Claremont-UC Undergraduate Research Conference on the European Union

Volume 2019 Article 10

8-23-2019

Atomic Dreams: Exploring the Promise of Nuclear Energy in Central-Eastern Europe

Ryann Welch
University of Florida

Follow this and additional works at: https://scholarship.claremont.edu/urceu

 Part of the International and Area Studies Commons, and the International Relations Commons

Recommended Citation

Welch, Ryann (2019) "Atomic Dreams: Exploring the Promise of Nuclear Energy in Central-Eastern Europe," *Claremont-UC Undergraduate Research Conference on the European Union*: Vol. 2019, Article 10. DOI: 10.5642/urceu.201901.10
Available at: https://scholarship.claremont.edu/urceu/vol2019/iss1/10

This Chapter is brought to you for free and open access by the Current Jounrals at Scholarship @ Claremont. It has been accepted for inclusion in Claremont-UC Undergraduate Research Conference on the European Union by an authorized editor of Scholarship @ Claremont. For more information, please contact scholarship@cuc.claremont.edu.

10

Atomic Dreams: Exploring the Promise of Nuclear Energy in Central-Eastern Europe

Ryann Welch
University of Florida

Abstract

Energy production and economic potential have been intertwined for centuries. Is nuclear energy a failed experiment, or the future of European energy? Nuclear energy has been scrutinized heavily for decades, especially in light of incidents such as Chernobyl and Fukushima. Issues of safe operation, radioactive waste storage, and threats to human health plague this energy source. However, Central-Eastern Europe's nuclear energy production has been increasing in terms of both production and investment, especially in the Visegrad Four states. The European Union's stance on nuclear energy is not black and white. While Western European member countries like Germany and France are moving away from this energy source, Eastern member states are expanding their nuclear production and consumption. As the European Union sets strict guidelines for nuclear operations while promoting a renewable energy agenda, it allocates substantial funding to nuclear energy projects in Central-Eastern European member and non-member states, in the name of regionalizing approaches to energy production. What is causing increased nuclear energy production in Europe, and how can the European Union rectify renewable energy agendas with regionalized energy funding? How will nuclear energy continue to affect Central-Eastern Europe in global energy relations? This paper focuses on Hungary and Ukraine's nuclear energy capabilities in particular, as they are both former communist states intending to modernize and build economic independence. Hungary and Ukraine's nuclear energy will be compared in terms of economic capability, social support, and influence of the European Union and Russia.

Keywords

nuclear energy, Hungary, Ukraine, Central-Eastern Europe

1. Introduction

Historically, the countries with the greatest access to energy sources and production sites have held a strong grip on the regional and local economies. From early biomass sources (like timber) to coal to steam, energy has evolved quickly and substantially through the last centuries. The warmest years in the world have been recorded in the past 35 years. Ocean levels have risen by six inches in the last century, and the frequency of severe storms has increased since the mid-20th century. The generally environmentally-minded European Union has composed energy plans to reduce its carbon footprint and decrease foreign energy dependency, including a 40% carbon emission reduction and a 20% increase in energy efficiency by 2030, based on the levels reported in 1990 (European Union Climate Action, 2014). Just after the Second World War, European countries turned to nuclear power for energy, for coal supplies had been depleted. In the 1950s, nuclear power was viewed as a chance for self-reliance and rebuilding for Europe (Hoffman, 1957).

Nuclear power has been scrutinized heavily since it began providing energy, especially considering incidents at plants such as Chernobyl and Fukushima. Issues of safe operation, radioactive waste storage, and threats to human health plague this energy source. However, Central-Eastern Europe 's nuclear energy production has been increasing despite these concerns, and Europe as a whole has seen heavy investment in furthering nuclear production. The question of which energy sources are the most economical and productive has become increasingly more relevant with new energy sources becoming available. Coal and natural gas are becoming less efficient and less globally desirable. At the same time, renewable energy sources often do not have the infrastructure needed for substantial economic development. For this reason, nuclear energy is a strong possibility for establishing a strong economy, especially in countries desiring to establish greater political and economic sovereignty.

