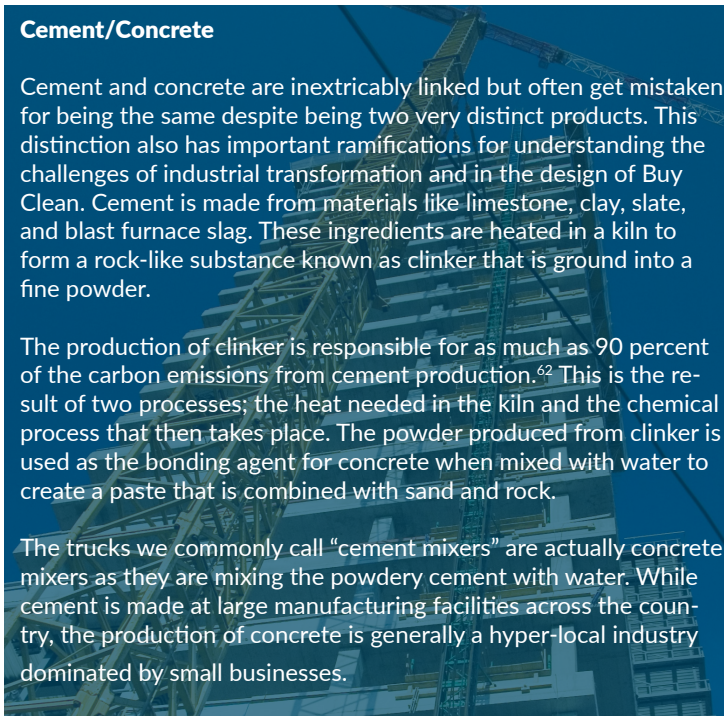
It is important to note that both steelmaking processes will be needed to meet future demand. A 2015 study in the Journal of Cleaner Production found that because of the demand for steel and scarcity of scrap, more than half of the steel produced in 2050 will still have to come from virgin materials like iron ore.[56] In addition, EAF steelmaking in North America is typically used to manufacture hot rolled shapes like angles, channel shapes, and rebar.[57] Hollow structural shapes used in buildings or steel deck used to reinforce concrete tend to come from BF/BOF mills. Since EAF steelmaking depends on the quality of scrap available, it is often unable to produce high-quality grades that might be needed. Facilities using the BF/BOF process are also larger and can produce larger quantities. For items like heavy plates, this additional capacity is needed.

As a result of these distinctions, Buy Clean will require different standards based on the type of steelmaking process being used. This will ensure an apples-to-apples comparison and will prevent BF/BOF mills from unintentionally being placed at a competitive disadvantage.

BGA commissioned a study by Global Efficiency Intelligence (GEI) that found the U.S., which is the 4th largest steel producing country—making over 85 million metric tons of steel in 2021—produces the second cleanest and low-carbon steel in the world.[58] Among the six largest steel producing nations—China, India, Japan, the U.S., Russia, and South Korea—which accounts for 75% of global steel production, the U.S. has the lowest CO2 intensity, according to the analysis. Steel produced in China and India is twice as carbon intensive as that made in the United States. Yet, despite making some of the lowest carbon steel in the world, the U.S. also imports more than any other country.[59] The steel industry is not alone in this dynamic as various other industrial products are exported around the world, yet the countries that consume them rarely account for the carbon it took to produce them. This "Carbon Loophole" hides the immense impact that outsourced industrial operations have on climate change.

According to an analysis by Global Efficiency Intelligence in 2018, the U.S. is the world's largest importer of embodied carbon emissions (the sum of all of the carbon emissions resulting from the production of a product or material), welcoming twice as much carbon pollution across its borders as any other country.[60] In fact, the U.S. imports as much as it produces in industrial climate pollution. Each year, the U.S. imports manufactured goods with 1.4 gigatons of embedded greenhouse gas emissions – nearly the same amount of climate pollution produced by all factories in the U.S. combined.[61] The largest exporter of carbon emissions is China, sending nearly three times as much climate pollution across the globe as anyone else. Trade between the U.S. and China forms the largest flow of embodied carbon emissions in the world. Altogether, these offshored emissions are estimated to account for nearly a quarter of the world's embodied GHG emissions.

With trade policies that encourage a race to the bottom in wages and labor and environmental standards, domestic manufacturing companies have little incentive to invest in reduced emissions, higher wages, or better treatment for workers. Such investments, which cost money, could cause manufacturing firms to lose business to companies in other countries that are allowed to exploit workers and dump pollution. Using public procurement to create a significant market for low-emission construction materials, coupled with significant direct investments in the transformation of industrial facilities to less emission-intensive processes can help overcome the restraints on manufacturers looking to reduce their emissions. In this way, Buy Clean can serve as an important tool for driving the industrial transformation necessary to confront climate change and toxic pollution while supporting and revitalizing domestic manufacturing and good jobs.



Cement/Concrete

Cement and concrete are inextricably linked but often get mistaken for being the same despite being two very distinct products. This distinction also has important ramifications for understanding the challenges of industrial transformation and in the design of Buy Clean. Cement is made from materials like limestone, clay, slate, and blast furnace slag. These ingredients are heated in a kiln to form a rock-like substance known as clinker that is ground into a fine powder.

The production of clinker is responsible for as much as 90 percent of the carbon emissions from cement production.[62] This is the result of two processes; the heat needed in the kiln and the chemical process that then takes place. The powder produced from clinker is used as the bonding agent for concrete when mixed with water to create a paste that is combined with sand and rock.

The trucks we commonly call "cement mixers" are actually concrete mixers as they are mixing the powdery cement with water. While cement is made at large manufacturing facilities across the country, the production of concrete is generally a hyper-local industry dominated by small businesses.

A KEY SOLUTION - BUY CLEAN

Buy Clean in the States

Using public infrastructure dollars to guide the industrial sector towards a more sustainable future is not without precedent. Led by the BlueGreen Alliance, Sierra Club, United Steelworkers, and other business, labor, and environmental organizations, a coalition was formed in 2016 to push for a new law in California that required state agencies to consider the embodied emissions of structural steel (hot-rolled sections, hollow structural sections, and plate), concrete reinforcing steel (rebar), flat glass, and mineral wool board insulation used in state-funded infrastructure projects. Many manufacturers in California already had to comply

with stringent emissions standards and were often losing out on public bids to lower cost, out-of-state or foreign bidders that did not face such standards.

The BlueGreen Alliance and its partners worked alongside Assemblymember Rob Banta to secure bipartisan passage of the Buy Clean California Act, which was signed into law by Governor Jerry Brown on October 15, 2017. Beginning in 2019, the Buy Clean California Act required contractors who bid on state infrastructure projects to disclose, via an environmental product declaration (EPD), the embodied greenhouse gas emissions data for covered materials produced in their facilities. This January, the California Department of General Services published the maximum acceptable Global Warming Potential (GWP) limit for these materials.[63] As of July 2022 contractors must meet these requirements in order to be eligible to bid on public infrastructure projects.

California Buy Clean was just the start. The Colorado Legislature, led by State Representatives Tracey Bernett and Barbara McLachlan, State Senator Chris Hansen, and supported by BGA, passed the Buy Clean Colorado Act during the 2021 legislative session. Governer Jared Polis signed the bill on July 6, 2021.[64] Buy Clean Colorado directs state agencies to accept and evaluate EPD information from architects, engineers, and contractors, and define methods that prioritize the use of the cleanest materials available in public projects. The law applies both to vertical building infrastructure, as well as horizontal infrastructure, including roads and bridges.

Colorado specifies several eligible materials requiring EPDs in public projects, including post-tension steel, reinforcing steel, structural steel, cement and concrete mixtures, asphalt and asphalt mixtures, glass, and wood structural elements. State agencies will regularly report their progress in reducing embodied emissions, lessons learned, and any emerging recommendations to improve Buy Clean processes.

On March 23, 2022, Oregon Governor Kate Brown signed Buy Clean legislation (HB 4139A) sponsored by Speaker Dan Rayfield and Senator Kate Lieber that passed with large bipartisan majorities in the Oregon Legislature.[65] The Oregon legislation tasks the Oregon Department of Transportation (DOT) with developing a Buy Clean program alongside a technical advisory committee made up of relevant state agencies, businesses, industry associations, workers, and environmental organizations.

Oregon's Buy Clean program will cover steel, concrete, and asphalt but provides the state with the authority to add materials through rulemaking after consulting with the technical advisory committee. The program will require bidders for state projects to have an EPD and grants DOT the ability to establish a grant program to help businesses develop EPDs for their eligible materials.

In addition to the aforementioned policies, BGA has been working alongside stakeholders in Washington and Minnesota to pass Buy Clean legislation. Both states have approved bills that required studies of Buy Clean to be completed.[66] Those studies have provided policymakers with critical information on the potential impacts of a state Buy Clean policy; helping lay the groundwork for future passage of such a program.

Influenced in part by the pioneering work of Buy Clean at the state level, similar legislative efforts to incorporate embodied emissions of infrastructure materials into procurement decisions are emerging in other states including New York, New Jersey, Maryland, and Virginia.

