

# US and European Energy Security amid Great-Power Competition

COL SHAWN M. WILLIS, USAF  
LT COL ANTHONY P. RIZZUTO, USSF  
DR. SVETLA BEN-ITZHAK

## Abstract

In response to Russia's 2022 invasion of Ukraine, Europe and the United States levied a series of economic sanctions, which prompted Moscow to retaliate by cutting Russia's natural gas supplies to Europe by 80 percent. This crisis not only affected Europe's energy security but also presented a threat to the US due to its close ties with its European allies. As a result, both Europe and the United States are expanding renewable energy sources to fully decouple from Russian energy supplies and reduce greenhouse gas emissions. However, as they increase renewable energy production, they are at risk of becoming dependent on Chinese renewable energy equipment and materials supply chains. This article argues that to prevent energy from being weaponized by Russia or China, the United States and Europe must develop an independent renewable energy market. To achieve this goal, the article proposes specific strategies and measures that the United States and Europe could adopt to create an independent renewable energy market and avoid relying on external sources for their energy needs.

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Energy security is a crucial consideration for all nations, as it has a direct impact on a state's military might, its economic growth, and the well-being of its citizens.<sup>1</sup> The International Energy Agency defines energy security as "the uninterrupted availability of energy sources at an affordable price."<sup>2</sup> Militaries, economies, and individual citizens depend on access to energy, and a state does not have freedom of action when other states control energy access and supply chains.

Europe relied heavily on Russia for meeting its energy demands before the 2022 Russian invasion of Ukraine. In response to economic sanctions imposed by the European Union, United States, and United Kingdom in the aftermath of the invasion,<sup>3</sup> Russia weaponized its energy exports by cutting off natural gas supply

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<sup>1</sup> Li-Chen Sim, "Russia's Impact on US National Interests: Ensuring Energy Security," *Russia Matters*, 10 September 2020, <https://www.russiamatters.org/>.

<sup>2</sup> "Energy Security," International Energy Agency, 2023, <https://www.iea.org/>.

<sup>3</sup> Chad P. Bown, "Russia's war on Ukraine: A sanctions timeline," Peterson Institute for *Realtime Economics* (blog), 14 March 2022, <https://www.piie.com/>.

to Europe by 80 percent, thereby posing a threat to European energy security.<sup>4</sup> Although European countries found alternative energy suppliers, the prices were significantly higher.<sup>5</sup> In March 2022, shortly after the invasion, the United States also banned all imports of Russian oil, liquified natural gas (LNG), and coal.<sup>6</sup> Concurrently, Europe and the United States are increasing their capacity for renewable energy production to eliminate their dependence on Russian energy and reduce greenhouse gas emissions. However, the transition to renewable energy has created a new energy dependence since China controls most renewable energy equipment production and material supply chains.

The 2022 US *National Security Strategy* (NSS) emphasizes that “Europe has been, and will continue to be, our foundational partner in addressing the full range of global challenges.”<sup>7</sup> The close ties between the United States and Europe imply that security issues for European states also pose security challenges for the United States. As a result, ensuring long-term energy independence for both the United States and Europe is crucial. To achieve this goal, the United States and Europe should expedite the expansion of renewable energy-generation capacity and establish autonomous supply chains for vital renewable energy materials and equipment to avoid falling into a new energy dependence trap.

This article examines Europe’s historical dependence on Russian energy and current obstacles Europe faces in decoupling from Russian energy supplies. Additionally, the article presents an overview of current energy policies and long-term goals of both the United States and Europe to accelerate renewable energy growth. The article argues that while the United States and Europe aim to achieve energy security by expanding renewable energy sources, they may inadvertently become dependent on China, which currently controls most renewable energy materials and supply chains. To avoid such dependence, the article recommends specific policy solutions to ensure long-term energy independence for the United States and Europe.

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<sup>4</sup> Sam Meredith, “Russia has cut off gas supplies to Europe indefinitely. Here’s what you need to know,” *CNBC*, 6 September 2022, <https://www.cnn.com/>.

<sup>5</sup> Stanley Reed, “Why Europe’s Electricity Prices Are Soaring,” *New York Times*, 25 August, 2022, <https://www.nytimes.com/>.

<sup>6</sup> “United States Bans Imports of Russian Oil, Liquefied Natural Gas, and Coal” (fact sheet: White House, Washington, DC, 8 March 2022), <https://www.whitehouse.gov/>.

