

A photograph of a steel mill interior. In the background, a large, glowing yellow-orange furnace is visible. In the foreground, a stream of bright orange sparks is falling from a point of contact. The overall lighting is warm and industrial.

# COLD STEEL HOT CLIMATE

THE WORLD'S BIGGEST UNTAPPED  
CLEAN ENERGY OPPORTUNITY



# AMERICA'S BIGGEST UNTAPPED CLEAN ENERGY OPPORTUNITY

## EXECUTIVE SUMMARY

Steel, through its unparalleled strength, durability, and flexibility, brought the United States and the world into the modern age. Our skylines, our roads, our homes, our working lives – so much in our economy has been made possible by this iconic, versatile, and carbon-intensive material. The tremendous economic growth made possible by steel demonstrates how far we will have to go to transform our carbon-driven economy to protect our planet and the well-being of its inhabitants.

We need to keep the world's average temperature from rising beyond 2 degrees Celsius while growing our economy in the United States and around the world. That means we must chart a new course where industries like steel can leverage a new competitive edge by embracing a bold idea: low-carbon products will garner more value in the global marketplace.

The energy use of the industrial sector is staggering, accounting for more than one-third of total final energy use worldwide and 24 percent of CO<sub>2</sub> in 2014.<sup>1</sup> Industrial CO<sub>2</sub> emissions are projected to grow by as much as 45-65 percent by 2050.<sup>2</sup> At the core of much of that industry – in the factories, buildings, vehicles, and other finished products – is steel. In fact, the iron and steel sector is the world's largest industrial source of climate pollution, producing 2.3 gigatons of CO<sub>2</sub> in 2009 – equivalent to the annual emissions of 569 coal-fired power plants.<sup>3,4,5</sup> In 2013, steel represented approximately 5 percent of final

energy use and 7 percent of emissions worldwide.<sup>6</sup> These facts prompt one irrefutable conclusion: to fight climate change, we must stall the growth in global emissions from the iron and steel industry.

Today, most of the steel produced in the United States has two primary inputs: scrap metal and electricity – lots and lots of electricity. In steelmaking regions, many steel plants are often the largest or one of the largest electricity customers. Shifting America and the world to clean energy means shifting the steel industry to clean electricity and carbon neutrality.

One company, Nucor Corporation, produces more crude steel than any other company based in the U.S. The company controls 29 percent of the U.S. steel market, by volume, and produces nearly 9 million metric tons more steel than its next competitor.<sup>7</sup> This dominance puts Nucor in the unique position to lead the industry in cleaning up its carbon footprint by aggressively pursuing the use of clean energy. At the same time, Nucor can drive systemic change in support of clean energy throughout the economy. Nucor's biggest customers, such as Skanska and General Motors, are being urged by customers to deliver sustainable buildings, infrastructure, and cars. A big step in meeting that demand is to address one of Nucor's largest avoidable environmental impacts: the dirty electricity used to produce the steel its customers purchase. This report details both why and how Nucor can lead the steel industry in embracing the clean energy revolution.

A large industrial ladle is being lifted by a crane in a steel mill. The ladle is tilted, and a thick stream of molten metal is being poured out, creating a large spray of bright orange sparks. The background shows the complex structure of the mill with various levels and walkways.

**The Iron and Steel sector is the world's largest industrial source of climate pollution, producing 2.3 gigatons of CO<sub>2</sub> in 2009—equivalent to the annual emissions of 569 coal-fired power plants.**

## STEEL: FORGED IN FIRE & HOT WITH OPPORTUNITY

About 70 percent of global steel production is made using iron ore as a primary raw material, mainly through blast and basic oxygen furnace steelmaking.<sup>8</sup> This process relies primarily on iron ore, limestone, and coke as raw material inputs.<sup>9</sup> Although this process of steelmaking has become much more efficient over time, the intensive burning of coal as a power source and as a feedstock input releases vast amounts of potent greenhouse gases (GHG).

In the United States today, 68 percent of steel is produced using a more energy efficient method: electric arc furnace (EAF) production.<sup>10</sup> EAFs melt primarily recycled steel scrap by running hundreds of millions of volt-amperes of power through a furnace, raising the temperature to nearly 3,300 degrees Fahrenheit and producing hundreds of tons of melt in under an hour.<sup>11</sup> Globally, EAFs make up 30 percent of steel production, but that number

is expected to grow as more scrap metal becomes available and more countries shift towards EAF production.<sup>12,13</sup>