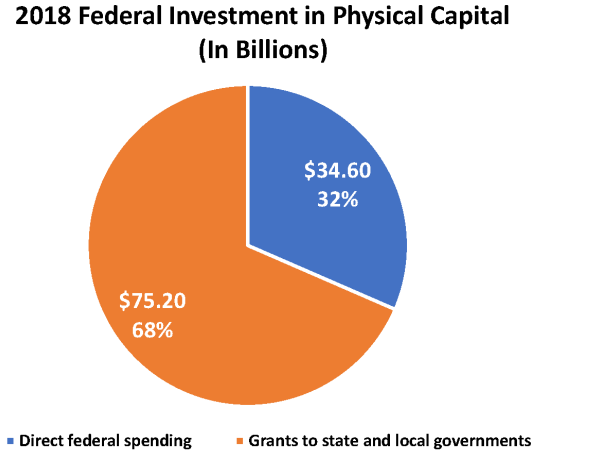
Buy America

While Buy Clean is novel in its approach to reducing industrial sector emissions, using public procurement to support domestic industry is not new. Federal Buy America laws exist, which incentivize investments in local manufacturing by giving preferences to domestically made materials and products in some federal aid infrastructure programs.[67] The basic idea, similar to that of Buy Clean, is that taxpayer dollars should be used to support domestic industry. Domestic manufacturers must abide by U.S. environmental, labor, health, and safety laws. It makes little sense to signal the importance of these protections only to send taxpayer dollars overseas, where producers

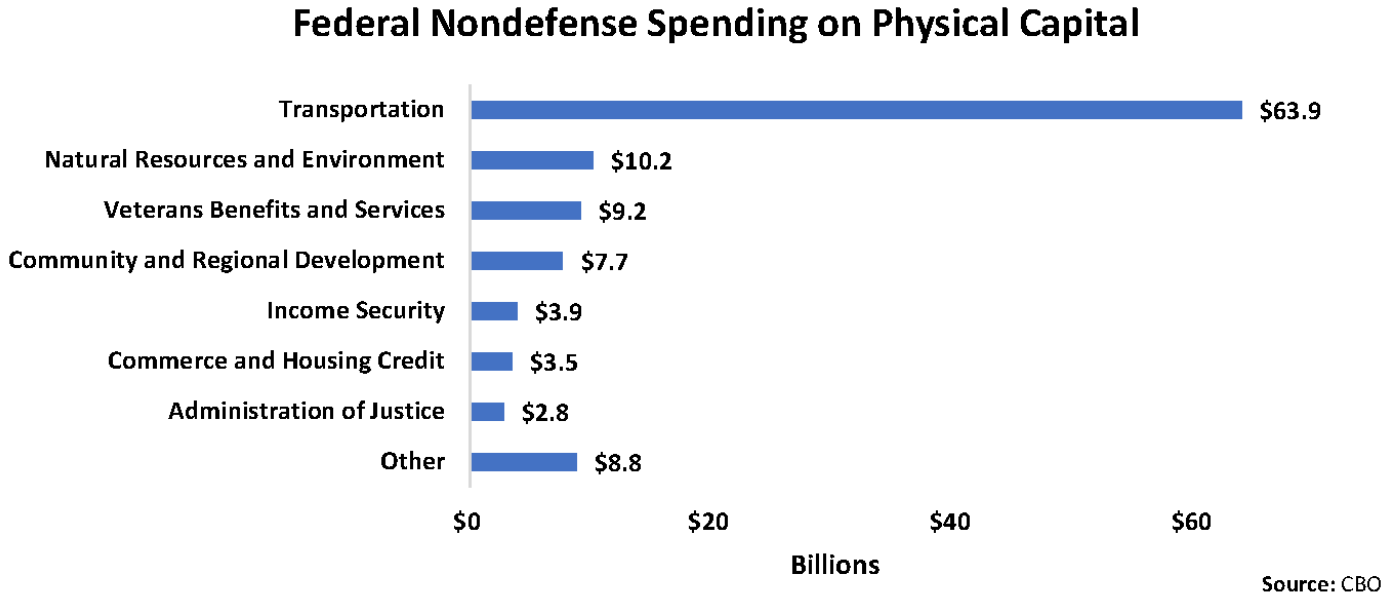
often operate in environments with low, or nonexistent, labor, safety, and environmental standards. Steering public infrastructure investments to U.S. manufacturers is an important part of creating a strong industrial base that can compete against heavily subsidized foreign manufacturing firms.

However, while Buy America has played an important role in supporting American manufacturing, it has long been limited in application and eroded over time with loopholes and weak enforcement from federal agencies. This means that billions in taxpayer dollars are spent every year on products produced overseas instead of those produced by American workers. There are a number of infrastructure programs that are not covered by Buy America at all and for those that are subject to Buy America, only a limited amount of material inputs are covered. This can result in as much as 95% of the capital spending on a highway project lacking Buy America coverage.[68]

The Build America, Buy America Act provision, included in the Bipartisan Infrastructure Law (BIL), will change that by expanding and strengthening Buy American provisions. The law expands Buy America to all federal programs that provide grants for the construction of infrastructure and closes loopholes that had undermined the effectiveness of the law.[69] Enhancing Buy America can



*Source: CBO, Federal Investment, 1962 to 2018, June 2019.

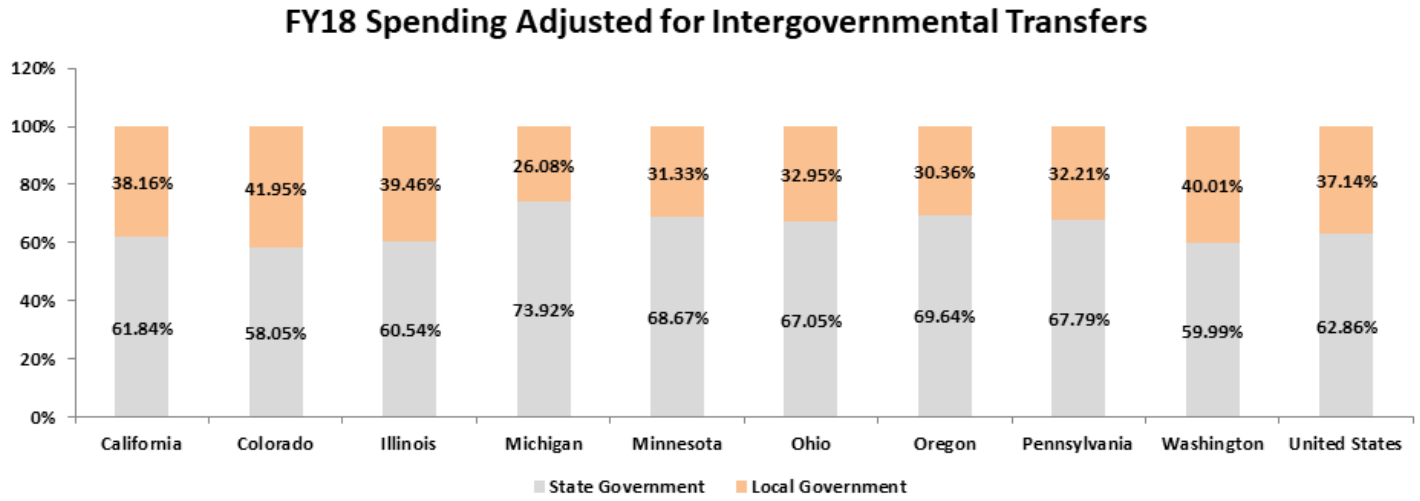


*Source: CBO, Federal Investment, 1962 to 2018, June 2019.

help ensure taxpayer dollars are invested at less carbon-intensive domestic facilities, showcasing how Buy America and Buy Clean can work in concert to reduce industrial emissions and support good jobs.

Moving Buy Clean Federally - Scope of Government Purchasing

The states mentioned above collectively spend billions on infrastructure projects and federal spending adds billions more. The Bipartisan Infrastructure Law (BIL) makes historic investments in infrastructure that will expand and accelerate the level of spending on these critical projects, creating the potential for U.S. taxpayer dollars to be used purchasing materials and manufactured goods that are produced in less carbon-intensive domestic facilities. Buy Clean will build on this progress by creating new markets for cleaner construction materials that can incentivize emission-reducing investments.



***Source: Census Bureau, Annual Survey of State and Local Government Finances**

According to a recent report by Global Efficiency Intelligence, the federal government spent $75.4 billion in 2012 on construction, building roads, bridges, schools, wastewater infrastructure and more, with an estimated $32.4 billion (43%) used for the procurement of goods and services.[70] This includes $2.3 billion on concrete and $190 million on steel. The Portland Cement Association has estimated that nearly half of all cement produced in the United States is purchased with public dollars. Simlarly, it is just 25% for steel, according to the American Iron and Steel Institute.[71] In 2020, nearly $1.5 trillion was spent on construction and more than $360 billion of that was federal, state, and local government spending.[72]

According to the Congressional Budget Office, the federal government spent $256 billion on physical capital in 2018.[73] Of that spending, $146 billion is on defense-related expenditures such as weapons and equipment, but that spending can also include construction materials. For example, in FY2020, the federal government spent over $30 million on contracts classified under cement and concrete manufacturing. Of that $30 million, $25 million was from the Department of Defense and another $5 million came from the Department of Veterans Affairs.