<sup>7</sup> *National Security Strategy* (Washington, DC: White House, October 2022), 38.

## **How Europe Became Addicted to Russian Oil and Subsequent Fallout**

Russia held a considerable economic influence over Europe prior to the 2022 invasion of Ukraine, as it accounted for approximately 33 percent of Europe's natural gas imports.<sup>8</sup> Certain European countries were particularly reliant on Russian gas. Poland, Finland, Slovakia, and Germany, which boasts the largest economy in Europe and significant fossil fuel consumption, imported a substantial portion of their gas exclusively from Russia.<sup>9</sup> Furthermore, Germany and Russia were on the verge of completing a second direct natural gas pipeline in 2022, which would have increased German gas imports from Russia to about 60 percent.<sup>10</sup> These Russian pipelines were strategically designed to export Russian oil to multiple European countries, granting Russia the capability to manipulate the flow of oil.<sup>11</sup> Given this setup, Moscow would have had the ability to curtail its supply of natural gas, leading to severe gas shortages, rationing, and industrial shutdowns, consequently inflicting significant economic damage.<sup>12</sup>

In February 2022, Russia invaded Ukraine, prompting many European countries to impose sanctions against Russia. In December 2022, the European Union and United Kingdom implemented a ban on Russian crude oil imports by sea, resulting in the elimination of approximately 90 percent of Russian oil imports.<sup>13</sup> Subsequently, in February 2023, the European Union further prohibited the importation of all refined products derived from Russian oil, including jet fuel, gasoline, and diesel.<sup>14</sup>

To compensate for a reduction in Russian oil imports and to reduce their energy dependence, European countries swiftly sought alternative energy sources.<sup>15</sup> However, each country possessed a distinct power infrastructure mix, leading to varying

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<sup>8</sup> Reed, "Why Europe's Electricity Prices Are Soaring."

<sup>9</sup> Somesh Jha, "Which European nations are handling the energy crisis best?," *Al-Jazeera*, 20 December 2022, <https://www.aljazeera.com/>; and Christiane Lemke and Helga A. Welsh, *Germany Today: Politics and Policies in a Changing World* (Lanham, MD: Rowman and Littlefield, 2018), 149.

<sup>10</sup> James Kirchick, *The End of Europe: Distactors, Demagogues, and the Coming Dark Age* (New Haven, CT: Yale University Press, 2017), 90.

<sup>11</sup> Kirchick, *The End of Europe*, 88.

<sup>12</sup> "Energy crisis poses threat to Europe's industrial sector," United Nations, 2 December 2022, <https://www.un.org/>.

<sup>13</sup> Julia Horowitz, "The West just scrambled the oil market. What happens next is up to Russia," *CNN Business*, 5 December 2022, <https://www.cnn.com/>.

<sup>14</sup> Ayesha Rascoe and Jackie Northam, "The EU is cutting off imports of Russian oil products," *NPR*, 5 February 2023, <https://www.npr.org/>.

<sup>15</sup> Laurenz Gehrke, "Germany to Upgrade Two Ports 'Quickly' to Receive Shipped Gas," *Politico*, 27 February 2022, <https://www.politico.eu/>.

capabilities to respond and mitigate the loss of Russian energy.<sup>16</sup> For instance, France heavily relies on nuclear power, but due to maintenance-related shutdowns of several nuclear power plants, it was unable to meet the energy demand.<sup>17</sup> Germany—despite being the world’s third-leading country in renewable energy investment—lacked a robust renewable energy infrastructure that could adequately respond to surges in demand. While wind power constitutes a significant portion of Germany’s renewable energy sources, it is subject to natural forces and cannot be easily or automatically increased. In fact, European wind farms experienced lower wind levels in 2022 than anticipated, exacerbating the energy shortfall even before the onset of the energy crisis.<sup>18</sup> As a result, Germany’s primary non-green-energy alternative, coal, could be utilized to meet the increased demand, but factors like low river water levels hindered the prompt startup and resupply of coal plants.<sup>19</sup>

In the absence of sufficient energy alternatives within Europe, European countries resorted to foreign LNG suppliers as a substitute for the Russian natural gas they previously relied upon. However, their efforts were uncoordinated, leading to several challenges. The lack of a centralized energy market,<sup>20</sup> the increased costs associated with processing and transporting LNG compared to piped natural gas,<sup>21</sup> and varying energy pricing policies across EU countries contributed to a significant rise in overall energy expenses for consumers.<sup>22</sup>