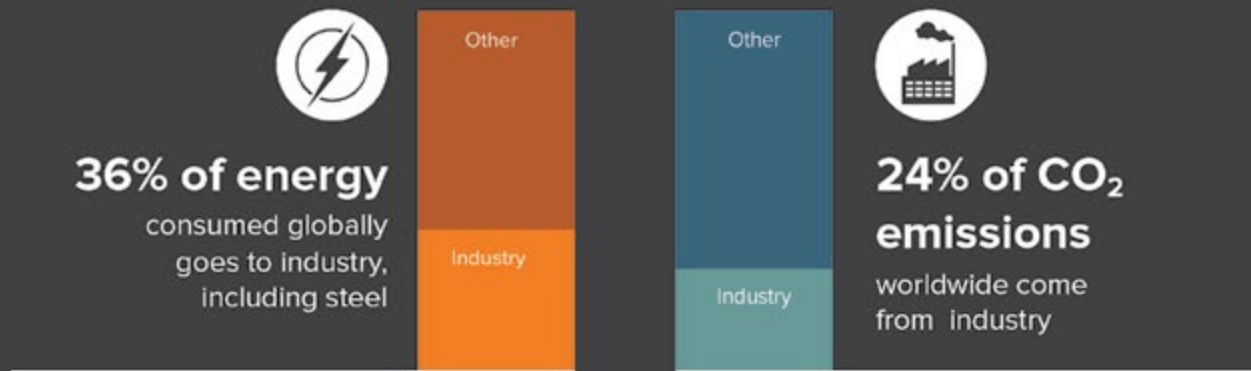
The amount of electricity used for EAF steel production is enormous, and this energy is often sourced from a grid dominated by dirty, climate-damaging energy sources. In 2017, EAFs consumed about 24.5 Terawatt-hours of electricity – roughly equal to the energy use of 2.28 million American homes in a year.<sup>14,15,16</sup> This electricity consumption released 11.1 million metric tons of CO<sub>2</sub> and cost the domestic steel industry \$2.7 billion.<sup>17,18</sup> This electricity has to come from somewhere, and that “somewhere” determines whether EAF steelmaking is part of the problem or part of the solution in the transition to a clean energy economy. The \$2.7 billion spent on electricity at EAFs could be used to support renewable energy instead of harmful and dirty fossil fuels.



Steel mill in Indiana

Photo by Jacob Lemmon

## WORRYING TRENDS: Industrial Energy Usage & Global Warming Pollution



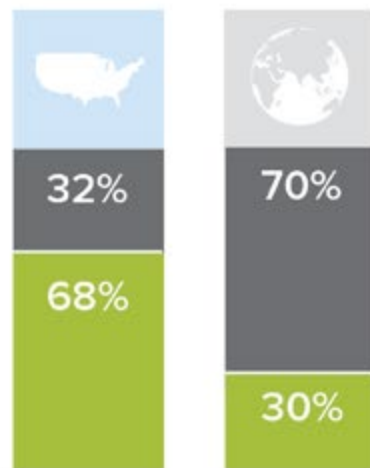
If current trends continue, increases in global industrial energy use will lead to a **45-65% increase in CO<sub>2</sub> pollution**