A significant share of federal spending on infrastructure comes in the form of grants to state and local governments. Of the $110 billion spent by the federal government in 2018 on non-defense capital investment, $75.2 billion (68% of the $110 billion) were grants to state and local governments. The vast majority ($63.9 billion) of those federal expenditures are on transportation. While a small slice of that spending is used by the federal government directly on transportation projects, 92% of federal transportation dollars are sent to state and local governments.

A similar type of relationship plays out between state and local governments. According to the census bureau, in 2018, capital outlays by state and local governments nationwide totaled $378 billion.[74] Of that amount, local government spending accounted for $243 billion. One reason local

governments account for such a significant share of spending is schools. Capital spending on E-12 schools ($69 billion) was the second largest category of state and local capital spending in 2018 after transportation ($104 billion). These projects are local in nature but could involve state funding. State governments account for 55% of state and local spending, but if adjusted for transfers to local governments, that share grows to 63%.

Placing requirements on federal spending to steer purchases toward low-emission construction materials would create a major new market for domestic companies working to meet the climate challenge. Federal and state spending are often interconnected. Some of the state spending on physical capital, for example, represents matching amounts required of some federal grants. If the federal government began to require that tax dollars be used to support industrial transformation and good jobs, it would have a powerful effect on spending at all levels. This could have significant spillover effects as manufacturers competing for public procurement dollars will also be selling cleaner materials to buyers in the private market. One estimate analyzing $6 billion in proposed federal pilot programs that would encourage the purchase of low-carbon construction materials estimated a cumulative annual emissions reduction of 25-46 million metric tons (MMT) of CO2 equivalent emissions annually by 2030.[75] Of that, 15-44 MMT of CO2e would be from the spillover effects of creating early and robust demand for low-carbon construction materials. It should be noted that this estimate is contingent on additional funding being available for environmental product declarations.

The impact Buy Clean could have on transforming American industry is massive, but only if done correctly. Working with its partners, the BlueGreen Alliance established a detailed framework for structuring a federal Buy Clean policy that rests on three core pillars:

1. Transparency & Disclosure;
2. Direct Investment & RD&D; and
3. Standards.

I – Transparency & Disclosure

In order to build a successful policy that both lowers emissions and is beneficial to domestic industry and workers, more data is needed. Policymakers need more granular information on federal infrastructure spending and comprehensive data on the embodied emissions in various construction materials.

Data on federal procurement and federal funding is lacking needed specificity. The aforementioned estimates from the Portland Cement Association and American Iron and Steel Institute about the amount of steel and cement purchased using public dollars are about the best estimates available. The previously mentioned study from Global

Efficiency Intelligence on the scope of federal procurement had to rely on Census Bureau data from 2012 when making estimates on the amount of construction materials purchased using federal dollars.

Part of the issue is that spending data available on the federal government's transparency portal (usaspending.gov) lacks detailed information on subcontractors. The Federal Funding Accountability and Transparency Act of 2006 (FFATA)[76] instructs the Office of Management and Budget (OMB) to create a searchable website that includes information about entities receiving federal funding—including contracts, subcontracts, grants, awards, and other financial assistance.[77] The required information includes the name and location of the company receiving the award; the size, purpose, and place of performance of the award; and information on the parent company of the recipient, if applicable.[78]

However, the effectiveness of FFATA has been limited by restrictions of its application to primary contractors and certain first-tier subcontractors. In a memorandum dated April 6, 2010, OMB indicated that implementation of the Act would not extend below the first tier.[79] Relying on this guidance, in 2012, the agencies responsible for issuing the Federal Acquisition Regulations (FAR) stated that "although the Transparency Act reporting requirements flow down to all subcontracts, regardless of tier, OMB . . . directed that the FAR be amended to limit the reporting of subcontract awards to the contractor's first-tier subcontractors."[80]

This narrow application of FFATA is inconsistent with both the text and the legislative history of the statute. FFATA does not contain any language limiting its disclosure requirements to a particular tier of recipients of federal funds. Instead, transactions valued below $25,000 are excluded from federal award reporting, as are entities whose gross income in the previous tax year did not exceed $300,000.[81] A full implementation of FFATA at levels of covered subawards would more accurately reflect Congress's intent and would be crucial to effective implementation of President Biden's federal Buy Clean initiative.

The federal government also needs to establish a consistent and effective means of calculating the embodied carbon that exists in construction materials used for public infrastructure. To do this, as in California and eventually Colorado and Oregon, Buy Clean would require contractors who want to bid for public projects to obtain environmental product declarations (EPD) for the products and materials that would be used in those projects. EPDs, which are typically valid for five years, are often referred to as a "nutrition label" for construction materials. These declarations follow international standards and are third-party verified. What is included in an EPD and what type of EPD a manufacturer gets can be influenced in part by policy. This is why the federal government can play a unique role in creating harmonized standards for these declarations. These actions will build trust and integrity while also helping manufacturers of cleaner materials avoid a patchwork of different standards and requirements.

Type III EPDs follow standards set by the International Standards Organization (ISO) and can be verified by a range of independent parties instead of relying on self-declarations like other ISO environmental labels.[82] This verification process must adhere to the international standards guiding life cycle assessment (ISO 14040 and ISO 14044) and the development of EPDs (ISO 14025 and 21930), and follow Product Category Rules (PCR) developed for each type of product.[83] These PCRs are developed by EPD program operators (e.g. ASTM, NSF, UL Environmental, SCS Global Services) following ISO 14027 in a process that is open and collaborative, involving a variety of stakeholders and public comment periods.[84]

The key part of an EPD is the life cycle assessment (LCA) calculated for the product, which aims to quantify a product's environmental impact throughout its life cycle. The primary stages of an LCA include product (expressed as A1-A3), construction (A4-A5), use (B), end-of-life (C), and beyond the life cycle (D). Currently, EPDs are required to include the cradle-to-gate emissions or the A1-A3 stages at a minimum, which includes extraction and upstream processing of materials, transportation, and manufacturing. For example, an EPD for a piece of rebar might quantify the

impact from the mining of iron ore or the processing of recycled steel, turning that raw material into steel, transport to fabrication shops, and product fabrication.

EPDs report GHG emissions over a product's lifecycle as global warming potential expressed as carbon dioxide equivalents (CO_2e). Global warming potential is not the only environmental impact reported in an EPD. These declarations also typically quantify additional environmental impacts calculated through a life cycle assessment, including acidification, eutrophication (e.g., algal blooms), ozone depletion, and smog formation. In addition to quantifying environmental impacts, EPDs might also include information on the manufacturer obtaining the EPD and its manufacturing processes.

Cradle-to-gate emissions are well suited for Buy Clean because from raw material extraction to when the product leaves the manufacturing facility are typically the largest source of emissions and therefore present the largest opportunity for investment in clean technologies and processes. The goal of a Buy Clean policy is to provide an incentive for manufacturers to invest in cleaner technologies and processes to reduce the emissions intensity of their operations. As a result, it makes sense to focus on the emissions that manufacturers have control over.

For these reasons, BGA has advocated for the use of Type-III product-specific EPDs that report facility-specific and supply-chain-specific data for production processes that contribute to 80% or more of a product's cradle-to-gate global warming potential and report the overall percentage of supply-chain-specific data. This ensures accurate reporting because end-stage fabricators or manufacturers cannot substitute industry averages for a product's carbon footprint.

Beyond what is currently possible with EPDs, BGA believes that a broader life cycle assessment will be necessary to meet the full potential of a Buy Clean policy. For example, while cradle-to-gate emissions typically account for the vast majority of a product's carbon footprint, a notable exception would be a material like wood, where transportation emissions from manufacturer to job site could be a significant share. Another example would be in the steel industry where the purchase of off-site renewable energy through Virtual Power Purchase Agreements are not yet captured in EPDs. For this reason, BGA supports efforts to bring experts together to identify gaps in what EPDs can currently capture and work towards methods that can fill those gaps.

In addition to these potential gaps in EPDs, more work needs to be done to ensure the health and environmental impacts beyond GHG emissions, such as a full spectrum of priority air and water pollutants and toxic chemicals, can be incorporated into a Buy Clean policy. Tools such as the Health Product Declaration[85] or the Declare Label[86] could be paired with EPDs to provide a more robust understanding of the impacts industrial processes have on the health of workers, fenceline communities, and consumers. This can provide the information necessary for Buy Clean to not only help in driving industry towards net-zero, but also to protect the health of manufacturing workers and the communities where industrial facilities are located, which are disproportionately low-income and communities of color.

Requiring companies to collect EPDs will provide the federal government with the necessary data to establish maximum acceptable global warming potential limits, a core part of the incentive structure Buy Clean would use to drive down emissions. EPDs will not only provide the federal government a tool for verifying a company's claims about the embodied carbon in its products, but that data will give policymakers a better understanding of the current situation within various industries. The data in EPDs can be used to establish industry averages and baselines. Buy Clean standards are meant to serve as a vehicle for moving U.S. industry towards a net-zero future, but it cannot set such limits without data from the firms seeking to compete for public funding.