While the decoupling of European countries from Russian gas triggered the 2022 energy crisis, several factors exacerbated the problem. These factors included the inability of renewable energy sources to scale up and meet the surge in demand, the absence of an interconnected LNG infrastructure across Europe,<sup>23</sup> challenges related to LNG shipping,<sup>24</sup> pressure on Europe to secure LNG for winter stockpiling,<sup>25</sup> the lack of a centralized energy market within the European

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<sup>16</sup> Todd Gillespie, “Plunge in Wind Power Is Next Big Test for European Power Market,” *Bloomberg News*, 8 December 2022, <https://www.bloomberg.com/>.

<sup>17</sup> Jeromin Zettelmeyer, Simone Tagliapietra, Geor Zachman, and Conall Heussaff, “Beating the European Energy Crisis,” International Monetary Fund Finance and Development, December 2022, <https://www.imf.org/>.

<sup>18</sup> Gillespie, “Plunge in Wind Power Is Next Big Test.” »

<sup>19</sup> Reed, “Why Europe’s Electricity Prices Are Soaring.”

<sup>20</sup> Lemke and Welsh, *Germany Today*, 155.

<sup>21</sup> “Why Nord Stream 2 is the world’s most controversial energy project; The Economist explains,” *The Economist*, 15 July 2021, <https://www.economist.com/>.

<sup>22</sup> Yana Popkostova, “Europe’s Energy Crisis Conundrum,” European Union Institute for Security Studies, 28 January 2022, <https://www.iss.europa.eu/>.

<sup>23</sup> Jha, “Which European nations are handling the energy crisis best?”

<sup>24</sup> Popkostova, “Europe’s Energy Crisis Conundrum.”

<sup>25</sup> Reed, “Why Europe’s Electricity Prices Are Soaring.”

Union, pricing policies linking electricity costs to fossil fuels prices,<sup>26</sup> and heightened global demand in the summer of 2022 following the relaxation of COVID-related restrictions.<sup>27</sup> As a result, the cost of natural gas in Europe reached an unprecedented peak in 2022, with prices ten times higher than the previous year.<sup>28</sup> Gas prices remain elevated in 2023, and if this trend persists, the International Monetary Fund estimates that European governments will need to allocate nearly 6 percent of their annual gross domestic product to mitigate energy costs.<sup>29</sup>

The energy crisis that unfolded in the aftermath of the Russian invasion of Ukraine and Europe's efforts to reduce its dependence on Russian gas imports underscores the complex balance between three key objectives in the European energy sector: (1) eradicating reliance on strategic competitors, such as Russia, who can exploit energy exports as a weapon, (2) ensuring affordable domestic energy supply, and (3) transitioning toward green energy to combat climate change.<sup>30</sup> The shift toward renewable energy sources not only reduces dependence on Russian energy but also contributes to greenhouse gas emission reduction. Moreover, renewable energy has the potential to lower consumer energy costs. According to the International Energy Agency, increased investments toward achieving net-zero emissions would result in lower average household energy costs in advanced economies by 2030 and 2050 compared to current levels.<sup>31</sup>

However, it is crucial to acknowledge that further development is required, as the renewable energy infrastructure in 2022 was inadequate to fully replace the energy previously supplied by Russian gas. The subsequent section explores the progress made by Europe and the United States in this regard, while also highlighting the remaining challenges that must be addressed.

### **Current EU and US Energy Policies**

Following the cessation of Russian gas imports by several countries in 2022, the European Union undertook various measures to mitigate energy costs. These included improving the interconnectivity of continental electrical grids to facilitate power sharing, pursuing multilateral LNG procurement contracts, revising EU energy market regulations to mitigate the impact of surge pricing, and exploring

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<sup>26</sup> Reed, "Why Europe's Electricity Prices Are Soaring."

<sup>27</sup> Popkostova, "Europe's Energy Crisis Conundrum."

<sup>28</sup> Reed, "Why Europe's Electricity Prices Are Soaring."

<sup>29</sup> Zettelmeyer, at al., , "Beating the European Energy Crisis."

<sup>30</sup> Zettelmeyer, at al., , "Beating the European Energy Crisis."