Source: International Energy Agency



## ELECTRICITY-DEPENDENT STEEL PRODUCTION ON THE RISE

Current steel production by technology, US vs Global

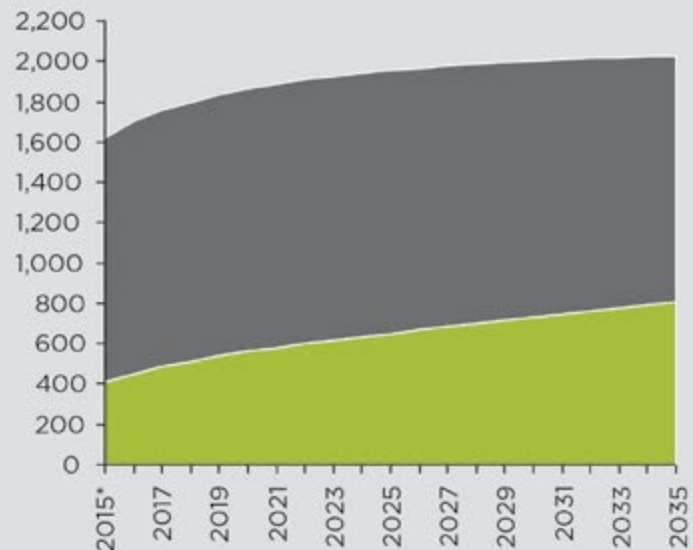


Blast Furnace/  
Basic Oxygen Furnace



Electric Arc  
Furnace

Global Crude Steel production by technology, MT



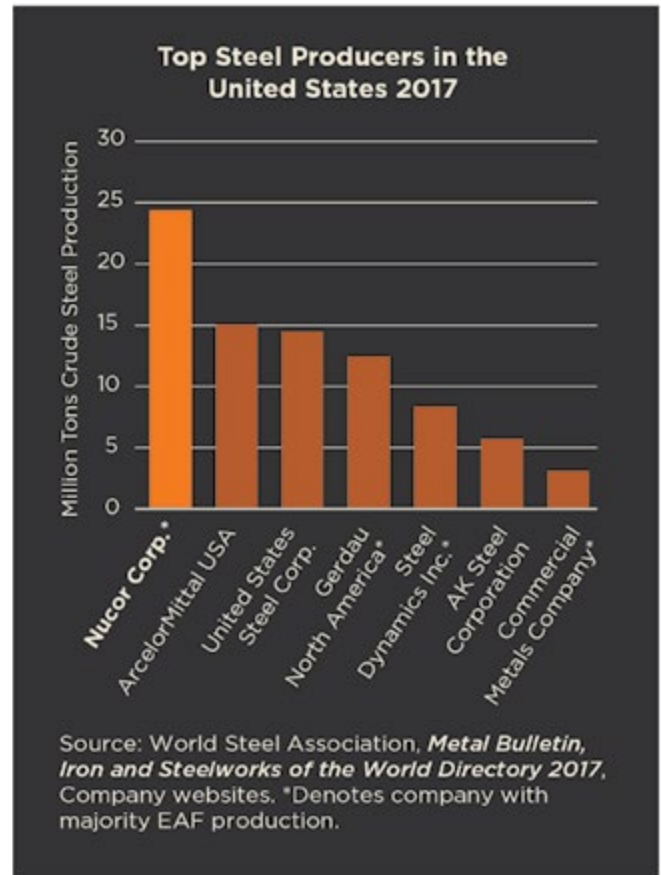
Source: World Steel Association

## THE 25 MILLION TON STEEL GORILLA: NUCOR INC.

There are seven major steel producers based in the United States, but one company, Nucor Corporation, dominates the domestic steel industry. Because Nucor uses EAFs to produce its steel, the company consumes massive amounts of electricity – more than the total usage of either Alaska, Delaware, Washington, DC, Hawaii, Maine, New Hampshire, Rhode Island, or Vermont.<sup>20</sup> As both the largest U.S. steel producer and steel industry electricity consumer, Nucor has the greatest opportunity and the greatest responsibility to lead the steel industry’s transition to clean energy.

Nucor’s reputation as a visionary leader and innovator is core to the company’s identity. In the late 1990s, the company’s rise was featured in Jim Collins’ iconic book, *Good to Great: Why Some Companies Make the Leap...and Others Don’t*. The company set itself apart from the rest of the U.S. steel industry by recycling scrap steel in EAFs and mini-mills, rather than producing primary steel using the integrated process. Nucor is proud to call itself “North America’s largest recycler” and highlights the emissions benefits of employing EAFs, yet the company has not fully embraced clean energy as its next advancement. Two Nucor divisions already power some of their operations with on-site solar panels, but none of Nucor’s EAF facilities have committed to sourcing renewable electricity. In other words, the company’s core steelmaking activities still use carbon-intensive electricity. Nucor’s 2017 Sustainability Report states that the company “looks forward to continuing its investment in solar as the technology continues to evolve,” but Nucor has not yet made a commitment to using solar, or other forms for renewable energy, to satisfy all the company’s enormous electricity needs.<sup>21</sup>

Nucor has not yet made a commitment to reduce its greenhouse gas emissions in the face of climate change. Instead, the company has aligned with climate deniers, opposed climate action, and maintained a disappointing record of environmental and other disclosures, all while investing in fossil fuels. At a



time of plummeting costs for renewable energy and increased global demand for climate action, Nucor is out of step with its biggest customers and is missing opportunities to reduce risk posed by high fossil fuel energy costs. In fact, Nucor is failing to live up to its visionary reputation when it comes to climate, clean energy, and transparency. Some of Nucor’s failures include:

- As a member of the Industrial Energy Consumers of America, Nucor lent its name to efforts to withdraw the United States from the Paris Climate Agreement – even as more than 1,000 other companies publicly declared their support for the U.S. remaining in the groundbreaking international agreement.<sup>22</sup> When IECA did this, other members, such as Corning, resigned their membership, but Nucor remained steadfast.<sup>23,24</sup>

- After Nucor was exposed as one of the 19 public corporations funding The Heartland Institute, former Nucor CEO Dan DiMicco stated that the climate change denial efforts of The Heartland Institute were “entirely appropriate.”<sup>25,26</sup> The Heartland Institute describes itself as “the world’s leading think tank pushing back at climate alarmism.”<sup>27</sup> Nucor’s financial support of climate denial programs contrasts with the stances of its global competitors, such as ArcelorMittal, a company that has been engaged on climate change issues for decades.
- In 2016, A federal judge dismissed a lawsuit by Nucor that “sought to block the Environmental Protection Agency from adopting a plan to control visible pollution in Arkansas.”<sup>28</sup> Nucor was trying to avoid compliance with the Clean Air Act on a technicality: that the EPA had missed a deadline to choose between two enforcement options, either the Arkansas plan or a substitute federal plan. The judge, not fooled by this maneuver, ordered Nucor to comply with the law.
- According to Nucor’s 2017 Security and Exchange Commission 10K filing, the company has a large stake in nearly 54,000 acres of fossil fuel assets in Colorado.<sup>29</sup>
- On a recent scorecard of the 2018 “Combined Toxic 100” polluters listed by the Political Economy Research Institute, Nucor ranked 16th for air pollution and 35th for water pollution.<sup>30</sup>
- In the 2017 Center for Political Accountability-Zicklin Index of Corporate Political Disclosure and Accountability,<sup>31</sup> Nucor ranked just 7.1 out of 100 — a score that the index authors refer to as “solidly in the basement” for accountability, and well below the average for any sector, including materials, energy, and industrials.



**Nucor Steel in Seattle**

Photo by Association of Washington Businesses

## WHY NUCOR'S CUSTOMERS SHOULD BE CONCERNED

Nucor's failure to lead on climate change also poses risk to the interests of their biggest customers: the multi-trillion-dollar global construction industry.<sup>32</sup> Nucor has built its brand around delivering the lowest cost, highest quality recycled steel to its customers. The construction industry uses that steel in projects for its rapidly-growing green building segment.

There is no more important construction firm buying steel from Nucor than Skanska.<sup>33</sup> As a dominant leader in the green building industry, Skanska is a \$18.8 billion dollar publicly traded company with a \$7.5 billion-dollar U.S. market. Skanska has built its brand and revenue growth strategy on a singular vision in the construction industry: a carbon neutral company by 2050 and complete alignment with the Paris Climate Accord goals.<sup>34</sup> As part of its sustainability platform, Skanska aims to source the most sustainable materials possible.