Two countries of particular interest in Central-Eastern Europe are Ukraine and Hungary. Both countries are former communist states, with nuclear energy infrastructure established and in use before the Soviet Union fell. They are both experiencing tangible increases in nuclear energy, in terms of both production and economic investment, despite decommissioning of nuclear plants by the European Commission and general skepticism towards nuclear energy. Hungary has since joined the European Union, while Ukraine appears unlikely to follow. There is a vastly complicated history surrounding nuclear energy in Central-Eastern Europe, as the impact of the Soviet system collides with modern European Union policies in the same states. What is causing increased nuclear energy production in Hungary and Ukraine, and what could these trends mean for the future of Central-Eastern Europe?

This paper will explore economic factors, legislative factors, and public opinions in both these countries and their role in further nuclear energy expansion, with a particular emphasis on the influence of the European Union and Russia on Hungary and Ukraine, respectively. Ultimately, the lures of increased economic independence, strong state-supported legislation, and problematic yet solid favorable public opinion have allowed the presence of nuclear energy to expand in Ukraine and Hungary. This paper will ultimately argue that different circumstances unique to each Central-Eastern European country explain these current nuclear trends, though there are also similar desires and contexts for the two countries. While economic independence and sovereignty appear to be the strongest factors influencing expanded nuclear energy in Ukraine and Hungary, this paper finds that public

support is a subtle yet fundamental factor in nuclear energy use as well.

2. Methodology

Nuclear energy is a relatively new energy source, and many long-term environmental and economic consequences are not widely researched or published. Increased nuclear energy trends are broadly explored in this paper. Nuclear energy investment, production, consumption, and public support are all factored into the discussion of increasing nuclear trends. This paper will not explore nuclear technology used as weapons or for military purposes.

This paper is split into three major sections corresponding to three factors best explaining increased nuclear energy use in Hungary and Ukraine: economic, political, and social. Economic support for nuclear energy production increases is largely derived from scholarly research, with supplemental data as available from the European Union and European Commission. Legislative information supporting nuclear energy is mostly taken from the agreements between the European Union and the United States, coupled with scholarly discussion of this legislation. Finally, public opinion data is cited from European Union surveys, as well as scholarly analysis of petitions, gatherings, and publications, to create a sense of general public discourse surrounding nuclear energy.

3. Background: The Soviet Period in Nuclear Energy

The idea of "atomic-powered communism"arose in the late 1950s, when the Soviet Union initiated several power connections between Soviet Republics, mainly using nuclear energy as a common and efficient source of power (Kasperski, 2015a). For Soviet authorities, scientists, and citizens, nuclear energy was the key towards economic advancement and fulfilling the social greatness promised by communism (Kasperski, 2015a). Consequently, the rise of nuclear energy was generally celebrated across communist countries in Eastern Europe. Before the Chernobyl accident, nuclear energy innovation was greatly encouraged and supported in Ukraine and much of Eastern Europe.

The Chernobyl accident, in which an improperly performed safety test triggered overheating and finally an explosion in reactor number four of the Pripyat plant, forced a re-evaluation of nuclear energy and its potential. Though Ukraine, Russia, and Belarus were most affected, radioactive material from the explosion traveled as far as Sweden and Norway (Semenov, 1983). Therefore, Eastern Europe's energy became an issue in every part of Europe. Health impacts and further safety concerns tarnished nuclear energy's reputation, causing decommissioning and distrust of this power source all over the world. Many scholars have linked this accident to the fall of the Soviet Union, as the Pripyat plant's destruction indicated failure of Soviet technology and broke the promise of "atomic-powered communism."

4. The European Union

The European Union (EU) is a significant producer of energy in the world, where exports account for over 50% of its energy production. Fossil fuels are responsible for nearly half of the European Union's power supply, while nuclear power accounts for one-third of power in the European Union (Pampel, 2011). Following climate change mitigation objectives, the European Union aims to reduce carbon emissions by 40%, and to become

the most energy efficient continent (European Commission, 2008). To increase energy efficiency, the EU has connected several member and non-member states through energy bridges, essentially creating a network of nuclear energy that can be exported between European countries. Out of the twenty-eight (as of 2016) member states, thirteen have active nuclear plants, with major nuclear industries in France, Germany, and Hungary (European Commission, 2008). Nuclear energy is responsible for nearly half of low-carbon power production in the European Union. The Official Journal of the European Union states the need to "diversify Europe's energy supply," which a state running half on fossil fuel combustion with a massive emission rate does not exemplify (European Commission, 2014).