Building Transparency, a nonprofit working to provide open access data and tools for the building industry to use in addressing embodied carbon's role in climate change, operates a public database of EPDs. According to the data from their Embod-

ied Carbon in Construction Calculator (EC3) Tool, EPDs already have pretty significant market penetration in certain sectors, particularly concrete.[87]

On April 8, 2022 the EC3 database contained over 38,000 EPDs for various products made by U.S. manufacturers such as concrete and steel, including 81 steel product EPDs. However, concrete represents roughly 92 percent of those EPDs. Nearly 56% of the concrete EPDs are from facilities located in California with another fifth of those EPDs from New Jersey manufacturers, which has a tax credit for concrete manufacturers that obtain an EPD. The large number of concrete EPDs reflects the wide array of concrete product mixes and new tools that have made it easier for companies to generate EPDs. This includes Climate Earth's Ready Mix EPD Generator[88]—which produces EPDs on-demand—as well as efforts by the National Ready Mixed Concrete Association to support EPD development.[89]

While expanding EPD usage is doable, companies, particularly smaller and mid-sized manufacturers, will need technical assistance and funding to help them obtain EPDs. The costs to obtain an EPD for a product can vary greatly, between $5,000 to $50,000 according to a study in Washington,[90] and an international study found the cost to be around $18,700.[91] In addition to these costs, the number of EPDs a company will need can vary greatly by industry. A steel producer might only need one EPD for the rebar it produces, but a concrete manufacturer might have dozens of different product specifications. The IRA provides a critical first step in expanding EPD adoption by providing $250 million over 10 years to provide businesses with grants and technical assistance for obtaining an EPD for the construction materials it produces.

Spurring greater adoption of EPDs can also help drive down costs by spurring competition among Life Cycle Assessment providers and EPD program operators. Ready-mix concrete is one industry that has already seen this happen as private sector demand for EPDs, along with state and local-level policies, are increasing EPD adoption. In just the past year, according to Building Transparency, there has been an increase in product specific EPD disclosures in multiple building material categories including cement, concrete, steel and mass timber.

II(A) – Industrial Transformation and Research, Development, Demonstration, and Deployment

In addition to providing funding for EPD costs, significant investments in industrial innovation are a necessary component of a successful Buy Clean policy as achieving the deep emissions reductions we need in the industrial sector will require major investments in new and emerging technologies.

One primary driver of industrial emissions is process heat, the high temperatures needed to operate equipment such as the furnaces that melt steel (operate at about 1,100°C) or the massive kilns (operate at about 1,400°C) used to make cement. Globally, 10% of total emissions are attributable to industrial heat, more than the combined CO2 emissions from all the world's cars (6%) and planes (2%).[92] Of total energy use in the manufacturing sector in 2014, process heat accounted for 70 percent.[93]

Several pathways exist to deeply reduce emissions in the industrial sector, but innovation, smart policies and investments, and deployment will be needed to achieve reductions in line with climate goals. Most steel and cement plants will begin their next investment cycle in the coming two decades, which further emphasizes the need for near-term investment in order to meet these goals otherwise companies will need to commit to another cycle of investment in emissions-intensive assets.[94]

Industrial Energy Efficiency and Material Efficiency and Reuse

A key way to improve the energy efficiency of manufacturing is through the use of cogeneration systems, often referred to as combined heat and power (CHP), or waste heat to power (WHP).[95] In addition to CHP and WHP, a range of commercially available efficiency technologies and measures exist that could reduce GHG emissions from manufacturing. For instance, studies have shown that efficiency improvements could result in a 15% to 20% reduction in energy consumption for steel.[96]

Associated deployment challenges for these technologies can hamper their application, however. For instance, internal capital investment competition can mean smaller investments that yield payback more quickly than CHP and end-use efficiency are often prioritized, especially as such technology is not viewed as a revenue generator. Additionally, there is often poor awareness or knowledge about the technical and economic potential of these technologies.[97]

We also need more innovation of technologies and business models to scale up the reuse of materials and support circular economies within manufacturing. Recycling is already an integral part of steel production, although we need to do more to reduce contaminants in steel products to further increase the recyclability of scrap steel. However, it is important to note that even in a more circular economy primary steel production will remain a major part of meeting the global demand for steel.[98] But increasing high-quality material recirculation is most important in subsectors like chemicals, where the recycling of plastics lags far behind other commodities.

Fuel and Feedstock Switching

Fuel switching to clean sources can also help reduce GHG emissions from the industrial sector, particularly with respect to process heat, which is the biggest source of energy use and related emissions in the sector. This could include switching to dispatchable clean energy sources, such as clean hydrogen along with the electrification of certain processes.

Solar thermal could play a role in addressing industrial energy demand as Concentrating Solar Power (CSP) plants are capable of producing heat at temperatures as high as ~1000°C, which make them applicable to certain manufacturing subsectors. Their disadvantage though is geographical mismatch between their optimal location and existing manufacturers. For example, currently operating CSP plants are concentrated in the Southwest, where the best solar resources exist, whereas U.S manufacturing is concentrated in Midwestern, Eastern, and Gulf Coast states.[99] Additionally, steelmaking, for instance, relies on very high temperatures for process heat, which cannot yet be achieved with heat from cleaner sources at a commercial scale. Part of this strategy should also include reshoring solar manufacturing. The United States was once a leader until a massive glut of solar products, driven by the use of forced labor in China, caused prices to drop 80% and cripple domestic manufacturers.[100]

New technological innovations are under development to address the emissions associated with high-temperature heat generation. One cutting-edge innovation for steel is "electrolysis," which could replace high-temperature chemical processes. In this method, electricity, rather than heat, would drive reduction and oxidation reactions.[101] The combination of renewable energy with electrolysis is currently being developed for primary steel production.[102]

For aluminum, inert anode technology could enable its production without direct carbon dioxide emissions during the aluminum smelting process, instead emitting pure oxygen. ELYSIS, a joint venture company, led by Rio Tinto and Alcoa, uses these inert anodes to replace carbon anodes traditionally used during electrolysis and the first installation and demonstration of this technology at a commercial scale will be at the Alma smelter run by Rio Tinto in Quebec. This technology was first developed at the Alcoa Technical Center outside of Pittsburgh, PA, and should this technology work at scale, it could dramatically reduce emissions from anode consumption.[103] However, anode consumption accounts for only 3% of emissions from global alumina and aluminum consumption. The vast majority of emissions from aluminum manufacturing are the result of electrolysis (80%) and alumina production (16%) so deep decarbonization of this sector will require technological advances in those two processes.[104]

Another innovative approach under development entails reducing emissions from the consumption of fossil fuel for heat and emissions from certain feedstocks by switching them with clean hydrogen or biomass.[105,106] For example, primary steel can be produced through direct reduction of iron ore with clean hydrogen[107] as a fuel and feedstock instead of coal.[108]

In Hamburg, Germany, ArcelorMittal launched a pilot project in 2019 to test steelmaking with hydrogen-based direct reduced iron (DRI) on an industrial scale, and in 2021 received funding from the German Government (€55M) and the European Investment Bank (€220M) to expand the project.[109,110] In Ghent, Belgium, with its partner Lanzatech, ArcelorMittal expects to complete the first large-scale plant to capture waste gas and biologically convert it into bio-ethanol before the end of 2022.[111] This project included significant funding from the European Union, European Investment Bank, and the Flemish government.[112] ArcelorMittal predicts a CO2 reduction of up to 87% compared with fossil transport fuels. In Sweden, SSAB, a global steel company, joined with LKAB, Europe's largest iron ore producer, and Vattenfall, one of Europe's largest electricity producers, on a project to produce steel using clean hydrogen that is on track to be produced commercially by 2026.[113] Approximately 37%of the roughly $150 million project will be funded by the Swedish Energy Agency.[114]

Carbon Capture, Utilization, and Sequestration (CCUS)

The Intergovernmental Panel on Climate Change (IPCC) Special Report found that CCUS will need to play a major role in decarbonizing the industrial sector in pathways limiting warming to both 1.5°C and 2°C, particularly in the key manufacturing industries with higher process emissions that result from the conversion of feedstocks into commodities, for example, iron ore into iron and steel, limestone into cement, and bauxite into

aluminum.[115] It needs to be emphasized that these emissions are associated with chemical conversions rather than energy use and we do not currently have near-term options other than CCUS to manage them.

Adoption of CCUS also means finding more effective ways to safely utilize CO2 emissions in ways that do not damage the environment or exacerbate impacts on environmental justice communities. For instance, captured CO2 may be sequestered through permanent geological storage under ironclad protections for clean water. Additionally, industrial facilities that capture and sell CO2 for non-polluting purposes such as mineral carbonation can reduce their emissions while also gaining an extra revenue stream, creating jobs in their company as well as downstream industries and suppliers. The economic benefit of this would encourage more carbon producers to capture their emissions, and could result in reduction of stationary source CO2 emissions from current levels.