Skanska's demonstrated leadership on climate and the environment is well-established.<sup>35</sup> The company

is perfectly positioned to lead the construction industry on climate action and to demand that steel suppliers, starting with Nucor, step up. If Skanska wants to be carbon neutral by 2050 and get halfway there by 2030, then requiring steel and other materials producers to both transition to clean energy and commit to achieving carbon neutrality is essential to this vision. Skanska should ask Nucor to commit to powering its operations with 100 percent clean electricity and set its sights on a carbon neutral vision for the company's global footprint.

Other end-users of Nucor steel should also be concerned about Nucor's lack of transparency and commitment to climate action. Auto-industry giants, like General Motors<sup>36</sup>, as well as customers for projects that the construction industry builds should start demanding clean energy steel.

Nucor is out of step with its biggest customers and with investors that prioritize climate action.<sup>37</sup> It is past time for Nucor to clean up its act and take responsibility for its impact on the environment, beyond making energy efficiency improvements.

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Skanska, a major client of Nucor, has branded itself as a green building company. Top: The LEED-Platinum Certified Stone34 development in Seattle. Bottom: Indian River Inlet Bridge, Sussex DE.

Photos by Lisa Picard; Lee Cannon



# NUCOR SUPPLY CHAIN: CONSTRUCTION INDUSTRY

Nucor clients & select projects known to use Nucor steel



## Select construction company clients

	Condo Development		 	 i-4 highway extension, Orlando, FL	 Arthur Ravenel Jr. Bridge, SC  Worcester Regional Transit Authority  WEST RIVER FRONT PARK Nashville, TN

Select clients/projects known to have used Nucor Steel

Source: Borealis Centre for Environment and Trade Research. See Appendix for complete list of citations.



Skanska skyscraper at 30 St Mary Axe, London

Photo by Paolo Margari

# NUCOR SUPPLY: AUTOMOTIVE INDUSTRY

Select clients known to use Nucor steel



## Automobiles



Jeep



## Off-road Vehicles & Machinery



Bobcat



WINNING  
COMPANY



NAVISTAR

## Building construction for Auto Industry



HONDA



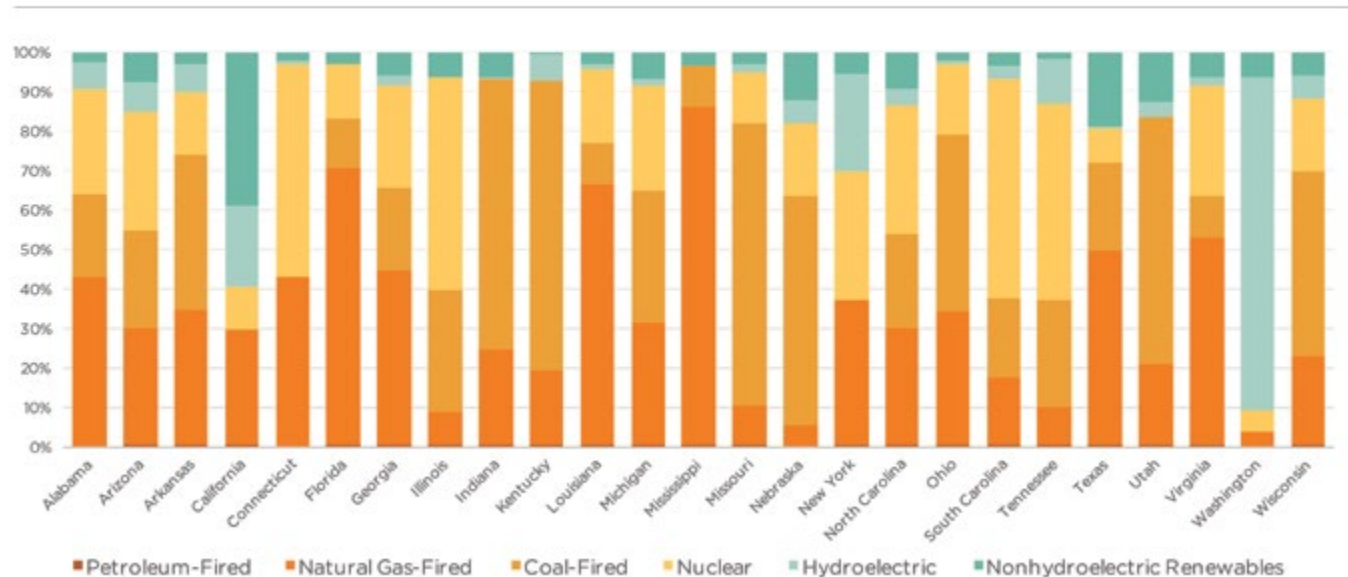
TOYOTA

# THE BILLION DOLLAR RENEWABLE ENERGY OPPORTUNITY: WHAT NUCOR COULD GAIN

Nucor’s EAF production facilities are located in 18 states, where, on average, fossil fuels power 61 percent of the grid. Just one percent is generated using solar, and almost 7 percent is generated using wind.<sup>38</sup> The chart below shows the breakdown of electricity sources in each of the states where Nucor owns and operates facilities. In contrast, the

cost of solar energy has declined 86 percent and the cost of wind power has declined 68 percent since 2009.<sup>39</sup> As a result, wind and solar energy is not just competitive with dirty energy sources, but it’s also cheaper in many parts of the United States. The levelized cost (unit-cost of electricity over a generating asset’s lifetime) of utility-scale