5. Current Trends in Hungary & Ukraine

While both are formerly Eastern European communist countries, the motivations and means for furthered nuclear energy are greatly dependent on economic capacities and historical contexts in Hungary and Ukraine. While Ukraine has a larger land area than Hungary, the number of reactors in each state are virtually proportionate to energy needs, with four in Hungary and fifteen in Ukraine (World Nuclear Association, n.d.).

Since Hungary joined the European Union in 2004, its nuclear energy production has been increasing. Around four nuclear plants power half of the country, the biggest of which is the Paks plant (World Nuclear Association, n.d.). The European Commission has extended deals with Hungary's nuclear plant because there were no "alternative suppliers" in case of an energy shortage, therefore increasing reliability and dependence on nuclear energy from this country (European Commision, 2008). This extension also elongated the life of two plants and commissioned construction of two more plants. Hungary also benefits from the EU power bridge, connecting the nuclear power plants (NPP) of several member and non-member states for mutual economic and energy supply benefit.

Ukraine is also a former communist country, but it is not a European Union member state. However, Ukraine has substantial economic ties to the European Union, practicing a policy of integration rather than Europeanization (Wolczuk, 2015). For example, Ukraine benefits from the power bridge connecting many Central and Eastern European countries' energy supplies for efficiency and cost-effectiveness. While some plants are being decommissioned, there are intentions to replace and use them again in coming years. Yet, the ghosts of the 1986 Chernobyl disaster linger in terms of public trust and support of nuclear power (Bromet, 2014).

6. Economic Opportunity as Means for Nuclear Energy

This paper will argue that economic development is the main factor for increased nuclear interest in Central-Eastern Europe, however, the exact motivations and prospects vary between the relevant countries. In the case of Ukraine, nuclear energy is intended to create a truly Ukrainian economy, independent of Russia. However, Hungary does not tie economic independence to decreased reliance. Hungary utilizes energy deals from the European Union and European Commission to improve their nuclear capacity, essentially valuing the idea of a stronger Hungary rather than an energy independent or self-reliant Hungary.

The Ukrainian economy has lived in the shadow of Russia for decades, spanning long before and long after the Soviet period. That being said, Ukraine is a strong and sig-

nificant nuclear energy producer, generating over 89.2 kilowatt hours of energy in 2010 and holding a top-five position among nuclear energy producing countries (Kasperski, 2015b). Further, the Ukrainian nuclear sector employs nearly 40,000 people as of 2015 (Kasperski, 2015b). The nuclear sector is at the forefront of the Ukrainian economy already, therefore the economic goals follow modernization of nuclear technology and creating a fully Ukrainian energy system.

Despite Ukrainian efforts to decrease economic dependence on Russia, the two countries' nuclear energy sectors are intricately entwined. Kasperski (2015b) argues that Ukraine's nuclear technology is "actually Russian nuclear technology with all of its political and economic baggage" (p. 59). While Ukraine possesses the necessary natural resources (most importantly, uranium) and political desire to create a more independent energy sector (Von Zon, 2014), most of the tools, technology, and processing stations are Russian. The Crimean conflict, in which Russia annexed the Russian-speaking peninsula of Crimea from Ukraine, catalyzed Ukrainian desire to create an independent and Russian-free economic system even further. It seems that Ukrainians viewed this annexation as Russia taking what was rightfully Ukrainian (Kasperski, 2015b). Therefore, Russian technology being used to process uranium supplies and conducting reactor operations appears to be another aspect of Russia involved in what is rightfully Ukrainian.

In terms of economic incentive for nuclear energy expansion, Hungary is not necessarily in competition with another state or force. Rather, the Hungarian government and people seem to desire a more prominent nuclear system for the purpose of becoming a stronger country. As of now, 70% of Hungarian energy is imported, and this number could raise to 90% if further action is not taken (World Nuclear Association, n.d.). Hungary does not intend to have a totally Hungarian-produced energy sector like Ukraine desires. Hungary is not a top nuclear-energy producing country, having just four nuclear reactors compared to Ukraine's fifteen. Since Hungary benefits from EU-sanctioned power bridges, clearly the intention behind expanding nuclear energy is not moving away from these power bridges. The EU provides legislation and investment that aids Hungary in its pursuit of more domestically produced energy, as the Framework Strategy for a Resilient Energy Union, an EU energy program, means to connect power structures to create an efficient and strong European power supply. Since Hungary is a part of this plan, it will receive the needed investment and political support from the European Union.

