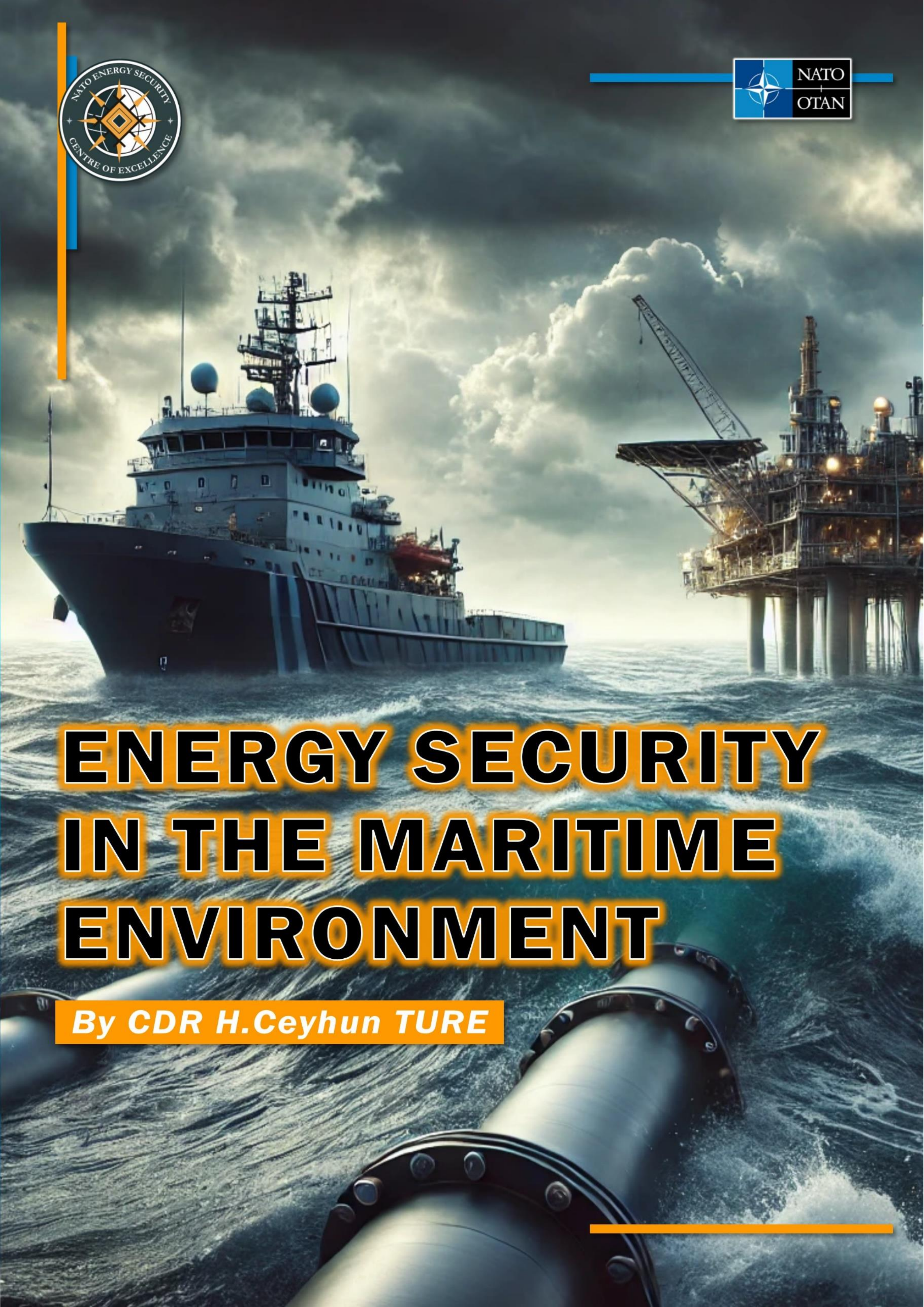

ENERGY SECURITY IN THE MARITIME ENVIRONMENT

By CDR H.Ceyhun TURE

Introduction

Energy security is a crucial element of NATO's collective security, recognized by member states as essential for their mutual safety. Disruptions in energy supply can weaken the readiness of NATO and its partners, directly affecting military operations. Consequently, energy security plays a significant role in enhancing the Alliance's resilience and countering hybrid threats. While energy security is primarily a national responsibility, it remains a critical concern for NATO, where the Alliance must continuously monitor developments and provide support within its capabilities.[1] Since NATO's role in energy security was first defined at the 2008 Bucharest Summit, it has been recognized as one of the seven baseline requirements for resilience in civil preparedness. The NATO Energy Security Centre of Excellence (ENSEC COE), based in Vilnius, Lithuania, has led efforts to enhance awareness and preparedness against hybrid threats to energy security since 2012.[2] Energy security remains a priority for member states, with NATO focusing on three main areas: raising energy security awareness, supporting the protection of critical energy infrastructure, and enhancing energy efficiency in military operations.[3]