**GRID MIX IN STATES WHERE NUCOR OPERATES**  
Including EAF & Finishing Facilities



Source: U.S. Energy Information Administration (May 2018)

solar and wind rivals the most efficient gas plant as the leastcost resource on a levelized basis before consideration of federal subsidies, which remain available to wind developers through 2019.<sup>40</sup>

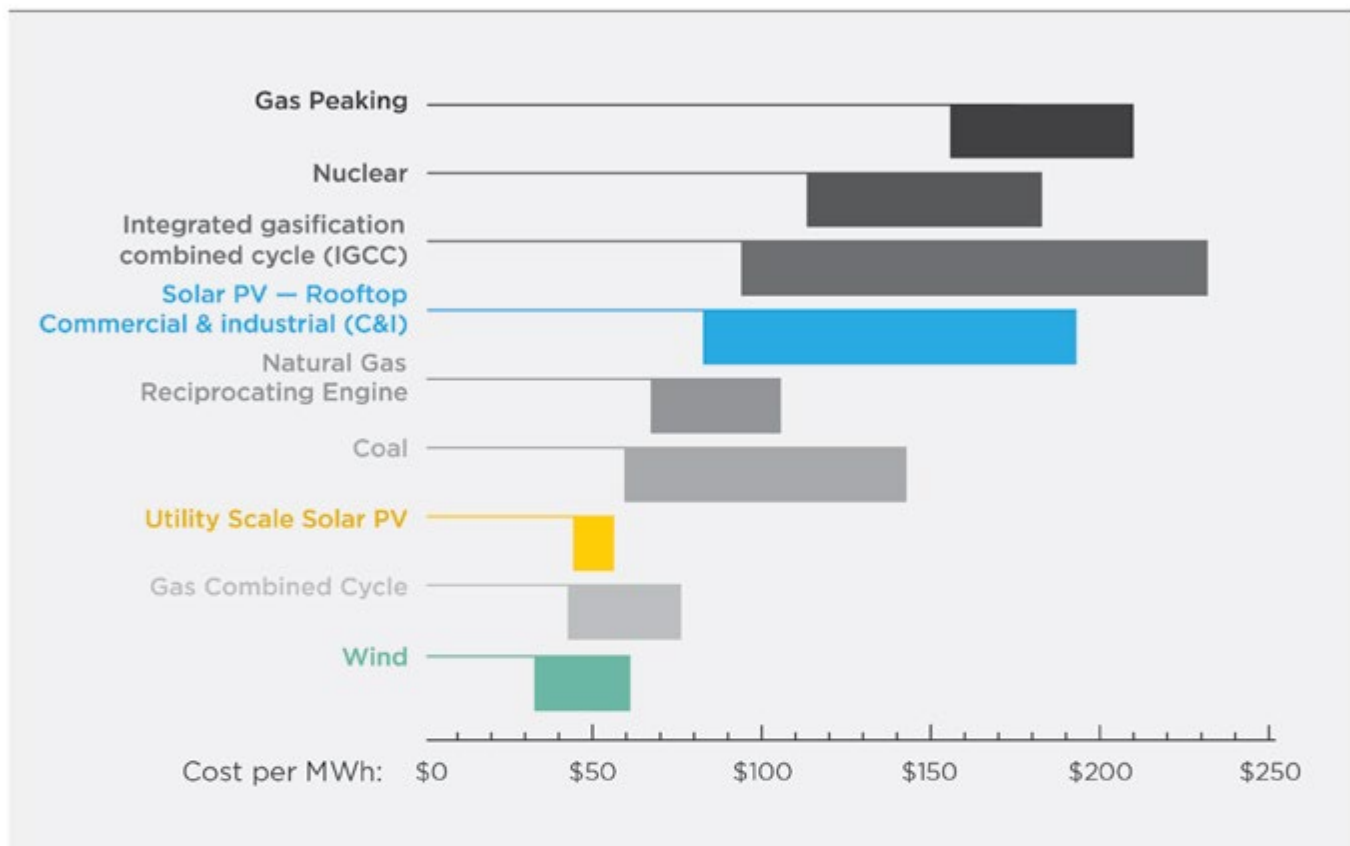
Levelized cost is important, but it is not the whole story. A company that enters a power purchase agreement (contractual agreement to purchase electricity) for solar or wind energy knows what the cost of electricity from that facility will be in the longterm. This is because the developer sells electricity produced by the renewable energy project to the corporate off-taker at a fixed price.

This cost stability is one of the major competitive advantages of large-scale solar and wind projects and the reason why a growing number of companies are committing to renewable energy procurement.