Despite different intents for expanding nuclear energy production, both Ukraine and Hungary have attracted investors from other countries and from global businesses. In terms of nuclear energy in Central-Eastern Europe, the economic deals and plans developed by these countries indicate a strong interest in nuclear energy from all over the world. Therefore, other Central-Eastern European countries will likely experience similar investment incentives that inspire further nuclear energy expansion. Ukraine has seen its fair share of external investors, though channeling these investments into an independent economic future is far simpler planned than executed. The U.S. Department of State has invested in Ukrainian nuclear energy, and Ukraine has imported U.S. nuclear fuel and materials[1]; however, it is largely a short-term solution.

In addition, there is economic potential for Ukraine to invest in other countries and companies' nuclear plans as well, indicating a healthy and developing market for this

1 Ukraine initially imported nuclear fuel from the Westinghouse company, and Energoatom has invested in Ukrainian nuclear plants (World Nuclear Association n.d.).

energy source. The European Union has shown interest in Ukraine as well, which indicates that EU benefits may extend far past member states. Ukraine is connected along the EU power bridge, as part of the Framework Strategy for a Resilient Energy Union. In terms of nuclear energy in Central-Eastern Europe, this indicates greater trends towards nuclear energy development and production, since there are significant investment opportunities from state sources in addition to independent companies.

Hungary's investments both in and out of the country tend to be more tied to other countries rather than independent companies. For example, Hungary has exported nuclear power to South Korea, reflecting an international demand for efficient and cost-effective nuclear power. Hungary is additionally a member of the Visegrad Four, along with Poland, Slovakia, and the Czech Republic. The Visegrad Four are former communist Central-Eastern European states that are pro-nuclear energy. Each of these countries has policies to extend nuclear plant life spans, commission more reactors, and connect nuclear energy systems and resources for a stronger Central-Eastern Europe (Nosko, 2010). Each of these countries has strong policies and energy practices that encourage less reliance on natural gas to limit Russian economic and political influence on their energy sectors. The Visegrad Four creates further policy incentives to maintain nuclear energy expansion in Hungary, while developing a sense of Eastern European solidarity and identity. Interestingly, Hungary has received over $10 million in investments from Russia for nuclear energy, which Ukraine has strived to move away from (World Nuclear Association, n.d.). This begs the question of whether Central-Eastern Europe will ever be fully economically free of Russian influence, since Hungary has readily taken what Ukraine aims to fully reject.

7. Legislative & Policy Support for Nuclear Energy Trends

Regardless of economic potential, it is necessary for the policy of these states to support expanded nuclear energy production and consumption. Economic independence remains the main factor in increased nuclear energy, and the degree to which policy and legislation support this increase varies between Hungary and Ukraine. Hungary's nuclear-energy-related legislation aims to expand current production and commission the construction of more power plants. Despite commonalities in expanding nuclear plant life, encouraging commissioning of further plants, and supporting economic investment in nuclear technology, Hungary and Ukraine have fundamentally different goals for the future of their energy sectors. Hungarian policies lean towards a strong Eastern European identity and a stable economy, while Ukrainian policy mainly aims to create an economy independent from Russia.

Both countries have domestic legislation supporting nuclear energy, however the effectiveness of this legislation has varied greatly between the two. A similarity between Ukrainian and Hungarian nuclear energy policies are agreements each county upholds with the United States in regards to ethical use of technology and proper disposal of radioactive waste. In both the 1991 U.S.-Hungary and the 1998 U.S.-Ukrainian agreements, the states involved agree to abide by the declaration that "peaceful nuclear activities must be undertaken with a view to protecting the international environment from radioactive, chemical and thermal contamination." The agreements address economic development of nuclear energy in Ukraine and Hungary and state that "economic and safe conduct of their nuclear programs" are a foremost objective (United States Congress, 1991; 1998).