CO2 is already used in some industrial processes, such as waste gas recycling used in steelmaking, and has the potential to shift from a burden to a valuable commodity in the future as research into safe and non-polluting carbon utilization advances. An example of this is the Al Reyadah project in Abu Dhabi, which came online in 2016 and became the world's first commercial steel carbon capture project.[116]

II(B) – The Need for Industrial Investment

These types of cutting edge projects are not being widely adopted in the United States because we don't have the policies and programs in place that incentivize and support the kind of investments needed to make them a reality. A major barrier to deep decarbonization is the nascent development stage and/or the capital cost of necessary technologies combined with an inability to spread cost across the supply chain. That is why the federal government must play a critical role in helping deploy and commercialize transformative technologies as decarbonization will not happen incrementally and requires high-risk near-term investments. If the United States does not start playing catch up with the countries making these investments, low- and zero-emission manufacturing will be commercialized in countries that are our global competitors. This will require an aggressive agenda to regain American leadership in clean technology innovation and deployment.

Despite the urgency of the climate crisis and the need to invest in industrial competitiveness, total federal support for research and development has been declining for decades from over 2% percent of GDP in the early 1960s to about 0.5% in 2019.[117] Restoring R&D spending to the 2% peak in 1964 would increase public funding for innovation by over $300 billion. Spending on energy-related R&D has declined even further from 3.6% of total R&D spending in 1964 to 2.8% of spending in 2019.[118] Pulling back on our investments in innovation made it harder to solve the climate crisis and risks leaving American companies and workers at a disadvantage in a globally competitive economy.

There is no reason the United States cannot be home to the cutting-edge industrial operations of the future, but we must make the necessary investments now. BGA and its partners have been at the forefront of that effort, releasing a bold Manufacturing Agenda in 2020 that lays out a roadmap for how the U.S. can once again lead the world in manufacturing the technologies and products of the future.[119] BGA is now working to maximize existing federal dollars, take advantage of recently enacted funding streams, and continue advocating for the new investments necessary to transform the industrial sector.[120]

The Bipartisan Infrastructure Law (BIL) provides important funds to the DOE to address industrial transformation, such as:

- $550 million to provide technical assistance and grants for energy efficiency and emissions reduction at small and medium-sized businesses. This funding will allow the DOE to help these firms not only reduce GHGs, but also create and retain jobs, and thereby help them continue to compete in an increasingly carbon constrained global economy;
- Funding to select and manage large-scale pilot and demonstration projects necessary to build next generation industries in the US. This includes $500 million for project demonstrations

of technologies to specifically reduce industrial emissions; and
- Funding for other programs and technologies that expand beyond the industrial and manufacturing scope such as $3.47 billion for CCUS; $3.5 billion for Direct Air Capture (DAC) hubs; and $8 billion to create regional hydrogen hubs. Under the right parameters, this investment could further develop the production, processing, delivery, storage, and end-use of clean hydrogen.

The restructure of the U.S. Department of Energy (DOE), and establishment of new under-secretaries and offices following passage of the BIL, provides an opportunity to align resources within the DOE toward the goal of reaching a net zero economy by 2050. This redesign will be critical to developing, demonstrating, and commercializing the innovative technologies and approaches necessary to deeply cut emissions in the industrial sector while securing domestic manufacturing and jobs.

The implementation of both the DOE restructure and the important manufacturing and industrial transformation funding provisions included in the BIL, if done correctly, will have a significant impact on helping achieve the goals of a comprehensive Buy Clean policy. However, significant funding and programmatic gaps remain. For example, while the BIL includes funding for technical assistance, energy efficiency, and emissions reduction, CCUS and industrial emissions demonstration projects, and clean hydrogen and DAC hubs, these latter programs are not targeted specifically at energy intensive industries and the funding allocated to deployment of emissions reduction technology for industrial firms is far smaller than the billions of dollars in investment necessary to meet the widespread need.

BGA has advocated for robust funding to help establish new domestic supply chains, spur development of new technologies, and modernize and cut emissions from industries like steel, cement, and aluminum. A new analysis, which BGA commissioned from the Political Economy Research Institute (PERI) at the University of Massachusetts Amherst, finds that the IRA's more than $50 billion in clean manufacturing investments will create more than 900,000 jobs over the next 10 years.[121]

One of the IRA's key investments in industrial transformation is the creation of a new Advanced Industrial Facilities Deployment Program to support emissions-reducing projects at steel, aluminum, cement, and other energy-intensive manufacturing facilities. The law offers $5.8 billion in funding for the new program, which represents an increase from earlier proposals due to the advocacy of BGA and its partners. This program alone will create nearly 120,000 good jobs over five years and cut nearly 70 million metric tons of annual climate pollution. The law also expands the 48C tax credit, making the credit available—for the first time—for manufacturers to install equipment that achieves an at least 20% reduction in climate pollution. The IRA also lays the groundwork for Buy Clean by offering manufacturers $250 million to develop EPDs to accurately report the embodied emissions in their materials and products.

The IRA also includes over $5 billion in pilot programs to encourage the purchase of low-carbon materials in certain federal projects. This includes $2.15 billion for the purchase of low-carbon materials for use in federal buildings and $2 billion for purchase of low-carbon materials for use in Federal Highway Administration projects. While the implementation of these pilot programs will be critical to their success, these funding streams could provide an important testing ground for a Buy Clean policy in the future.

The BIL and IRA provide historic investments in expanding clean technology manufacturing and industrial facility retooling, but more will need to be done to meet the scale of industrial transformation that is required. BGA has also called for the expansion and funding of broader programs that provide the economic, technical, and workforce infrastructure and support to strengthen advanced manufacturing ecosystems and communities. This includes funding for the National Institute of Standards and Technology, the Hollings Manufacturing Extension Partnership, expansion of Manufacturing USA, and to the Economic Development Administration for support

of economic growth clusters and other relevant economic development measures. A new Critical Manufacturing Supply Chain Resilience initiative at the Department of Commerce should be funded at $5 billion.

III – Establishing Buy Clean Standards

Robust investments in RD&D will help ensure that domestic manufacturers have the resources necessary to upgrade facilities and adopt the latest technologies available to reduce emissions. Once these programs are funded and widely available to manufacturers, and a strong foundation of embodied emissions data is in place, the work of creating Buy Clean standards can move forward. Contractors will have to meet these standards in order to be eligible for federally-funded construction projects and are meant to serve as a vehicle for reducing emissions in U.S. industry while boosting its global competitiveness.

BGA envisions a process that would bring together a federal interagency working group to use data from EPDs to establish emissions thresholds for bidding companies. The stakeholder process should include representatives from covered industries, representatives of associated workforce including organized labor, representatives from fenceline communities, and environmental organizations.

BGA also recommends development of a robust process for determining product category eligibility, which must include significant stakeholder input. This process must also consider separate standards that account for differences in production processes and technologies, as they can create significant competitive and economic disadvantages for domestic facilities. The clearest example of this is structural steel, where steel from Electric Arc Furnace facilities and integrated steelmaking facilities must be treated separately. The same may also be said for certain domestic cement and concrete technologies.

Standards should strengthen over time and be directly correlated with investments and other forms of direct financial support (as described above) to allow domestic industry to innovate, reduce emissions, and improve sustainability as standards become more stringent.

Establishing standards for construction materials should be considered a floor for the more transformational changes that a Buy Clean initiative can incentivize. BGA also recommends establishing a high-achievers' market, through which the government would procure a certain percentage from the highest performing bidders.

This high-achievers market would reward firms that:

- Meet high-road labor standards;
- Meet an exceptional absolute level of both GHG emissions and air, water, and land pollution reduction, aiming for zero, net-zero, or net-negative emissions; and
- Create accessible jobs in marginalized communities, using equitable hiring practices that support communities of color, low-income communities, and deindustrialized communities.

While standards coupled with investment would help raise the floor of domestic performers, a high-achievers' market would help raise the ceiling on performance, further pushing for innovation and improved technologies and processes.

THE PATH FORWARD

The framework BGA has laid out for a federal Buy Clean policy has been developed alongside our partners and stakeholders with the goal of optimizing the effectiveness of a policy that has not yet been deployed at a federal level. Recent action by the Biden administration now provides a remarkable opportunity to put this framework into action. On December 8, 2021, President Biden signed Executive Order 14057 (EO), "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability,"[122] which accompanied the release of the Federal Sustainability Plan.[123] These actions have launched the first-ever national Buy Clean program, with the goal of using the scale and procurement power of the federal government to help achieve net-zero emissions economy-wide by no later than 2050.

To help achieve this goal, the EO established a federal Buy Clean initiative, a Net-Zero Emissions Procurement Federal Leaders Working Group, and a Buy Clean Task Force to provide recommendations on policies and procedures to expand consideration of embodied emissions and pollutants of construction materials in Federal procurement and federally funded projects.

Led by the Council on Environmental Quality (CEQ) and White House Office of Domestic Climate Policy, the Buy Clean Task Force is composed of representatives from Departments of Defense, Energy, and Transportation; the Environmental Protection Agency; the General Services Administration; and the White House Office of Management and Budget (OMB), and any others as designated by the Chair of CEQ.[124]

Among other provisions, the Task Force is charged with providing recommendations to the Chair of CEQ and the Director of OMB on policies and procedures to expand consideration of embodied emissions and pollutants of construction materials in Federal procurement and federally funded projects, to include:

- Recommendations on materials and priority pollutants to be covered under Buy Clean;
  - For materials, this could include steel, concrete, cement, aluminum, flat glass, wood products, insulation, unit masonry, and others; and
  - For pollutants, this could include GHGs, and other air, water, and land pollutants.
- Recommendations on mechanisms for collecting environmental performance information for primary processing facilities of eligible materials;
  - The EO specifically highlights environmental product declarations (EPDs), a commonly-used reporting mechanism that includes a calculation of embodied GHGs of a given material; and
  - The Task Force is also tasked with providing recommendations for auditing EPDs.
- Recommendations for financial and technical assistance, or other mechanisms, to support domestic manufacturers in the reporting and reduction of embodied emissions; and
- Recommendations for pilot programs to incentivize procurement of lower embodied-emission materials.