Nucor’s fossil-fuel-based energy costs a lot of money. The company had approximately \$761 million in utility contracts as of 2017,<sup>41</sup> making energy one of the largest contractual obligations on its balance sheet and a determining driver of the total cost of steel production each year. Looking ahead, uncertainty of fossil fuel costs poses a significant risk for the company, as outlined in Nucor’s most recent annual report:

“Another significant uncertainty we face is the cost of energy. The availability and prices of electricity and natural gas are influenced today by many factors, including changes in supply and demand, advances in drilling technology and, increasingly, by changes in public policy relating to energy production and use. Proposed regulation of greenhouse gas emissions from new and refurbished power plants could increase our cost of electricity in future years, particularly if such regulation is adopted in a form that requires deep reductions in greenhouse gas emissions.”<sup>42</sup>

## THE COST OF CLEAN ENERGY CONTINUES TO PLUMMET



Source: Lazard's Levelized Cost of Energy Analysis - Version 11.0



2009-2017

The cost of solar declined **86%**

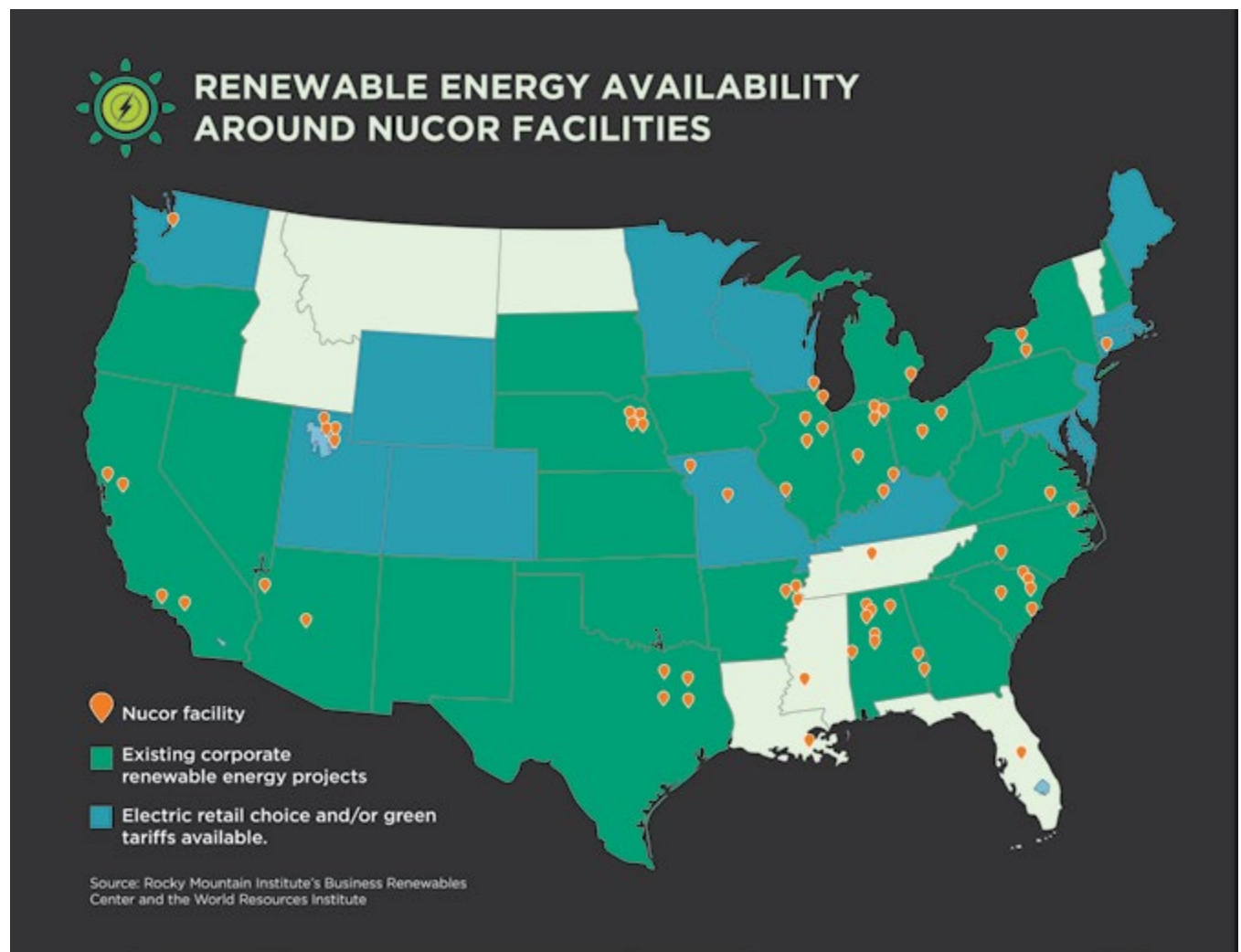
The cost of wind declined **67%**

In fact, the Company has a fiduciary responsibility to protect its shareholders from excessive energy costs and risks. This is likely why the company has a large stake in fossil fuel assets in Colorado, as referenced earlier in this report. By seeking a renewable energy procurement strategy, Nucor could minimize the risks from fossil fuels' cost uncertainty and volatility.

Thanks to the hard work of powerful coalitions of environmentalists, scientists, labor, companies, clean energy industry leaders, and investors, the movement toward a 100 percent clean energy system has unprecedented momentum. More than 100 corporations, including Apple, Facebook, and General Motors, have committed to sourcing 100 percent renewable electricity through the RE100

initiative and through other similar business and renewable energy coalitions. The result has been an explosion in the demand for, and development of, sizeable solar and wind projects. These corporations have benefited from predictable and cheap renewable electricity prices while reducing their GHG emissions.

The next frontier in corporate clean energy procurement is for heavy industrial companies like Nucor to join the effort. In nearly every state where Nucor operates, it has a clean energy procurement option. Where those options need to be created or improved upon, Nucor's considerable lobbying power could make a big difference in creating new electricity procurement solutions that are good for the company and the climate.