Furthermore, the Hungarian and Ukrainian parliaments have passed legislation

that supports a pro-nuclear policy. In 1993, Ukrainian Parliament ended a moratorium on nuclear reactor construction that had been in place since the Chernobyl accident (Kasperski, 2015b). Hungarian Parliament voted to expand nuclear plant production and life by 20 years with no safety or economic objections in the early 2000s, and in 2003 Ukrainian Parliament also voted to extend nuclear plant lifetimes (Kasperski, 2015b).

Besides domestic parliamentary legislation, Hungary's nuclear sector is also tied to European Union legislation. Being a member state, Hungary is bound by European Union standards for nuclear energy and radioactive waste disposal. The EU has also committed to decreasing emissions by 35% and becoming the most energy-efficient continent, which provides political in addition to economic support for Hungary (European Commission, 2018). While the EU does have general policies towards decommissioning nuclear plants and treating radioactive waste that apply to all member states, it leaves specific domestic policy up to the member states. The goal of this approach is to allow economic stability and development that is appropriate for the needs of every member state (Barnes, 2017).

It is necessary to address the European Union's recent decommissioning of nuclear plants in explaining its role in Eastern European nuclear energy policy. It is incorrect to say that the European Union is necessarily against nuclear energy. The nuclear power plant connection is not an exception to current policy. According to the European Commission (2018), while nuclear plants are being decommissioned, they are to be replaced with more modern plants. The European Union intends to replace outdated nuclear technology and bring every plant up to current European Commission safety standards. Further, it is also incorrect to state that the nuclear power bridge connections are solely for European Union benefit. The European Union asserts member states' "right to determine conditions for exploiting their own resources" (European Commission, 2008). For nuclear power, the European Union affirms "strengthen[ing] the role of national regulatory authorities" to manage nuclear plants with "independence from national governments" (European Commission, 2018, p. 1).

Ukrainian government tends to have difficulties in enforcing legislation, leaving the actual investments virtually stuck or not as effective as desired. The first indication of a solid policy in favor of a Russian-free nuclear sector occurred in 1995, when the Ukrainian parliament approved legislation that intended to produce energy through solely Ukrainian means and technology (Kasperski, 2015b). However, the same legislation also revealed long-term issues with effective nuclear policy in Ukraine, as this overly optimistic policy failed due to a lack of funding and political support. In 2009, Ukrainian legislature promoted new uranium extraction policies that encouraged domestic labor and technology, rather than importing from Russia. In 2006, the Ukrainian government announced a plan to generate over 7,000 megawatts of additional capacity in the fifteen current reactors. Kasperski (2015b) argues that this number was highly unlikely to be met, much like many other of Ukraine's recent nuclear policy goals. While Ukraine appears to have the intentions of creating a stable and independent nuclear energy sector, it appears that current policy is simply too ambitious given current political and economic conditions. Kasperski (2015b) brings attention to bureaucratic challenges in creating a stable nuclear policy, stating that Ukraine has had challenges with effective policy since its independence, a point supported also by Von Zon (2014). Nuclear energy and safety policy have been "chaotic" at best, with frequent creation, destruction, then re-creation of policies and legislative bodies. Furthermore, there is little policy towards management of employees and bureaucrats who are involved

with expanding nuclear energy production, creating another obstacle towards a stable and independent system (Von Zon, 2014).

While it is clear the Ukrainian government is overwhelmingly supportive of increased nuclear energy production, Ukraine appears to continually support policy that is far beyond its current economic and political means. In contrast, Hungary has a strong policy foundation thanks to the European Union, where Hungary's nuclear energy objectives are protected despite other member state's rejection of nuclear energy. It is in the European Union's interest to support Hungary and other Central-Eastern European states through policy, as nuclear energy is arguably the most established energy source that will fulfill its carbon emission reduction goals. It seems likely that the European Union will continue to support Central-Eastern European states in their pursuit of expanded nuclear energy production and consumption, as these pursuits will create a more energy efficient and connected Europe. Ukraine represents states that have received far less exterior policy support, though there is developing legislative infrastructure to meet future economic goals for its nuclear energy sector.