With this EO, the administration is taking the decisive steps to ensure that federal procurement—like all federal activities—are undertaken in a way that reduces greenhouse gas (GHG) emissions, improves health and environmental outcomes in communities harmed by environmental injustice, and creates good jobs across the United States.

The U.S. faces a series of misaligned incentives

as it tries to confront a core piece of our climate crisis: industrial emissions. Despite creating good-paying jobs and serving as key to middle-class economic security, unfair trade policy has decimated domestic manufacturing. Deindustrialization has resulted in job loss and increased racial inequities while also making it even more difficult to tackle a huge source of emissions that are key to addressing climate change.

Meanwhile, no market exists to reward the domestic companies that are making investments to reduce emissions. However, the billions the federal government spends on public infrastructure could hold the key to reforming these perverse incentives and creating a market for firms that innovate to reduce emissions and create good jobs. A federal Buy Clean policy that prioritizes transparency, invests in innovation, and ties public dollars to low-emissions materials holds the promise of transforming some of the most pollution-intensive and economically vital sectors in our economy, allowing us to confront climate change while rebuilding the middle class and advancing environmental justice.

ENDNOTES

1 Propublica, *"Poison in the Air,"* November 2, 2021. Available online: https://www.propublica.org/article/toxmap-poison-in-the-air

2 International Monetary Fund, *Manufacturing Jobs and Inequality: Why is the U.S. Experience Different?*, September 13, 2019. Available online: https://www.imf.org/en/Publications/WP/Issues/2019/09/13/Manufacturing-Jobs-and-Inequality-Why-is-the-U-S-47001

3 Bloomberg CityLab, *"From $250 Million to $6.5 Billion: The Bay Bridge Cost Overrun,"* October 13, 2015. Available online: https://www.bloomberg.com/news/articles/2015-10-13/how-the-cost-of-remaking-the-san-francisco-bay-bridge-soared-to-6-5-billion

4 Governing, *"A First Among States, California Plugs the 'Carbon Loophole',"* November 28, 2017. Available online: https://www.governing.com/archive/gov-california-targeting-supply-chain-emission.html

5 SFGate, *"Union settles suit over Chinese crane workers,"* May 17, 2002. Available online: https://www.sfgate.com/business/article/Union-settles-suit-over-Chinese-crane-workers-2834387.php

6 Ironworker Management Progressive Action Cooperative Trust, *"Bay Bridge's Troubled China Connection,"* June 27, 2014. Available online: http://www.impact-net.org/news/2014/06/27/bay-bridges-troubled-china-connection

7 San Francisco Chronicle, *"Broken bolts may delay Bay Bridge opening,"* May 27, 2013. Available online: https://www.sfgate.com/bayarea/article/Broken-bolts-may-delay-Bay-Bridge-opening-4390299.php

8 Alliance for American Manufacturing, *"The China-Built Bay Bridge Has Another Problem,"* October 8, 2015. Available online: https://www.americanmanufacturing.org/blog/the-china-built-bay-bridge-has-another-problem/

9 Alliance for American Manufacturing, *"The Made-in-China Bay Bridge Continues to Cost California,"* June 9, 2014. Available online: https://www.americanmanufacturing.org/blog/the-made-in-china-bay-bridge-continues-to-cost-california/

10 BlueGreen Alliance, *Testimony of Kimberly Glas, Executive Director of the BlueGreen Alliance, United States Senate Subcommittee on Multilateral International Development, Multilateral Institutions, and International Economic, Energy, and Environmental Policy*, Wednesday, May 9, 2018. Available online: https://www.foreign.senate.gov/imo/media/doc/050918_Glas_Testimony.pdf

11 Intergovernmental Panel on Climate Change, *AR6 Climate Change 2021: The Physical Science Basis*, 2021, Available online: https://www.ipcc.ch/report/ar6/wg1/

12 U.S. Environmental Protection Agency (EPA), *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, April 2021. Available online: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2019

13 International Energy Agency (IEA), *Emissions by sector*. Available online: https://www.iea.org/reports/greenhouse-gas-emissions-from-energy-overview/emissions-by-sector

14 Intergovernmental Panel on Climate Change (IPCC), *Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development*, 2018. Available online: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf; *IPCC, "Global Warming of 1.5°C."* Available online: https://www.ipcc.ch/sr15/

15 McKinsey & Company, *Decarbonization of Industrial Sectors: the next Frontier*, 2018, Available online: https://www.mckinsey.com/industries/oil-and-gas/our-insights/decarbonization-of-industrialsectors-the-next-frontier

16 Third Way, *Industry Matters: Smarter Energy Use Is Key for US Competitiveness, Jobs, and Climate Efforts*, 2018. Available online: https://www.thirdway.org/report/industry-matters-smarterenergy-use-is-key-for-us-competitiveness-jobs-and-climate-effort

17 Ibid.

18 Utility Dive, *"EIA: US Far off Track for Global Climate Goals as Fossil Fuel Reliance Persists,"* January 2019. Available online: http://www.utilitydive.com/news/eia-us-far-off-track-for-globalclimate-goals-as-fossil-fuel-reliancepers/546857/

19 Third Way, *Industry Matters: Smarter Energy Use Is Key for U.S. Competitiveness, Jobs, and Climate Efforts*, 2018. Available online: https://www.thirdway.org/report/industry-matters-smarter-energy-useis-key-for-us-competitiveness-jobs-and-climate-effort

20 Center for Climate and Energy Solutions, *Decarbonizing U.S. Industry*, July 2018. Available online: https://www.c2es.org/wp-content/uploads/2018/06/innovation-manufacturing-background-brief-07-18.pdf

21 U.S. Environmental Protection Agency (EPA), TRI National Analysis - Manufacturing Sectors, 2022. Available online: https://www.epa.gov/trinationalanalysis/manufacturing-sectors

22 U.S. Environmental Protection Agency, Smart Sectors Program - Cement and Concrete, 2022. Available online: https://cfpub.epa.gov/wizards/smartsectors/cement-concrete/#Home

23 U.S. Environmental Protection Agency, Smart Sectors Program - Iron and Steel, 2022. Available online: https://cfpub.epa.gov/wizards/smartsectors/ironsteel/#Chart

24 Political Economy Research Institute, *Regional Variation in Environmental Inequality: Industrial air toxics exposure in U.S. cities*, February 2014. Available online: https://peri.umass.edu/publication/item/563-regional-variation-in-environmental-inequality-industrial-air-toxics-exposure-in-u-s-cities

25 The Proceedings of the National Academy of Sciences (PNAS), *Racial disparities in pollution exposure and employment at US industrial facilities*, August 22, 2018. Available online: https://www.pnas.org/doi/epdf/10.1073/pnas.1721640115

26 U.S. Bureau of Labor Statistics (BLS), *Employment, Hours, and Earnings from the Current Employment Statistics survey (National) for goods-producing industries*, 2021. Available online: https://data.bls.gov/timeseries/CES0600000001?amp%253bdata_tool=XGtable&output_view=data&include_graphs=true; BLS includes the Agriculture, Forestry, Fishing and Hunting; Mining, Quarrying, and Oil and Gas Extraction; Construction; and Manufacturing industries in its calculations of the goods producing sector.