## THE GREENING OF THE STEEL INDUSTRY IS UNDERWAY

Globally, there are many examples of companies in the steel industry that are making great strides towards reducing their carbon footprint while gaining a competitive edge in the market. Here are a few examples:

- **EVRAZ Steel in Colorado**

EVRAZ Steel, with a steel mill located in Pueblo, Colorado, is the single biggest customer of Colorado's largest utility, Xcel Energy. In 2018, the two companies signed a deal for 240 MW of solar capacity.<sup>43</sup> This would ensure close proximity to a clean, low-cost energy source, and could guarantee an ultra-low rate for the steel mill in Pueblo to lower their cost of production.

- **Liberty One Steel in Australia**

For the last several years, Liberty One Steel has been teaming up with researchers at the University of New South Wales to commercialize Polymer Injection Technology, which utilizes old tires and other waste to replace some of the other inputs in EAF steelmaking and achieves a 10-20 percent carbon reduction.<sup>44</sup> This "green steel" method is promising because it both utilizes waste and reduces on-site process emissions that switching to renewable electricity cannot address.

- **SSAB in Sweden**

Just this year, Swedish steel-maker SSAB announced a joint venture project that will seek to produce emissions-free steel at scale

by 2040 and will rely on the abundance of renewable electricity available in the region. Pilot technology is already being advanced.<sup>45</sup>

- **Mahindra Group in India**

Based in Mumbai, the Mahindra Group announced earlier this year that its companies Mahindra Sanyo Steel and Tech Mahindra would set science-based GHG emissions targets as part of the conglomerate's larger commitment to leadership on climate change.<sup>46</sup> Science-based targets are a critical part of any company's plan to reduce their greenhouse gas emissions on a scale and timeline that will keep the Earth's warming under 2 degrees Celsius.

- **ArcelorMittal, the #1 Steel Producer in the World**

Headquartered in Luxembourg but with significant production in the United States and around the world, this company has been engaged in policy and technology conversations focused on decarbonizing steel for decades. Because its production is mostly through blast furnace facilities, they have prioritized investment in and development of scalable carbon capture and reuse technology.<sup>47</sup>

In 2018, EVRAZ Steel, the single biggest customer of Xcel Energy in Colorado, signed a deal for 240 MW of solar capacity, ensuring access to a clean, low-cost energy source to lower their cost of production.



Photo by Suwin



Even as the steel industry shifts to clean energy, it will still produce a lot of emissions. Investing in large-scale forest protection is one of the best and lowest-cost approaches to compensating for this remaining pollution.



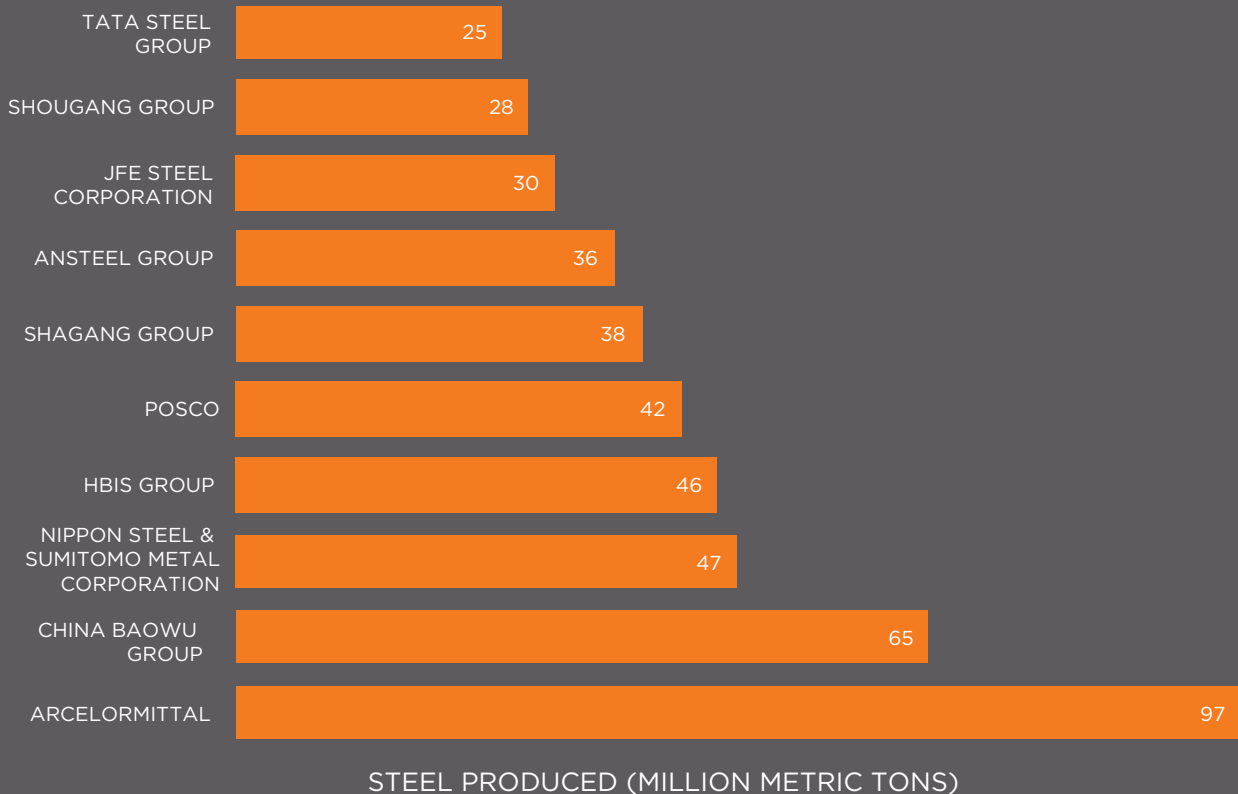
## TOWARD A CARBON NEUTRAL STEEL INDUSTRY