8. Public Discourse & Opinion as a Factor in Nuclear Energy

Finally, public perception can give insight into current nuclear energy trends as well as the future of this energy source in Eastern Europe. Though both countries are experiencing economic and political investment in nuclear energy with strong public support, the exact parameters of this support vary greatly. Ukrainians tend to be far more conscious of nuclear safety, while Hungarians tend to be generally less aware of the implication of expanded nuclear energy production.

A European Commission public survey suggests that Hungarians are generally pleased with the amount of nuclear energy being produced in their country. Around 50% of Hungarian respondents stated that they believed nuclear energy production levels should remain as they are, while 17% desired an increase and 24% desired a decrease (European Commission, 2008). This data puts Hungarians as the country with the ninth-highest interest in expanding nuclear energy production among the European Union member countries. Likewise, Hungary represents one of the lowest percentages of respondents in favor of reducing nuclear energy production, behind Romania, Italy, Bulgaria, and Slovakia. Interestingly, the European Union member countries that most supported expanding or maintaining nuclear energy were mostly Central-Eastern European, including Hungary, Slovakia, the Czech Republic, and Bulgaria. This data suggests that the proportion of nuclear energy production in Hungary is generally favored. Further European Commission public survey results also suggest that Hungarian generally trust nuclear energy. 57% of Hungarian respondents stated that they did not view nuclear energy as a "threat to them or their families" (European Commission, 2008). According to this survey, Hungarians had the sixth-highest confidence in nuclear energy among member states. The European Commission (2008) survey also indicated that Hungarians reported the highest confidence in nuclear energy materials being "sufficiently protected against misuse" (p. 27).

However, Marples' (1989) analysis of Hungarian public discourse towards nuclear energy questions the generally positive outlook presented in the European Commission's survey data. In analyzing public discourse in Hungary surrounding nuclear energy, there is a general lack of petitions, public forums, or any such public inquiries into nuclear energy. While public reception tends to be generally positive, Marples raises concerns for the full

extent of the public's knowledge. The European Commission's (2008) survey reflects a generally positive outlook for nuclear energy, however, there was no baseline of knowledge established for respondents. Public perception may be in favor of expanded nuclear energy production and consumption, however, the actual construction and life extension of new plants may generate concern (p. 34). It is easy to be enthralled by the promise of economic stability and domestic energy independence, but the lack of public knowledge about nuclear energy now may result in disdain or concern later on in energy production and advancement.

Of particular interest are public opinion data and discourse surrounding nuclear energy in Ukraine, especially considering plans for economic and technological expansion of this form of power. Though thorough public surveys regarding public interest in nuclear energy are not available for Ukraine, several researchers have conducted independent public opinion surveys and discourse analysis which are helpful to this essey. Kharlamova (2016), for example, analyzed Ukrainian public opinions towards renewable energy sources. For this particular research, nuclear energy was not considered a renewable source, however, the survey found that Ukrainians generally have low interest in renewable energy sources like wind and solar energy, while reporting public discontent with existing coal energy production and use.

Kasperski (2015b) raises concern for the level of public interest and awareness in Ukraine's ambitious nuclear plans. Ukraine has not forgotten the environmental devastation of Chernobyl, and yet, the future of nuclear energy remains cautiously optimistic in this country. The most publicly controversial nuclear energy project conducted in Ukraine was the re-opening of the Pripyat plant of Chernobyl, due to energy shortage in the early 1990s, as Kasperski has found. These shortages were caused by economic and political instability after the fall of the Soviet Union. The Ukrainian public expressed severe concern for the safety of this project, and from there Ukrainian Parliament considered health implications and public concerns as reasons to potentially override a nuclear project. However, in 1993, a moratorium on nuclear reactor construction was lifted by the Ukrainian parliament, which was contrary to the public sentiment that any use of the Pripyat plant should be avoided.[2] Despite these two vastly different public approaches to nuclear energy expansion, it seems that the Ukrainian public is generally receptive to increasing economic and political independence through this energy method. Nuclear energy has progressively been viewed as an opportunity for Ukrainian "self-sufficiency and sovereignty," rather than a symbol of Russian or Soviet control (Kasperski, 2015b).