27 BLS, *Manufacturing: NAICS 31-33*, 2021. Available

online: https://www.bls.gov/iag/tgs/iag31-33.htm
28 Economic Policy Institute, *The Manufacturing Footprint and the Importance of U.S. Manufacturing Jobs*, January 2015. Available online: https://www.epi.org/publication/the-manufacturing-footprint-and-the-importance-of-u-s-manufacturing-jobs/
29 Third Way, *Industry Matters: Smarter Energy Use is Key for US Competitiveness, Jobs, and Climate Efforts*, October 10, 2018. Available online: https://www.thirdway.org/report/industry-matters-smarter-energy-use-is-key-for-us-competitiveness-jobs-and-climate-effort
30 Economic Policy Institute (EPI), *"Yes, manufacturing still provides a pay advantage, but staffing firm outsourcing is eroding it,"* March 12, 2018. Available online: https://www.epi.org/publication/manufacturing-still-provides-a-pay-advantage-but-outsourcing-is-eroding-it
31 National Science Board (NCB) and National Science Foundation (NSF), *Research and Development: U.S. Trends and International Comparisons*, January 15, 2020. Available at https://www.ncses.nsf.gov/pubs/nsb20203/
32 BLS, *Labor Force Statistics from the Current Population Survey*. Available online: https://www.bls.gov/cps/tables.htm#union
33 AFL-CIO, *Building Power for Working People*, 2021. Available online: https://aflcio.org/what-unions-do/empower-workers#:~:text=Union%20Jobs%20Help%20Achieve%20Work%2DLife%20Balance&text=There%27s%20more%20to%20life%20than,schedules%20and%20no%20mandatory%20overtime
34 BlueGreen Alliance, *Making Clean Deliver*, August 2021. Available online: https://www.bluegreenalliance.org/site/making-clean-deliver/
35 Economic Policy Institute, *Black workers face two of the most lethal preexisting conditions for coronavirus- racism and economic inequality*, 2020. Available online: https://www.epi.org/publication/black-workers-covid/
36 Bureau of Labor Statistics, *New Release*, January 22, 2021. Available online: https://www.bls.gov/news.release/pdf/union2.pdf
37 Economic Policy Institute, *We can reshore manufacturing jobs, but Trump hasn't done it*, 2020. Available online: https://www.epi.org/publication/reshoring-manufacturing-jobs/#:~:text=Overall%2C%20the%20U.S.%20has%20suffered,Census%20Bureau%202020a%2C%202020b
38 Economic Policy Institute, *Unfair trade deals lower the wages of US workers*, March 13, 2015. Available online: https://www.epi.org/publication/unfair-trade-deals-lower-the-wages-of-u-s-workers/
39 Ibid.
40 U.S. International Trade Commission, DataWeb, Available online: https://dataweb.usitc.gov/
41 Economic Policy Institute, *Growing China trade deficit cost 3.7 million American jobs between 2001 and 2018*, January 30, 2020. Available online: https://www.epi.org/publication/growing-china-trade-deficits-costs-us-jobs/
42 National Bureau of Economic Research, *The Surprisingly Swift Decline of U.S. Manufacturing Employment*, December 2012. Available online: https://www.nber.org/papers/w18655
43 International Monetary Fund, *Manufacturing Jobs and Inequality: Why is the U.S. Experience Different?*, September 13, 2019. Available online: https://www.imf.org/en/Publications/WP/Issues/2019/09/13/Manufacturing-Jobs-and-Inequality-Why-is-the-U-S-47001
44 Economic Policy Institute, *Trading away the manufacturing advantage*, September 30, 2013. Available online: https://www.epi.org/publication/trading-manufacturing-advantage-china-trade/
45 Centre for Economic Policy Research, *Torn Apart? The Impact of Manufacturing Employment Decline on Black and White Americans*, June 2018. Available online: https://cepr.org/active/publications/discussion_papers/dp.php?dpno=12992
46 U.S. Bureau of Labor Statistics (BLS), *Exploring Midwest manufacturing employment from 1990 to 2019*, November 2021. Available online: https://www.bls.gov/opub/mlr/2021/article/exploring-midwest-manufacturing-employment-from-1990-to-2019.htm
47 Economic Innovation Group, *Uplifting America's Left Behind Places: A Roadmap for a More Equitable Economy*, February 2021. Available online: https://eig.org/wp-content/uploads/2021/02/Spatial-Inequality-Policy-Brief.pdf
48 Public Citizen, *Trade Discrimination: The Disproportionate, Underreported Damage to U.S. Black and Latino Workers From U.S. Trade Policies*, January 2021. Available online: https://www.citizen.org/wp-content/uploads/PC_Trade-Discrimination-Report_1124.pdf
49 United States Department of Defense, *Fiscal Year 2020 Industrial Capabilities Report to Congress*, January 2021. Available online: https://www.businessdefense.gov/Portals/51/USA002573-20%20ICR_2020_Web.pdf?ver=o-3D76uGwxcg0n0Yxvd5k-Q%3d%3d
50 Economic Policy Institute, *Aluminum producing and consuming industries have thrived under U.S. Section 232 import measures*, May 25, 2021. Available online: https://www.epi.org/publication/aluminum-producing-and-consuming-industries-have-thrived-under-u-s-section-232-import-measures/
51 Organisation for Economic Co-Operation and Development (OECD), *OECD.Stat Steelmaking Capacity*, Available online: https://stats.oecd.org/Index.aspx?datasetcode=STI_STEEL_MAKINGCAPACITY
52 American Iron and Steel Institute, Steel Production, Available online: https://www.steel.org/steel-technology/steel-production/
53 World Steel Institute, *Fact Sheet: Steel and raw materials*, Available online: https://www.worldsteel.org/en/dam/jcr:16ad9bcd-dbf5-449f-b42c-b220952767bf/fact%2520sheet%2520raw%2520materials%25202021.pdf
54 American Iron and Steel Institute (AISI), *Profile 2019–2020*, Available online: https://www.steel.org/wp-content/uploads/2020/12/2020-AISI-Profile-Book.pdf
55 Global Efficiency Intelligence, *How Clean is the U.S. Steel Industry?*, November 2019. Available online: https://www.globalefficiencyintel.com/us-steel-industry-benchmarking-energy-co2-intensities
56 Journal of Cleaner Production, *The impact of climate targets on future steel production – an analysis based on a global energy system model*, September 15, 2015. Available online: https://www.sciencedirect.com/science/article/pii/

S0959652614004004
57 Architecture 2030, *Carbon Smart Materials Palette - Steel*, Available online: https://materialspalette.org/steel/
58 Global Efficiency Intelligence, *Steel Climate Impact: An International Benchmarking of Energy and CO2 Intensities*, April 2022. Available online: https://www.globalefficiencyintel.com/steel-climate-impact-international-benchmarking-energy-co2-intensities
59 Ibid.
60 Global Efficiency Intelligence, *The Carbon Loophole in Climate Policy*, August 2018. Available online: https://www.globalefficiencyintel.com/carbon-loophole-in-climate-policy
61 Ibid.
62 British Broadcasting Corporation, *"Climate change: The massive CO2 emitter you may not know about,"* December 17, 2018. Available online: https://www.bbc.com/news/science-environment-46455844
63 California Department of General Services Procurement Division, *Buy Clean California Act*, 2021. Available online: https://www.dgs.ca.gov/PD/Resources/Page-Content/Procurement-Division-Resources-List-Folder/Buy-Clean-California-Act
64 Colorado General Assembly, *Global Warming Potential For Public Project Materials*. Available online: http://leg.colorado.gov/bills/HB21-1303
65 Oregon Legislature, *HB4139*, 2021. Available online: https://olis.oregonlegislature.gov/liz/2022R1/Measures/Overview/HB4139
66 BlueGreen Alliance, *Buy Clean in the States*, 2022. Available online: https://www.bluegreenalliance.org/site/buy-clean/buy-clean-in-the-states/
67 Alliance for American Manufacturing, *"How Buy Clean Can Help the U.S. Close the 'Carbon Loophole'"* April 21, 2021. Available online: https://www.americanmanufacturing.org/blog/how-buy-clean-can-help-the-u-s-close-the-carbon-loophole/
68 Ibid.
69 U.S. Senator Sherrod Brown, *"Brown Calls For Strong 'Buy America' Rules For Taxpayer-Funded Infrastructure Projects,"* April 28, 2021. Available online: https://www.brown.senate.gov/newsroom/press/release/brown-calls-for-strong-buy-america-rules-for-taxpayer-funded-infrastructure-projects
70 Global Efficiency Intelligence (GEI), *Scale of Government Procurement of Carbon-Intensive Materials in the United States*, January 2021. Available online: https://www.globalefficiencyintel.com/scale-of-government-procurement-of-carbonintensive-materials-in-us
71 ClimateWorks, *Rebecca Dell testimony for U.S. House of Representatives Committee on Energy and Commerce Subcommittee on Environment and Climate Change*, March 18, 2021. Available online: https://docs.house.gov/meetings/IF/IF18/20210318/111348/HHRG-117-IF18-Wstate-DellR-20210318.pdf
72 Census Bureau, *Value of Construction Put in Place at a Glance*, 2022. Available online: https://www.census.gov/construction/c30/c30index.html
73 Congressional Budget Office, *Federal Investment, 1962 to 2018*, June 2019. Available online: https://www.cbo.gov/system/files/2019-06/55375-Federal_Investment.pdf
74 Census Bureau, Annual Survey of State and Local Government Finances, 2022. Available online: https://www.census.gov/programs-surveys/gov-finances.html
75 Third Way, *"Building Back Better With Clean Materials Offers Big GHG Savings,"* January 13, 2022. Available online: https://www.thirdway.org/blog/building-back-better-with-clean-materials-offers-big-ghg-savings
76 Federal Funding Accountability and Transparency Act, *Pub. L. No. 109–282*, 2006, Available online: https://www.govinfo.gov/content/pkg/PLAW-109publ282/pdf/PLAW-109publ282.pdf.
77 Ibid.
78 Ibid.
79 U.S. Office of Management and Budget (OMB), *Open Government Directive–Federal Spending Transparency*, April 6 2010, Available online: https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/open_gov/OpenGovernmentDirective_04062010.pdf.
80 77 Fed. Reg. 44,047 and 44,054, *Reporting Compensation and First-Tier Subcontract Awards*, July 26 2012, Available online: https://www.govinfo.gov/content/pkg/FR-2012-07-26/pdf/2012-17724.pdf.
81 Federal Funding Accountability and Transparency Act, *Pub. L. No. 109–282*, 2006, Available online: https://www.govinfo.gov/content/pkg/PLAW-109publ282/pdf/PLAW-109publ282.pdf.
82 International Standards Organization, Environmental Labels, June 2019. Available online: https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100323.pdf
83 Carbon Leadership Forum, *Guidance on Embodied Carbon Disclosure*, December 2020. Available online: https://carbonleadershipforum.org/guidance-on-embodied-carbon-disclosure/
84 UL, *Product Category Rules*, 2022. Available online: https://www.ul.com/services/product-category-rules-pcrs
85 Health Product Declaration Collaborative, Use The HPD, 2022. Available online: https://www.hpd-collaborative.org/use-the-hpd/
86 International Living Future Institute, Declare - The Nutrition Label For Products, 2022. Available online: https://declare.living-future.org/
87 Building Transparency, Embodied Carbon in Construction Calculator (EC3) Tool, 2022. Available online: https://buildingtransparency.org/ec3
88 Climate Earth, EPD Essential, 2022. Available online: https://www.climateearth.com/ready-mix-epd-generator/
89 National Ready Mixed Concrete Association, Environmental Product Delcarations, 2022. Available online: https://www.nrmca.org/association-resources/sustainability/epd-program/
90 Carbon Leadership Forum, *Buy Clean Washington Study*, 2019, Available online: https://carbonleadershipforum.org/buy-clean-washington-study/
91 24th CIRP Conference on Life Cycle Engineering, *International survey of the costs of assessment for environmental product declarations*, 2016, Available online: https://www.sciencedirect.com/science/article/pii/S221282711631318X
92 Vox, *"This climate problem is bigger than cars*

