Fire from the Gods: Safely Promoting Nuclear Energy

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In Greek mythology, the titan Prometheus stole fire from the gods and passed it to humanity as an improvement in civilization, but in doing so earned the wrath of Zeus. In recent months, the weaponization of Russian energy supplies in conjunction with its invasion of Ukraine has driven an unprecedented global energy crisis that could cause European blackouts in a bleak winter. Meanwhile, Russia has occupied Zaporizhzhia, the largest nuclear power plant in Europe, threatens to use nuclear weapons, and may even have targeted key European energy infrastructure in an attack on the Nord Stream pipeline in September 2022. Promoting nuclear energy adoption could be a key solution to addressing the energy security of Europe. However, as in the Promethean narrative, the profound potential to society offered by emissions-free reliable nuclear energy also raises the specter of nuclear weapons proliferation and reintroduces questions about the safety of nuclear power reactors during peacetime and conflicts.

For the past seventy years, the North Atlantic Treaty Organization (NATO) has alleviated the fear of nuclear war with the Russian Federation through its Article 5 deterrence policy, where an attack on any NATO ally necessitates a response from the entire alliance. However, the Ukraine war illustrates how Russian warfare has extended beyond the traditional battlefield and crippled portions of the alliance. While Russia has not violated the territorial integrity of NATO, reliance on Russian energy has made some allied states vulnerable to the weaponization of energy supplies and undercut the alliance's use of economic sanctions.

The lack of viable energy alternatives to Russian fossil fuels puts NATO in the conundrum of choosing between external security aims and internal energy concerns. The key to energy diversity will be decoupling nuclear weapons policy from nuclear energy development. As NATO moves deeper into the twenty-first century, the alliance must develop an energy portfolio resilient to violations of the rules-based international order, whether that violation is an invasion of a non-NATO country or noncompliance in international forums such as the Nuclear Nonproliferation Treaty Review Conference.

NATO's Recent Blindspot—Not Viewing Nuclear Energy as Critical to Climate and Energy Security

NATO is the primary political-military forum that brings Europe and North America together daily. Since 1991, NATO has evolved from a sixteen-nation defensive alliance designed to quell Soviet aggression into a dynamic thirty-two-nation security provider. The post-Cold War expansion includes not only membership expansion, but scope. NATO has released three strategic concepts post-Cold War, in 1999, 2010, and 2022, which serve as the alliance's guiding light.[1] In 2010, NATO added climate change and energy security into the alliance's areas of responsibility, but failed to establish a nuclear energy policy.

The oversight is most apparent within the 2022 Strategic Concept and the NATO 2030 Review released in 2021.[2] Both documents articulate the institution's desire to build member-state resilience by strengthening each nation's civil preparedness and homeland security capacity. The 2022 Strategic Concept goes one step further, highlighting that each NATO ally needs to build systems that defend against attacks on its energy infrastructure. NATO reaffirmed in its September 2022 response to the Nord Stream attacks that "any deliberate attack against allies' critical infrastructure would be met with a united and determined response."[3] The documents encourage nations to pursue renewable energy and limit greenhouse gases. However, the reports do not explore nuclear power's role as a key part of a nation's energy portfolio. The blind spot highlights a gap in NATO's energy independence and resilience policy objectives. The

alliance's lack of nuclear energy policy potentially contributed to the Russian invasion of Ukraine. By enabling the Kremlin to believe Europe relied on Russian energy, Putin may have believed that Europe would not dare to stand up to his aggression in the region for fear of freezing their own populations.

In the 2022 strategic plan, NATO calls on its members to combat authoritarian actors who threaten the alliance's interests, values, and democratic way of life by bolstering systems to defend each nation's infrastructure. However, NATO does not codify what constitutes a sufficient improvement. Eight NATO members are currently amongst the world's fifteen highest nuclear power-generating countries, positioning the alliance well to extend leadership in this sector.[4] We see diversifying a country's national energy sector as a critical component for national defense moving forward and believe that nuclear energy can play a key role in achieving energy security and climate goals.