<sup>31</sup> "Prices and affordability," International Energy Association, 2021, <https://www.iea.org/>.

the possibility of establishing a unified energy market across the European Union.<sup>32</sup> In September 2022, EU member states reached an agreement to initiate energy consumption reduction efforts, impose revenue limits on electricity providers benefiting from high energy prices, collect financial contributions from fossil fuel providers, and provide direct monetary support to small- and medium-sized businesses to alleviate energy expenses.<sup>33</sup> In December 2022, the EU members also implemented policies to coordinate gas purchases, facilitate gas exchanges across international borders, and establish a common set of rules to regulate energy prices.<sup>34</sup>

Concurrently, the United States and European Union established a joint Task Force on Energy Security aimed at ensuring a stable supply of LNG from the United States to Europe and expediting the transition toward clean, renewable energy sources.<sup>35</sup> Consequently, the US increased LNG exports to Europe by 141 percent in 2022 compared to the previous year.<sup>36</sup> However, apart from bolstering LNG supply to Europe, the US has yet to implement specific policies to support the EU's energy initiatives adopted in September and December 2022 (as discussed above). Currently, there exists an opportunity for the US to actively assist the EU in its energy initiatives, thereby enhancing EU energy independence, further reducing reliance on Russia, and strengthening US-European ties in line with the 2022 US *National Security Strategy (NSS)*.

## **Renewables: Key to Energy Independence or to New Dependence on China?**

Increased collaborative investments in renewable energy between the United States and Europe hold the potential to completely eliminate long-term energy dependence on Russia. The growth of clean and renewable wind and solar

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<sup>32</sup> Conall Heussaf, et al., "An assessment of Europe's Options to Reduce Energy Prices," *Policy Contribution* 17/22, September 2022, 13 <https://www.bruegel.org/>; and Popkostova, "Europe's Energy Crisis Conundrum."

<sup>33</sup> Zettermeyer, et al., "Beating the European Energy Crisis."

<sup>34</sup> "EU Energy Platform: Work advances on joint gas purchasing after legal proposal is agreed by Energy Ministers" (press release, European Commission, Brussels, 20 December 2022), <https://ec.europa.eu/>.

<sup>35</sup> "Joint Statement between the United States and the European Commission on European Energy Security" (press release, White House, Washington, DC, 25 March 2022), <https://www.whitehouse.gov/>.

<sup>36</sup> Victoria Zaretskaya, "Europe was the main destination for U.S. LNG exports in 2022," *Today in Energy*, 22 March 2023, <https://www.eia.gov/>.

energy has surpassed initial capacity projections and is expected to continue its upward trajectory.<sup>37</sup>

For instance, initial estimates in 2006 predicted that global solar photovoltaic energy would generate around 85 gigawatts in 2030. However, thanks to significant cost reductions and technological advancements, it is now anticipated that solar power will generate over 2,500 gigawatts of energy in 2030, surpassing the initial projections by 30 times. To put this into perspective, one gigawatt can power approximately 750,000 homes.<sup>38</sup> Similarly, wind capacity has also exceeded expectations. In 2006, it was projected that wind power would generate 400 gigawatts by 2030. However, the current estimates have increased fourfold, with the expected wind capacity reaching 1,600 gigawatts in 2030.<sup>39</sup> If these trends persist, nearly 60 percent of the world's electricity will come from renewable sources by 2035.<sup>40</sup> Embracing renewable energy aligns with the climate objectives of the United States and Europe to reduce greenhouse gas emissions.<sup>41</sup>

In 2022, President Joe Biden signed into law the Inflation Reduction Act, marking the most significant action taken by the US Congress to date in advancing clean energy development and combating climate change. This legislation allocated USD 370 billion for investments to “lower energy costs for families and small businesses, accelerate private investment in clean energy solutions in every sector of the economy and every corner of the country, strengthen supply chains for everything from critical minerals to efficient electric appliances, and create good-paying jobs and new economic opportunities for workers.”<sup>42</sup>

To ensure energy security for the United States and Europe, it is crucial for the Washington to engage in collaborative efforts with European countries as part of their renewable energy initiatives. However, the establishment and maintenance of renewable energy infrastructure often entail reliance on other nations for the pro-

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<sup>37</sup> McKinsey & Company, “Global Energy Perspective, 2022,” 26 April 2022. <https://www.mckinsey.com/>.

<sup>38</sup> AJ Dellinger, “Gigawatt: The solar energy term you should know about,” *CNET*, 16 November 2021, <https://www.cnet.com/>.

<sup>39</sup> Florian Heineke et al., “Renewable-energy development in a net-zero world,” McKinsey & Company, 28 October 2022, <https://www.mckinsey.com/>.