and much harder to solve," January 31, 2020. Available online: https://www.vox.com/energy-and-environment/2019/10/10/20904213/climate-change-steel-cement-industrial-heat-hydrogen-ccs
93 ACEEE, *Transforming Industry: Paths to Industrial Decarbonization in the United States*, May 2020. Available online: https://www.aceee.org/sites/default/files/pdfs/ie2001.pdf
94 International Energy Agency, *"Aligning investment and innovation in heavy industries to accelerate the transition to net-zero emissions,"* July 20, 2020. Available online: https://www.iea.org/commentaries/aligning-investment-and-innovation-in-heavy-industries-to-accelerate-the-transition-to-net-zero-emissions
95 Third Way, *Industry Matters: Smarter Energy Use Is Key for US Competitiveness, Jobs, and Climate Efforts*, 2018. Available online: https://www.thirdway.org/report/industry-matters-smarterenergy-use-is-key-for-us-competitiveness-jobs-and-climate-effort
96 Energy Transitions Commission, *Mission Possible: Reaching Net-Zero Carbon Emissions from Harder to Abate Sectors by Mid-Century*, 2018. Available online: http://www.energytransitions.org/sites/default/files/ETC_MissionPossible_FullReport.pdf
97 Third Way, *Industry Matters: Smarter Energy Use Is Key for US Competitiveness, Jobs, and Climate Efforts*, 2018. Available online: https://www.thirdway.org/report/industry-matters-smarterenergy-use-is-key-for-us-competitiveness-jobs-and-climate-effort
98 Material Economics, *The Circular Economy - A Powerful Force for Climate Mitigation*, 2018. Available online: https://materialeconomics.com/publications/the-circular-economy
99 Ibid.
100 Scientific American, *"Why China Is Dominating the Solar Industry,"* December 19, 2016. Available online: https://www.scientificamerican.com/article/why-china-is-dominating-the-solar-industry/
101 McKinsey & Company, *Decarbonization of Industrial Sectors: the next Frontier*, 2018, Available online: https://www.mckinsey.com/industries/oil-and-gas/our-insights/decarbonization-of-industrialsectors-the-next-frontier
102 Climate Action Tracker, *Manufacturing a Low-Carbon Society: How Can We Reduce Emissions from Cement and Steel? Climate Action Tracker*, 2017. Available online: http://climateactiontracker.org/documents/60/CAT_2017-10-18_DecarbIndustry_CATAnalysis.pdf.
103 ELYSIS, *"Start of construction of commercial-scale inert anode cells,"* June, 2021. Available online: https://elysis.com/en/start-of-construction-of-commercial-scale-inert-anode-cells
104 Global Efficiency Intelligence, *Aluminum Climate Impact - An International Benchmarking of Energy and CO2 Intensities*, February 2022. Available online: https://www.globalefficiencyintel.com/aluminum-climate-impact-international-benchmarking-energy-co2-intensities
105 McKinsey, *"Decarbonization of industrial sectors: The next frontier,"* June 1, 2018. Available online: https://www.mckinsey.com/industries/oil-and-gas/our-insights/decarbonization-of-industrial-sectors-the-next-frontier
106 International Energy Administration, *CO2 Abatement in the Iron and Steel Industry*, 2012. Available online: http://www.usea.org/sites/default/files/012012_CO2%20abatement%20in%20the%20iron%20and%20 steel%20industry_ccc193.pdf
107 Climate Action Tracker, *"Manufacturing a Low-Carbon Society: How Can We Reduce Emissions from Cement and Steel?,"* October 2017. Available online: https://newclimate.org/wp-content/uploads/2017/10/memo_decarb_industry_final1.pdf
108 McKinsey, *"Decarbonization of industrial sectors: The next frontier,"* June 1, 2018. Available online: https://www.mckinsey.com/industries/oil-and-gas/our-insights/decarbonization-of-industrial-sectors-the-next-frontier
109 ArcelorMittal, *"German Federal Government commits its intention to provide €55 million of funding for ArcelorMittal's Hydrogen DRI plant,"* September 7, 2021. Available online: https://corporate.arcelormittal.com/media/news-articles/german-federal-government-commits-its-intention-to-provide-55-million-of-funding-for-arcelormittal-s-hydrogen-dri-plant
110 European Investment Bank, *"ArcelorMittal and the EIB announce €280 million of funding for research and innovation supporting the steel company's decarbonisation objectives,"* September 27, 2021. Available online: https://www.eib.org/en/press/all/2021-315-arcelormittal-and-the-eib-announce-eur280m-of-funding-for-research-and-innovation-supporting-the-steel-company-s-decarbonisation-objectives
111 ArcelorMittal, *"ArcelorMittal expands partnership with carbon capture and re-use specialist LanzaTech through US$30 million investment,"* December 9, 2021. Available online: https://corporate.arcelormittal.com/media/press-releases/arcelormittal-expands-partnership-with-carbon-capture-and-re-use-specialist-lanzatech-through-us-30-million-investment
112 ArcelorMittal, *"ArcelorMittal Belgium lifts bioreactors into place at its groundbreaking Steelanol plant for carbon-neutral steelmaking,"* April 2021. Available online: https://belgium.arcelormittal.com/en/lifting-bioreactors-steelanol/
113 SSAB, *"HYBRIT– Toward fossil-free steel."* Available online: https://www.ssab.com/company/sustainability/sustainable-operations/hybrit
114 BioEnergy International, *"Swedish Energy Agency awards record funding to HYBRIT,"* June 18, 2018. Available online: https://bioenergyinternational.com/research-development/swedish-energy-agency-awards-record-funding-to-hybrit
115 Intergovernmental Panel on Climate Change (IPCC), *Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development*, 2018. Available online: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf; IPCC, "Global Warming of 1.5°C." Available online: https://www.ipcc.ch/sr15/
116 The National, *"Abu Dhabi starts up world's first commercial steel carbon capture project,"* November 5, 2016. Available online: https://www.thenational.ae/business/abu-dhabi-starts-up-world-sfirst-commercial-steel-carbon-capture-project-1.213295

117 U.S. Office of Management and Budget (OMB), *Historical Tables, Budget of the United States Government, Fiscal Year 2021*, February 10 2020, Available online: https://www.govinfo.gov/content/pkg/BUDGET-2021-TAB/pdf/BUDGET-2021-TAB.pdf

118 Ibid.

119 BGA, *Manufacturing Agenda - A National Blueprint for Clean Technology Manufacturing Leadership and Industrial Transformation*, June 25, 2020. Available online: https://www.bluegreenalliance.org/resources/manufacturing-agenda-a-national-blueprint-for-clean-technology-manufacturing-leadership-and-industrial-transformation/

120 BGA, *Manufacturing Investments to Build Back Better*, November 2021. Available online: https://www.bluegreenalliance.org/wp-content/uploads/2021/10/BGA-MFG-Industrial-Factsheet_FINAL_102121.pdf

121 Political Economy Reserach Center University of Massachusetts Amherst, *Job Creation Estimates Through Proposed Inflation Reduction Act*, 2022. Available online: https://www.bluegreenalliance.org/site/9-million-good-jobs-from-climate-action-the-inflation-reduction-act/

122 The White House, *Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability*, December 8, 2021. Available online: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/12/08/executive-order-on-catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability/

123 The White House, *Federal Sustainability Plan: Catalyzing America's Clean Energy Industries and Jobs*, December 2021. Available online: https://www.sustainability.gov/pdfs/federal-sustainability-plan.pdf

124 The White House, *Fact Sheet: Biden-Harris Administration Advances Cleaner Industrial Sector to Reduce Emissions and Reinvigorate American Manufacturing*, February 15, 2022. Available online: https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/15/fact-sheet-biden-harris-administration-advances-cleaner-industrial-sector-to-reduce-emissions-and-reinvigorate-american-manufacturing/