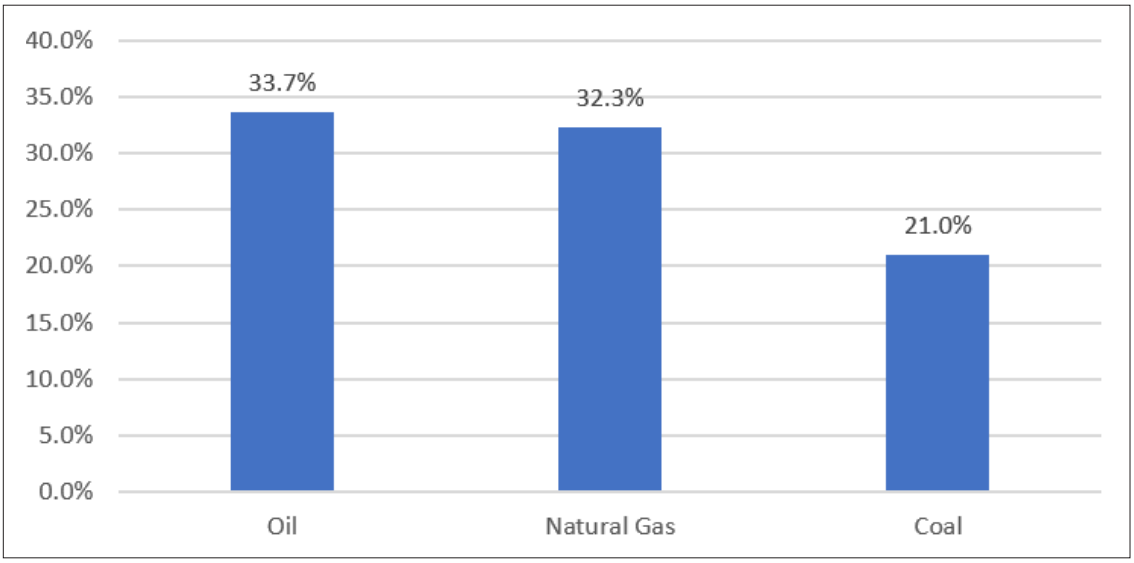
A Necessary Renaissance

The Russian invasion of Ukraine has highlighted the strategic importance of securing Europe's energy supply. In 2021, oil, natural gas, and coal supplied over two-thirds of European energy, much of which was imported.[5] Crucially, over the same period, Russian supplies provided for approximately one-third of European oil and natural gas consumption and over one-fifth of European coal consumption.[6] Curtailments of Russian energy supplies into the European and global markets have caused significant economic hardship and pose a major risk to European economies.

While renewable energy will play an important role in addressing energy security and climate concerns over the longer term, it cannot be relied upon as the sole near-term solution for several reasons. One issue is urgency: despite decades of investment and concerted policy efforts across Europe to support the energy transition away from fossil fuels, renewable sources of energy—including wind, solar, and biofuels—reflected less than 15% of European energy consumption in 2021.[7] Another is reliability: wind and solar are intermittent sources of energy that require conditions such as wind and sunlight. Currently, battery technology is not sufficiently advanced to economically store renewable energy at scale. As a result, other energy sources—including fossil fuels—are often still necessary to address intermittent renewable supply.

Similarly, simply diversifying fossil fuel imports away from Russia may not be feasible as a short-term fix due to global supply constraints and infrastructure issues—particularly in the case of natural gas. The world uses natural gas for power generation, heating, and industrial uses. However, to be economically transported outside of a pipeline network, it must be cooled to the point that it becomes liquified natural gas (LNG). In 2021, Europe imported 17.8 billion cubic feet a day (bcf/d) of natural gas from Russia, primarily via pipelines.[8] Substituting this volume from alternative sources will require overseas imports in liquified form. While the EU's total LNG import capacity is estimated to be 15.2 bcf/d, the distribution of these regasification facilities is uneven.[9] A lack of integration in the natural gas pipeline networks across the continent connecting regasification facilities to downstream markets means that while increased LNG imports will be a crucial part of the overall solution of addressing European energy security, it may not be a viable option for some countries seeking to replace Russian volumes.