While public opinion in Ukraine generally appears to suggest a pro-nuclear-power stance, there are concerns that this public opinion is more anti-Russian than pro-nuclear. In terms of Eastern European nuclear trends, the public seems to be generally in favor of increased nuclear energy production and consumption. As seen in the cases of Hungary and Ukraine, the exact reasons for public support of nuclear projects depends on historical and political context in each country. Based on public discourse and survey results, it seems that Hungarians are not overly concerned with safety and operating procedures of nuclear energy plants, supporting this energy source as a means of expanded economic opportunity and stability. Ukrainians are cautiously optimistic about expanding nuclear energy use, with

2 In fairness to the Ukrainian government, the Pripyat plant utilized technology that was antiquated even by 1993, and plants constructed using mid-20th century Soviet technology were being decommissioned and replaced regardless (Kasperski, 2015a).

the pain of the Chernobyl disaster still present in public discourse. However, the idea of nuclear energy as a means to obtain a more sovereign and stronger Ukraine maintain public support. While every Eastern European country will have various concerns and degrees of public discourse, themes of economic strength are present everywhere. It is necessary for the public of any country to first support the economic potential for nuclear energy, then be convinced that this energy is safe and sustainable. Evidence for this claim is also found in the European Commission survey data for Western European states like France and Germany. In these countries, the public generally has concerns about the safety of nuclear energy and desires greater plant decommissioning, as nuclear energy is not as economically strong as it is in Eastern Europe.

9. Concluding the Cases of Hungary & Ukraine

Hungary and Ukraine are in complicated yet promising positions. Both countries deal with the legacy of communism in their energy sectors, in addition to the Russian influence felt in other aspects of Eastern European life. Ukraine desires growth and stability without Russian influence, and hopes to establish a Ukrainian-driven economy. Hungary desires a stronger economy and stability as well; however, it is tied to the European Union and other Eastern European countries. Nuclear energy with its associated infrastructure and investment interest, has the potential to generate economic benefits for both countries. While economic interests are the primary drivers of increased production and consumption of nuclear energy, social and legislative factors complement these interests. In the next few decades, it seems more likely for Hungary to develop a stronger nuclear energy sector thanks to European Union legislation and investment interests. While Ukraine has a more prominent nuclear energy sector currently, it seems that substantial reductions in economic reliance on Russia will require significant economic investment as well as more effective legislation.

10. Implications for Central-Eastern Europe and for the Future of Nuclear Energy

Nuclear energy enjoys political, economic, and social support in Central-Eastern Europe, as evidenced by this analysis. The next obstacle to increased nuclear energy production will most likely be environmental. This paper did not delve into environmental consequences of nuclear energy, as research indicated that many Central-Eastern European countries are not overly concerned with this aspect. However, there are concerns of groundwater pollution, earthquakes, and air contamination from the fusion process that generates nuclear energy. Hungarian scholars have expressed concern for the Paks plant and the health of groundwater due to nuclear energy, as the effects of such expansion have not been fully studied (Hajdin, 2016). Indeed, it appears concerning that public discourse has generally not considered environmental impact, even if this disregard is understandable considering the potential for economic and political sovereignty through nuclear energy.

Bauer (2012) assesses that world nuclear power production will increase 37-110% by 2035. In order to meet the European Union's energy goals, it seems that member states must capitalize on expanding nuclear sectors. Most nuclear power plants only have a projected lifetime of 30-35 years, so refurbishment is a necessity in addition to investment in new plants. The demand for energy in general will only increase, and relying on fossil fuels

is both detrimental to the EU's economy and to the environment (Kaygusuz, 2008).

Nuclear energy is a chance for recovery, growth, and strength for Eastern Europe. Given renewed interest and rebuilt trust in this form of energy, it seems that substantial economic growth is the main factor behind increased nuclear trends. It is a matter of managing investments, maintaining public support, and finding legislative support to keep this chance alive. It seems that nuclear energy is intrinsically entwined in the fears and hopes of so many.

References

Adamantiades, A., & Kessides, I. (2009). Nuclear power for sustainable development: Current status and future prospects. *Energy Policy, 37*(12), 5149-5166. doi:10.1016/j.enpol.2009.07.052

Barnes, Pamela M. (2017). *Politics of nuclear energy in the European Union. Framing the discourse: actors, positions and dynamics*. Barbara Budrich Publishers.