<sup>40</sup> “Global Energy Perspective 2022,” McKinsey & Company, 26 April 2022, <https://www.mckinsey.com/>.

<sup>41</sup> *The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050* (Washington, DC: US Department of State and the US Executive Office of the President, November 2021), 5–6, <https://www.whitehouse.gov/>; and “2030 Climate Target Plan,” European Commission, 2023, <https://climate.ec.europa.eu/>.

<sup>42</sup> *Inflation Reduction Act Guidebook* (Washington, DC: White House, 2022).

curement of necessary components and technologies.<sup>43</sup> In this context, China's dominance in critical renewable energy technologies, such as solar panel production and high-strength magnets for wind turbines, as well as control over critical material supply chains, grants Beijing significant influence over the growth of the renewable energy market. This presents the risk that as Europe endeavors to reduce its energy dependence on Russia by transitioning to renewable energy sources, it may inadvertently become reliant on China. Similarly, the United States faces the same challenge as it seeks to expand its renewable energy production.

### **Policy Recommendations on How to Achieve Energy Security**

To achieve energy independence, this article proposes several recommendations for the United States and its European allies to regain control over critical supply chains for renewable energy materials and production. These recommendations include:

1. **Reinvigorating domestic solar panel production:** The United States and Europe should prioritize the revitalization of domestic manufacturing capabilities for solar panels. By boosting domestic production, they can reduce reliance on foreign suppliers and ensure a stable and secure supply of solar panels.
2. **Establishing domestic supply chains for critical renewable energy materials:** Efforts should be made to establish domestic supply chains for critical materials used in renewable energy technologies. This would involve developing domestic sources or diversifying supply from reliable partners to reduce dependency on a single country, such as China.
3. **Expanding slower-growth renewable sources:** While wind and solar energy are growing rapidly, other slower-growth renewable sources should also be considered. This diversification can help mitigate risks and ensure a more balanced energy mix. Technologies like geothermal, biomass, and hydropower should be further explored and expanded.
4. **Increasing research investments to improve renewable energy technologies:** It is essential to invest in research and development to enhance the efficiency, cost-effectiveness, and scalability of renewable energy technologies. By fostering innovation, the United States and Europe can accelerate the transition to cleaner energy sources and strengthen their competitive edge in the global renewable energy market.

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<sup>43</sup> Li-Chen Sim, "Russia's Impact on US National Interests: Ensuring Energy Security," *Russia Matters*, 10 September 2020, <https://www.russiamatters.org/>.

By implementing these recommendations, the United States and Europe can regain control over critical supply chains, reduce dependence on external sources, and achieve greater energy independence in the realm of renewable energy.

### ***The United States and Europe Must Reinvigorate Domestic Solar Panel Production***

By the end of 2021, China had established a dominant position in the global solar panel industry. More than 80 percent of solar cells and assembled solar panels were manufactured in China, and they produced nearly all the photovoltaic wafers used in solar panels.<sup>44</sup> The International Energy Agency highlights China's control over nearly every aspect of the raw materials and supply chain.<sup>45</sup> China holds more than 75 percent of polysilicon production, a critical material in current solar panel technology. This is in contrast to the past when polysilicon production was more evenly distributed among the United States, Europe, South Korea, Japan, and China in 2010.<sup>46</sup> However, by 2021, North America's share in the solar panel supply chain had diminished to just 2.8 percent, indicating a significant shift in global dynamics.<sup>47</sup>

While the US solar energy industry experienced substantial growth in 2021, its ability to sustain this expansion is uncertain due to its heavy reliance on equipment from foreign sources. To address this issue, the 2022 Inflation Reduction Act allocated USD 425 million for clean energy initiatives, offering the potential to revitalize a domestic solar supply chain.<sup>48</sup> Nevertheless, the clean energy initiative faces resistance from sectors tied to traditional industries such as US oil and gas production, as demonstrated by the introduction of a bill in Wyoming to phase out the sale of electric vehicles by 2035.<sup>49</sup> Such protectionist arguments have serious implications for US energy security.

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<sup>44</sup> "Special Report on Solar PV Global Supply Chains," International Energy Agency, July 2022, 7, <https://iea.blob.core.windows.net/>.

<sup>45</sup> "Solar PV Global Supply Chains Executive Summary," International Energy Agency, July 2022, <https://www.iea.org/>.