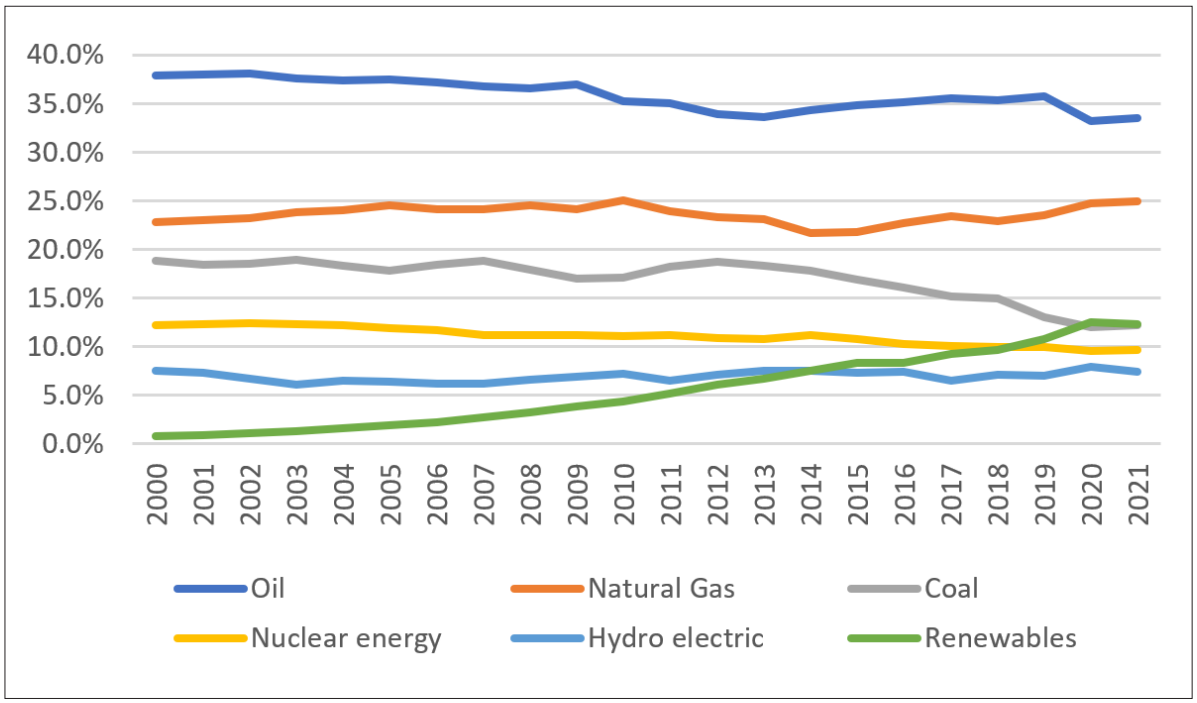
Figure 1: Russian Imports as a Share of European Demand Pre-Conflict (2021 Average)



This figure demonstrates Russian imports as a share of European demand in 2021. In this figure, Europe is defined as European members of the OECD plus Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Georgia, Gibraltar, Latvia, Lithuania, Malta, Montenegro, North Macedonia, Romania, Serbia, and Ukraine. Oil reflects imports of Russian crude oil and refined products.

Source: BP Statistical Review of World Energy 2022 71st Edition

Figure 2: Share of Fuel in European Energy Consumption Over Time (2000-2021)



This figure compares the consumption of various energy sources in Europe between 2000 and 2021. The types of energy compared are oil, natural gas, coal, nuclear energy, hydro electric, and renewables (which includes solar, wind, and biofuels combined). In this figure, Europe is defined as European members of the OECD plus Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Georgia, Gibraltar, Latvia, Lithuania, Malta, Montenegro, North Macedonia, Romania, Serbia, and Ukraine.