While transitioning to clean energy for all grid-sourced electricity and scaling less carbon intensive production methods are both key to decarbonizing steel, these actions alone will not eliminate all the industry's emissions. Fossil fuels like coal and natural gas will remain essential inputs in steelmaking in the immediate future, and these will always emit carbon pollution. That is why it is essential for the industry to set goals to shift toward carbon neutrality through carbon off-setting and other strategies mentioned in the section above.

Even as the steel industry cleans their electricity and shifts to cleaner methods of production, they still will have a lot of emissions. But they can compensate for 100 percent of this remaining

pollution by investing in other strategies to keep carbon out of the atmosphere. One of the best and lowest-cost approaches is investing in largescale forest protection and restoration. This is being done successfully for an average of \$3 per ton of CO<sub>2</sub>e.<sup>48</sup> Other low-cost ways steel companies can reduce pollution is by investing in methane elimination devices, increasing energy efficiency, and investing in expanded clean energy infrastructure. The global steel industry is worth about \$900 billion dollars and the top ten global steel producers could offset their annual emissions for a total of about \$150 million, or just 0.017 percent of the industry's total value.<sup>49,50</sup> In contrast, climate change has an estimated annual cost of about \$360 billion in the United States alone.<sup>51</sup>

### TOP 10 GLOBAL STEEL PRODUCERS



Source: World Steel Association

## HOW NUCOR COULD LEAD THE WAY

Nucor and other steel companies have both the opportunity and the responsibility to lead by adopting clean energy and taking climate action. With the expected growth in industrial energy use, it is essential that companies like Nucor reduce their carbon footprint if we hope to avoid the worst impacts of long-term climate disruptions. Renewable energy is already cost-effective today, and its costs keep coming down. That may help to explain why so many leading companies have urged that the United States remain in the Paris Climate Accord: they know that clean energy makes good business sense, and they need regulatory certainty to know that all companies (domestic and international) are playing by the same rules.<sup>52</sup> Relying on clean energy and creating lower carbon products reduces risks for companies and better serves shareholders,

employees, customers, and the planet.

If Nucor steps up on this issue, it could reposition itself and American industry more broadly as leaders, ready to do what it takes to remain competitive in an increasingly climate-conscious world. Nucor's leadership is needed to put in place industry standards and eventually policy that could ensure the right incentives to reward low carbon products on a global scale and prevent American emissions being outsourced to Asia and elsewhere through trade.

Mighty Earth is calling on the steel industry and their largest customers like the construction and auto industries to take action. Nucor should lead the way by taking the following steps:

- Set aggressive, science-based greenhouse gas reduction targets in 2019 and challenge their competitors in the industry to do the same.
- Commit to procure 100 percent of the company's electricity from renewable energy by 2030. Additionally, annual progress toward these goals and annual accountability through public disclosures for investors and customers will be essential.
- Set continuous annual energy efficiency goals as part of its science-based targets strategy and include annual progress in public disclosures as well.
- Commit to carbon neutrality for the full scope of its emissions as a way to begin meeting and exceeding science-based targets.
- Provide full transparency about risks that climate change pose for their investors. The company should report on their actions to mitigate these risks each year to remain competitive in an increasingly carbon-constrained global economy
- Provide annual disclosure of where the company's energy is coming from and the effects fossil fuels have in the full scope of their direct and indirect emissions.
- Advocate at the state, national, and international level for clean energy and start working with the clean energy industry and utilities to craft solutions that can help meet their unique needs while greening the grid as fast and responsibly as possible.

- Join Renewable Energy Buyers Alliance, the Climate Group’s RE100 and EP100 and start working with experts like the Rocky Mountain Institute’s Business Renewables Center on developing feasible and affordable renewable energy solutions for steel and other heavy industrial companies on a global scale.
- Work with the Steel Manufacturers Association, American Iron and Steel Institute, World Steel Association and other steel and heavy industrial trade associations to provide guidance on science-based targets and renewable energy procurement.
- Customers like Skanska and GM should ask their steel and other materials suppliers, starting with Nucor, for transparent accounting of the embodied carbon in those materials and begin working with those materials industries on plans to reduce their embodied carbon. These plans should account for where steel is produced and eventually reward producers to continually reduce the embodied carbon of their products.
- Skanska should use its influence in the construction sector to develop new LEED and other construction industry standards to fully account for the embodied carbon used to produce steel and other materials and to guide the transformation of building materials markets.

The case is clear: it is time for the steel industry to step up and lead on climate. As the largest industrial emitter of carbon pollution, the global steel industry not only has the responsibility to act, but also will face the inevitable and inescapable

market pressure to decarbonize. Nucor has the opportunity to lead the steel industry in envisioning its future as a provider of “clean energy steel” and proving that American industry can and will address climate change.



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## APPENDIX

### Supply Chain Infographic References

To provide more thorough references for the data and information uses to create the supply chain infographics that appear in the report, Mighty Earth has compiled a full listing of specific sources referencing the companies represented in the graphics.

#### Construction:

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