<sup>46</sup> Matt Blois, "The US solar industry has a supply problem," *Chemical and Engineering News* 100, no. 33 (18 September 2022), <https://cen.acs.org/>.

<sup>47</sup> Michelle Davis et al., "Solar Market Insight Report 2021 Q4," Solar Energy Industries Association, 14 December, 2021, <https://www.seia.org/>.

<sup>48</sup> "Biden-Harris Administration Announces \$425 Million to Expand State Clean Energy Programs," US Department of Energy, 26 August 2022, <https://www.energy.gov/>.

<sup>49</sup> "SJ0004 - Phasing out new electric vehicle sales by 2035," State of Wyoming Legislature, 2023, <https://wyoleg.gov/>.

Despite being a net energy exporter since 2019,<sup>50</sup> the United States cannot indefinitely rely on fossil fuels as global reserves of oil, natural gas, and coal are projected to be exhausted the next few decades.<sup>51</sup> To ensure energy security, the United States must expand domestic renewable energy sources before fossil fuel supplies are exhausted. China has positioned itself as a leader in the renewable energy sector, and now it is crucial for the United States and Europe to develop their own capabilities and reduce dependence on China for building their renewable energy infrastructure.

### ***The United States and Europe Must Establish Domestic Supply Chains for Critical Renewable Energy Materials***

China currently holds a dominant position in the global supply of key materials such as rare earth elements (REE), polysilicon, and lithium, which are vital for wind, solar, and battery technologies. Researchers indicated that China controls approximately 60 percent of global REE production<sup>52</sup> and 85 percent of global refined REE supply.<sup>53</sup> Such a large share of REE production and supply gives significant pricing power and influence of the global supply to Beijing's central planners, potentially impacting up to USD 1 trillion of trade.<sup>54</sup> An illustrative example of China's influence occurred in 2010 when it imposed an export ban on REE to Japan following a maritime incident near the Senkaku Islands, leading to a global surge in REE prices. The price of dysprosium oxide, a crucial material used in turbine magnets, experienced a staggering 1,500 percent increase.<sup>55</sup>

By leveraging its control of REE and other key material supply chains, China has positioned itself as the market leader in essential components for renewable energy technologies that rely on these materials. For example, China controls 90 percent of the rare earth magnet supply. This dominance extends to the specific

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<sup>50</sup> "U.S. energy facts explained," US Energy Information Administration, 10 June 2022, <https://www.eia.gov/>.

<sup>51</sup> Hannah Ritchie, Max Roser, and Pablo Rosado, "Years of fossil fuel reserves left," *Our World in Data*, 2020, <https://ourworldindata.org/>.

<sup>52</sup> Michelle Michot Foss and Jacob Koelsch, "Of Chinese Behemoths: What China's Rare Earths Dominance Means for the US," Rice University's Baker Institute for Public Policy, 19 December 2022, <https://www.bakerinstitute.org/>.

<sup>53</sup> Ross Embleton and David Merriman, "Rare earth elements: frequently asked questions," Wood Mackenzie, 1 October 2022, <https://www.woodmac.com/>.

<sup>54</sup> Foss and Koelsch, "Of Chinese Behemoths."

<sup>55</sup> "China's Maritime Disputes," Council on Foreign Relations, 2023, <https://www.cfr.org/>; Jan Dodd, "Rethinking the use of rare-earth elements," *Windpower Monthly*, 30 November 2018, <https://www.windpowermonthly.com/>; and Foss and Koelsch, "Of Chinese Behemoths."

magnets required for manufacturing electric vehicle motors and wind turbines.<sup>56</sup> The significance of REE extends beyond energy production and affects multiple US and European security technologies. For example, each F-35 stealth fighter contains 920 pounds of REE.<sup>57</sup> Consequently, China's control over REE not only poses a threat to the expansion of wind energy and electric vehicles in the United States but also raises concerns regarding the security of US defense production.

Similarly, China currently controls approximately 60 percent of the global lithium chemical supply<sup>58</sup> and produces about 75 percent of all lithium batteries.<sup>59</sup> These batteries are extensively used in the electric vehicle industry and play a crucial role in the transition to renewable energy for the United States and Europe. To mitigate China's dominance in REE and other critical materials, it is imperative for the United States to reestablish a domestic supply and processing chain for REE and to collaborate with European allies to develop domestic capabilities for other critical materials like lithium.