Source: BP Statistical Review of World Energy 2022 71st Edition

Unlike wind and solar, nuclear energy is available 24/7, regardless of weather or season. And unlike fossil fuels, no greenhouse gases are emitted during the operation of nuclear power plants. As a result of these characteristics, the International Energy Agency (IEA) estimates in its net zero emissions by 2050 scenario that nuclear power generation must double between 2022 and 2050 to achieve climate goals.[10] However, due to various factors, including perceived safety considerations, nuclear energy generation in Europe has declined since 2004 and fell by 21.4% through 2021.[11] The decline is not consistent with global trends where nuclear energy generation has increased to record levels despite several years of curtailed consumption following the 2011 Fukushima nuclear disaster.

Taking decisive action to keep nuclear plants open, developing new facilities, and exploring opportunities to distribute electricity generated at these facilities can play a key role in addressing Europe's energy crisis both in the short and long term. At the end of 2021, the average age of the nuclear power capacity in Europe was thirty-eight years old with many reactors approaching the end of their operating licenses.[12] By comparison, the average age of nuclear power capacity across China is only five years old.[13] Lifetime extensions on European—and global—facilities can help delay closures which may account for a reduction of nearly 40% of global capacity by 2030, even though many facilities can technically operate safely for decades longer.[14] In the case of Germany—which has had over thirty operating nuclear power plants over recent decades— urgent action is needed to extend the operations of the last three operating plants which Berlin planned to phase out by the end of 2022.[15]

Longer term, the construction of new facilities utilizing small modular reactors and integrating nuclear energy with other transition industries—such as using electricity from nuclear power to produce hydrogen—may help reverse the declines in nuclear energy generation in Europe.[16] However, even with full government support, new nuclear energy facilities may take years to construct.[17] As a result, urgent clarity on government policy outlook may help to facilitate a greater role for nuclear energy in addressing Europe's energy crisis while also making progress on longer-term climate goals.

Playing with Fire

China and Russia are capitalizing on nuclear interest. According to the International Energy Agency's 2022 report on nuclear energy, "of the thirty-one reactors that began construction since the beginning of 2017, all but four are of Russian or Chinese design."[18] The lack of Western competitiveness in nuclear energy affords China and Russia the ability to challenge and potentially reshape previously established nuclear safety and security regulatory standards.[19] To cede any ground in nuclear energy development and manufacturing could mean a long-term loss of Western competitiveness to at least one country, Russia, that has shown a willingness to waiver on nuclear safety and security norms for unlawful political aims.

Following Russia's actions in Ukraine and Iran's recent blitz towards increased uranium enrichment, leaders in Brussels should reflect on what a nuclear renaissance without NATO at the forefront could mean. Russia's remarks on nuclear weapons use, and its actions in the Zaporizhzhia and Chernobyl nuclear power plants are a glimpse into that future. The absence of nuclear energy research and development among NATO allies is concerning and provides grounds for developing the critical technology beyond military use to keep pace with nuclear powers outside the transatlantic region.

To effectively increase the use of nuclear energy, NATO allies must navigate the inextricable link between nuclear energy and nuclear weapons via policy aims that tackle not just a shift in infrastructure, but public perception and mindset as well. While academics have illustrated an overestimation in the pipeline from civilian nuclear programs to weapons programs, public perception is that nuclear energy comes with a significant safety risk.[20] According to a YouGov poll conducted before Russia's invasion, European and American public opinion split when responding to the question of whether nuclear energy is unsafe, with 44% saying yes and 56% saying no.[21] The divide highlights the educational challenge NATO members face. Therefore, providing allied citizens an education on the safe use of nuclear power is paramount to increasing public confidence.

As we are seeing now, security does not only include military protection of physical territory and infrastructure. Allowing Western competitiveness in nuclear energy to lapse could put the world in a precarious situation. Additionally,

NATO strategists should develop a campaign explaining the benefits of nuclear power, as a safe and reliable way to make progress on climate goals.