Bauer, N. (2012). Economics of nuclear power and climate change mitigation policies. *Proceedings of the National Academy of Sciences, 109*(42), 16805–16810., doi:10.1073/pnas.1201264109.

Bromet, E. J. (2014). Emotional consequences of nuclear power plant disasters. *Health Physics, 106*(2), 206-210. doi:10.1097/hp.0000000000000012

European Commission (2008). *Attitudes towards radioactive waste*. Retrieved from http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_297_en.pdf

European Commission (2018, June 14). *Decommissioning of nuclear facilities*. Retrieved from https://ec.europa.eu/energy/en/topics/nuclear-energy/decommissioning-nuclear-facilities

European Union Climate Action. (2014). Retrieved from https://ec.europa.eu/clima/citizens/eu_en

Hajdin, B., & Polomcic, D. (2016). The impact of the enlargement of the nuclear power plant Paks (Hungary) on groundwater resources in Vojvodina. *Tehnika, 71*(4), 545-552. doi:10.5937/tehnika1604545h

Hoffman, George W. (1957). The role of nuclear power in Europe's future energy balance. *Annals of the Association of American Geographers, 47*(1), 15-40.

Kasperski, Tatiana (2015a). Nuclear dreams and realities in contemporary Russia and Ukraine." *History and Technology, 31*(1), 55–80. doi:10.1080/07341512.2015.1054146.

Kasperski, Tatiana (2015b.). Nuclear power in Ukraine: Crisis or path to energy independence? *Bulletin of the Atomic Scientists*, *71*(4), 43–50., doi:10.1177/0096340215590793.

Katona, Tamás János (n.d.) Future of the Nuclear Power Generation in Hungary. *International Atomic Energy Agency* .

Kaygusuz, K. (2008) The future of nuclear power and renewable energy sources in the European Union. *Energy Sources, Part B: Economics, Planning, and Policy, 3*(4), 348-361, DOI: 10.1080/15567240701492832

Kharlamova, G., Chernyak, O., & Nate, S. (2016). Renewable energy and security for Ukraine: Challenge or smart way? *Journal of International Studies, 9*(1), 88-115. doi:10.14254/2071-8330.2016/9-1/7

Klyar, Dagmar, Wittneben.(2012). Nuclear energy in the European Union after Fukushima: Political and economic considerations. *CESifo DICE Report 10*(3):9-15.

Marples, D. R. (1989). Nuclear energy development in Eastern Europe. *Chernobyl and Nu-*

clear Power in the USSR. Palgrave Macmillan: London.
Mearsheimer, J. J. (1993). The case for a Ukrainian nuclear deterrent. *Foreign Affairs, 72*(3), 50. doi:10.2307/20045622
Nosoko, Andrej. (2010). Energy security. *Visegrad Security Cooperative Imitative*.
Pampel, F. C. (2011). Support for nuclear energy in the context of climate change. *Organization & Environment, 24*(3), 249-268. doi:10.1177/1086026611422261
Semenov, B.A. (1983). Nuclear power in the Soviet Union. *International Atomic Energy Association Bulletin*.
United States, Congress (1991). *Atomic energy, peaceful uses of nuclear energy: Agreement between the United States of America and Hungary.* Signed at Vienna June 10, 1991.
United States, Congress (1998). *Atomic energy, peaceful uses of nuclear energy: Agreement between the United States of America and Ukraine*. Signed at Kiev, May 6, 1998 with Annex and Agreed Minute.
Wagner, A., Grobelski, T., & Harembski, M. (2016). Is energy policy a public issue? Nuclear power in Poland and implications for energy transitions in Central and East Europe. *Energy Research & Social Science, 13*, 158-169. doi:10.1016/j.erss.2015.12.010
Wolczuk, Kataryna. (2016). Managing the flows of gas and rules: Ukraine between the EU and Russia. *Eurasian Geography and Economics, 57*(1), 113-137. doi: 10.1080/15387216.2016.1174072
World Nuclear Association (n.d.). *Nuclear power in Hungary.*
World Nuclear Association (n.d.). *Nuclear power in Ukraine.*
Zon, H. V. (2014). *Political economy of independent Ukraine: Captured by the past*. Palgrave Macmillan UK.