The United States has taken the first steps toward rebuilding US material supply chains. In March 2021, the US Department of Energy announced a USD 30 million plan aimed at securing domestic supply chains for REE, lithium, cobalt, and other materials.<sup>60</sup> Sustained and deliberate focus is vital to ensure each link in the supply chain is not reliant on China. An example highlighting the need for caution is MP Materials' Mountain Pass mine in California, which is the sole US REE mining and processing facility. It is worth noting that this facility is nearly 10-percent owned by the Chinese company Shenghe Resources,<sup>61</sup> and more than 94 percent of MP Materials' total revenue for the first three quarters of 2022 came from sales to Shenghe.<sup>62</sup> Without complete control over the supply chain between the United States and its European partners, Beijing will retain coercive power over the United States and Europe.

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<sup>56</sup> Eric Onstad, "China frictions steer electric automakers away from rare earth magnets," *Reuters*, 19 July 2021, <https://www.reuters.com/>.

<sup>57</sup> Science History Institute, "The Case of Rare Earth Elements," *Science Matters*, 2020, <https://www.sciencehistory.org/>.

<sup>58</sup> "World Energy Outlook 2022," International Energy Agency, November 2022, 113, <https://iea.blob.core.windows.net/>.

<sup>59</sup> "Global Supply Chains of EV Batteries," International Energy Agency, July 2022, <https://iea.blob.core.windows.net/>.

<sup>60</sup> Samantha Subin, "The new U.S. plan to rival China and end cornering of market in rare earth metals," *CNBC*, 17 April 2021, <https://www.cnbc.com/>.

<sup>61</sup> Mary Hui, "The West is rebuilding its rare earths supply chain—but China still looms large," *Quartz*, 25 November 2022, <https://qz.com/>.

<sup>62</sup> Mary Hui, "A US rare earths miner is staging a comeback to take on China," *Quartz*, 16 November 2020, <https://qz.com/>.

## ***The United States and Europe Must Expand Slower-Growth Renewable Energy Sources***

Other renewable energy sources—including hydroelectric, biofuels, and geothermal—play significant roles in the shift toward renewable energy, although their growth rates may be slower compared to solar and wind. In 2021, hydroelectric power accounted for more than 60 percent of the world’s renewable energy supply.<sup>63</sup> However, projections indicate a 23-percent decrease in net capacity additions between 2021 and 2030, primarily due to fewer hydroelectric projects in China, Latin America, and Europe.<sup>64</sup> Nevertheless, the US Department of Energy’s Wind and Water Power Technologies Office conducted an analysis suggesting that US hydropower could increase by nearly 50 gigawatts of combined electricity generation and storage capacity by 2050.<sup>65</sup>

Biofuels offer an alternative approach to reduce dependence on fossil fuels. In 2021, the United States produced approximately 15 billion gallons of ethanol and 2.5 billion gallons of biodiesel/renewable diesel.<sup>66</sup> While biofuels offer many advantages, further studies are necessary to determine the environmental impact of factors such as water resource strain resulting from biomass growth, deforestation, and potential food shortages caused by displacing food crops for biomass crops.<sup>67</sup>

Geothermal energy, which harnesses heated steam from the Earth to generate electricity, represents another renewable energy source with significant potential for enhancing energy independence and security in the United States and Europe. In 2019, geothermal power capacity reached around 3.7 gigawatts. However, the US National Renewable Energy Laboratory’s 2021 geothermal market report concluded that geothermal power capacity could potentially reach 60 gigawatts by 2050.<sup>68</sup>

The optimal path to renewable energy production for the United States and Europe involves a diverse mix of all renewable energy sources. This approach ensures a resilient infrastructure that is not solely reliant on a single energy source. While solar and wind energy have experienced substantial growth in recent years, other

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<sup>63</sup> Hannah Ritchie, Max Roser, and Pablo Rosado, “Renewable Energy,” *Our World in Data*, 2021, <https://ourworldindata.org/>.

<sup>64</sup> “Hydropower,” International Energy Agency, 2023, <https://www.iea.org/>.

<sup>65</sup> Water Power Technologies Office, “A New Vision for United States Hydropower,” US Department of Energy, n.d., <https://www.energy.gov/>.

<sup>66</sup> “U.S. Bioenergy Statistics,” US Department of Agriculture, 19 January 2023, <https://www.ers.usda.gov/>.

<sup>67</sup> “16 Important Pros and Cons of Biofuels to Know,” *Our Endangered World*, 5 February, 2023, <https://www.ourendangeredworld.com/>.