NATO's Role as a Coordination Mechanism for Nuclear Policy Amongst Members

NATO has continually expanded its sphere of influence, scope, and definition of defense to address new challenges for its members. Over the past two years, NATO has ventured into cyber security and economic sanctions. In 2021, the alliance created a civilian-military Defense Innovation Accelerator for the North Atlantic (DIANA) to boost the alliance's ability to harness civilian technological innovations and compete with artificial intelligence advancements in China.[22] Additionally, since the start of the war in Ukraine, NATO coordinated economic sanctions against Russia and established a process to provide Ukraine with military weapons and interoperability support.[23] Moving forward, NATO should facilitate energy security among its members by encouraging the development of nuclear energy along with infrastructure that could support the transmission and exchange of electricity generated from nuclear facilities amongst allies.

Since NATO's 2014 Wales Summit, a large point of contention within the alliance from the United States' perspective has been the lack of countries meeting the targets of 2% of GDP on defense spending and 20% of their annual defense budget on major new equipment.[24] Although the Ukraine War has increased the number of countries meeting the targets, the tension of what constitutes a nation contributing its fair share is as old as the alliance itself and will undoubtedly resurface.[25] NATO should expand the definition of defense spending to account for allies taking steps to increase their energy security and resilience. The shift will incentivize NATO members to contribute to transatlantic security by developing a robust energy portfolio that can withstand coercive measures by non-NATO countries, namely near-peer rivals Russia and China.

Conclusion

The current war in Ukraine highlights how security in the twenty-first century goes beyond territorial integrity on the battlefield and into new arenas like energy. While NATO's initial purpose was to "keep the Americans in, the Russians out, and the Germans down," the institution has and will continue to evolve because security challenges are increasingly complex.[26] While NATO's Article 5 guarantee has resisted Russian aggression in member lands, its ability to fully implement its policy objectives without military force depends on the alliance's ability to develop and defend critical infrastructure.

NATO has already identified energy security as a key area of cooperation, but the resistance of some allies to expand the use of nuclear energy has hampered the alliance's collective ability to respond to Russia's aggression in Ukraine. As the world deals with a historic energy crisis and seeks to address climate change, NATO increasing the availability and use of nuclear energy is essential to reduce greenhouse gases in the long term and provide consistent energy to allied nations in the short term. Increasing nuclear energy generation will also make the alliance less dependent on Russian fossil fuels and, therefore, resistant to the Kremlin's aggression in the region.

Moving forward, NATO must approach energy security with the same intensity it pursues territorial defense. Today, rivals Russia and China have energy and economic footholds on sizable portions of the alliance that can limit NATO's ability to project power worldwide. While NATO is the strongest military alliance in the world, it must shift its efforts beyond the battlefield and into the energy and economic arenas to reach its full potential.

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[1] "The Alliance's Strategic Concept (1999)," North Atlantic Treaty Organization, accessed November 10, 2022, https://www.nato.int/cps/en/natohq/official_texts_27433.htm#:~:text=At%20their%20Summit%20meeting%20in,years%20of%20the%20Cold%20War; "Strategic Concept 2010," North Atlantic Treaty Organization, accessed November 10, 2022, https://www.nato.int/cps/en/natohq/topics_82705.htm; "NATO 2022 Strategic Concept," North Atlantic Treaty Organization, accessed November 10, 2022, https://www.nato.int/strategic-concept/.

[2] North Atlantic Treaty Organization, *NATO 2030: United for a New Era*.

[3] "Statement by the North Atlantic Council on the Damage to Gas Pipelines," North Atlantic Treaty Organization, accessed October 30, 2022, https://www.nato.int/cps/en/natohq/official_texts_207733.htm?selectedLocale=en.

[4] "Top 15 Nuclear Generating Countries," The Nuclear Energy Institute, accessed November 10, 2022, https://www.nei.org/resources/statistics/top-15-nuclear-generating-countries.

[5] BP Statistical Review of World Energy 2022 71st Edition (Statistical Review of World Energy-all data), https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html; Europe is defined as "European members of the OECD plus Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Georgia, Gibraltar, Latvia, Lithuania, Malta, Montenegro, North Macedonia, Romania, Serbia, and Ukraine."

[6] BP Statistical Review of World Energy 2022 71st Edition (Statistical Review of World Energy-all data), https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html; Europe is defined as "European members of the OECD plus Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Georgia, Gibraltar, Latvia, Lithuania, Malta, Montenegro, North Macedonia, Romania, Serbia, and Ukraine." Oil reflects imports of Russian crude oil and refined products.

[7] BP Statistical Review of World Energy 2022 71st Edition (Statistical Review of World Energy-all data), https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html; Europe is defined as "European members of the OECD plus Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Georgia, Gibraltar, Latvia, Lithuania, Malta, Montenegro, North Macedonia, Romania, Serbia, and Ukraine."

[8] Statistical Review of World Energy 2022 71st Edition (Statistical Review of World Energy-all data), https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html; Europe is defined as "European members of the OECD plus Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Georgia, Gibraltar, Latvia, Lithuania, Malta, Montenegro, North Macedonia, Romania, Serbia, and Ukraine."

[9] "Liquefied Natural Gas," European Commission, accessed August 11, 2022, https://energy.ec.europa.eu/topics/oil-gas-and-coal/liquefied-natural-gas_en.

[10] International Energy Agency, *Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Systems*, 8.

[11] BP Statistical Review of World Energy 2022 71st Edition (Statistical Review of World Energy-all data), https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.

[12] International Energy Agency, *Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Systems,* 16.

[13] International Energy Agency, *Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Systems*, 16.

[14] International Energy Agency, *Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Systems*, 15.

[15] International Energy Agency, *Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Systems*, 26.

[16] International Energy Agency, *Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Systems* 9.

[17] International Energy Agency, *Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Systems*, 22.

[18] International Energy Agency, "Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Energy Systems," September 2022, https://www.iea.org/reports/nuclear-power-and-secure-energy-transitions.

[19] Robert Ichord, Jr., "Nuclear Energy and Global Energy Security in the New Tripolar World Order," *Atlantic Council* (blog), October 12, 2022, https://www.atlanticcouncil.org/blogs/energysource/nuclear-energy-and-global-energy-security-in-the-new-tripolar-world-order/.

[20] Nicholas L. Miller, "Why Nuclear Energy Programs Rarely Lead to Proliferation," *International Security* 42, no. 2 (November 1, 2017): 40–77, https://doi.org/10.1162/ISEC_a_00293.

[21] Matthew Smith, "What Do Europeans and Americans Think about Nuclear Energy?," YouGov, December 13, 2021, https://yougov.co.uk/topics/international/articles-reports/2021/12/13/what-do-europeans-and-americans-think-about-nuclea.

[22] "NATO Launches Innovation Fund," North Atlantic Treaty Organization, accessed November 10, 2022, https://www.nato.int/cps/en/natohq/news_197494.htm.

[23] Jens Stoltenberg, "Opening Remarks at a Joint Meeting of the European Parliament's Committee on Foreign Affairs and the Subcommittee on Security and Defense," North Atlantic Treaty Organization, accessed November 10, 2022, https://www.nato.int/cps/en/natohq/opinions_197902.htm?selectedLocale=en.

[24] "Wales Summit Declaration," North Atlantic Treaty Organization, accessed November 10, 2022, https://www.nato.int/cps/en/natohq/official_texts_112964.htm.

[25] "Defence Spending Pledges by NATO Members Since Russia Invaded Ukraine," UK Parliament, accessed November 10, 2022, https://commonslibrary.parliament.uk/defence-spending-pledges-by-nato-members-since-russia-invaded-ukraine/.

[26] Stephen Walt, "NATO Isn't What You Think It Is," *Foreign Policy*, July 26, 2018, https://foreignpolicy.com/2018/07/26/nato-isnt-what-you-think-it-is/.