<sup>68</sup> “NREL 2021 U.S. Geothermal Market Report Released,” US Department of Energy, 13 July 2021, <https://www.energy.gov/>.

sources have the potential to increase the overall energy-generation capacity beyond that of solar and wind alone. Therefore, increased investment in proven hydroelectric, biofuel, and geothermal energy generation can prove reliable and economically viable.

### ***The United States and Europe Must Increase Renewable Energy Technology Research***

Progress in renewable energy research is continuously advancing, leading to improvements in efficiency, cost-effectiveness, and reliability. However, simply regaining market share in existing renewable energy technologies is insufficient. The United States and Europe must also spearhead the development of the next generation of renewable energy production.

Exciting advancements in solar cell technology offer promising prospects for reducing the cost and energy requirements of traditional solar cells.<sup>69</sup> Ongoing research is exploring alternative materials to REE<sup>70</sup> and other critical materials such as lithium,<sup>71</sup> which could potentially reshape the renewable energy supply chain.

Moreover, there are wind energy technologies available that do not rely on materials and magnets controlled by China. For example, induction generator wind turbines do not use permanent magnets and, therefore, do not require REE. However, transitioning away from REE-based permanent magnets does have certain trade-offs. Permanent magnet generators offer higher efficiency and energy-generating capacity compared to induction generator turbines, and they require less maintenance.<sup>72</sup> As alternative solutions are developed, it is crucial for the United States and Europe to establish domestic production capabilities and supply chains to maintain control over their energy security.

## **Conclusion**

In conclusion, the energy crisis caused by Russia's natural gas export cuts in 2022 highlighted Europe's heavy dependence on Russian fossil fuels. To address this

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<sup>69</sup> David L. Chandler, "Explained: Why perovskites could take solar cells to new heights," *MIT News*, 15 July, 2022, <https://news.mit.edu/>.

<sup>70</sup> Tanner Stening, "Researchers may have just solved the rare earths crisis," Northeastern University, 17 October 2022, <https://news.northeastern.edu/>.

<sup>71</sup> "Sodium-based Material Yields Stable Alternative to Lithium-ion Batteries," *UT News*, 6 December, 2021, <https://news.utexas.edu/>.

<sup>72</sup> Paul Dvorak, "The big generator debate: Permanent magnet designs versus double-fed induction versions," *Windpower Engineering & Development*, 15 June 2014, <https://www.windpowerengineering.com/>.

vulnerability, European countries, with assistance from the United States, initiated efforts to reduce their reliance on Russian energy sources. However, these measures have been costly and have not provided long-term solutions. Europe and the United States are now focused on expanding their renewable energy capacities to achieve sustainable energy independence. Nevertheless, they face challenges due to China's dominant position in renewable energy equipment production and critical material supply chains.

This article emphasized the importance of energy security for Europe and the US in light of the European energy crisis following the Russian invasion of Ukraine. Additionally, the article explored renewable energy sources as a key component of achieving energy security for both regions. Furthermore, the article highlighted the risks associated with China's continued influence over the renewable energy market. To mitigate the potential dependence on China and ensure long-term energy independence, the article recommends reinvigorating domestic solar panel production, establishing domestic supply chains for critical renewable energy materials, expanding slower-growth renewable sources, and increasing research investments to enhance renewable energy technologies. By pursuing these strategies, Europe and the United States can strengthen their energy security and reduce reliance on external sources. 🌟

**Col Shawn Willis, USAF**

Colonel Willis is a physicist in the United States Air Force and currently serves as the associate dean of the Air Force Institute of Technology graduate school, Wright-Patterson Air Force Base, Ohio, [shawn.willis@us.af.mil](mailto:shawn.willis@us.af.mil).

**Lt Col Anthony P. Rizzuto, USSF**

Lieutenant Colonel Rizzuto is an acquisition officer in the United States Space Force and currently assigned to the Joint Staff at the Pentagon, Washington, DC. [anthony.rizzuto@spaceforce.mil](mailto:anthony.rizzuto@spaceforce.mil).

**Dr. Svetla Ben-Itzhak**

Dr. Ben-Itzhak is assistant professor, space and international relations, at Air War College, Air University, Maxwell Air Force Base, Montgomery Alabama, [svetla.ben-itzhak@au.af.edu](mailto:svetla.ben-itzhak@au.af.edu).

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