Maritime security, in accordance with the NATO Strategic Concept approved in 2010, was further developed through the Alliance Maritime Strategy document in 2011.[4] The NATO Maritime Security Centre of Excellence (MARSEC COE) in Istanbul, Türkiye, actively supports NATO in maritime security matters, aiming to expand the capabilities of NATO and partner nations by providing comprehensive, innovative, and timely expertise in the field of maritime security operations.[5] The Alliance Maritime Strategy document emphasizes the importance of safeguarding the freedom of navigation, sea-based trade routes, critical infrastructure, energy flows, protection of marine resources, and environmental safety as essential components of the security interests of Allies. Additionally, NATO's maritime forces are prepared to contribute to energy security, including the protection of critical energy infrastructure and sea lines of communication.[6]

Mitigating strategic vulnerabilities, enhancing energy security, and investing in stable and reliable energy supplies, sources, and suppliers are of critical importance. Combined with a focus on maritime security for protecting critical energy infrastructure and trade routes, these efforts promote peace and

---

[1] NATO 2030, United for a New Era, Analysis and Recommendations of the Reflection Group Appointed by the NATO Secretary General, 2020.
[2] NATO Energy Security, NATO Website, Accessed 14.10.2024, https://www.nato.int/cps/en/natohq/topics_49208.htm
[3] Energy Security: A Critical Concern for Allies and Partners, NATO Website, Julijus GRUBLIAUSKAS & Michael RUHLE, 2018.
[4] Alliance Maritime Strategy, Accessed 24.09.2024, NATO Website, https://www.nato.int/cps/en/natohq/official_texts_75615.htm
[5] NATO MARSEC COE Website, Accessed 17.10.2024, https://www.marseccoe.org/history/
[6] Alliance Maritime Strategy, Accessed 24.09.2024, NATO Website, https://www.nato.int/cps/en/natohq/official_texts_75615.htm

prosperity for the Alliance and its partners.[7] NATO's approach to energy and maritime security highlights the close interconnection between these areas, emphasizing the need for a coordinated and comprehensive strategy to address shared challenges, particularly in safeguarding critical maritime energy infrastructure and shipping routes in the maritime environment. This article begins by defining energy security, explores its relationship with maritime security, discusses the threats and challenges to energy security in the maritime environment, and concludes with actionable recommendations.

Definition of Energy Security

When it comes to defining energy security, the answer is often, "it depends." This response highlights the varying perspectives on energy security among countries and organizations.[8] For example, producer nations prioritize **energy demand**, while consumer nations focus on **supply security**. From a geopolitical standpoint, energy is viewed as a **strategic asset** that can shape international relations. Yet, for a soldier on the ground, it is merely a commodity that enables force deployment. The public may emphasize **environmental sustainability**, adding another layer to the definition. All these perspectives are correct, and each reflects the unique priorities of different stakeholders.

In defining energy security, four key elements stand out in the literature: Availability, Affordability, Efficiency, and Sustainability. **Availability** involves ensuring a sufficient, reliable, and uninterrupted energy supply, along with diversifying energy sources, production, and suppliers. It emphasizes reducing dependence on a single source and maintaining a steady flow of energy resources and routes. **Affordability** goes beyond merely low and stable prices; it also ensures fair access to energy services, making energy economically accessible to all sectors of society. The 2022 global energy crisis highlighted the critical importance of reliable and affordable energy supplies for societies.[9] **Efficiency** focuses on maximizing the effective use of energy through advanced technology, better-performing equipment, and changes in consumer behaviour. This includes measures such as fuel substitution, upgrading to more efficient equipment, adopting new practices, and shifting to products and services that require less energy. NATO is actively working on the transition to clean energy, focusing on technological innovation while maintaining military effectiveness through its **Energy Transition by Design** initiative[10], recognizing that global energy demand is expected to increase by 2050.[11] The final component **sustainability** ensures that energy systems are not only environmentally responsible but

[7] NATO Strategic Concept 2022, NATO Website, Accessed 12.10.2024, https://www.nato.int/nato_static_fl2014/assets/pdf/2022/6/pdf/290622-strategic-concept.pdf
[8] Baltic Defence College Operational Level Energy Security Course, 18 March 2024, NATO HQ Climate and Energy Security Section.
[9] International Energy Agency (IEA), World Energy Outlook 2024.
[10] NATO Website, Accessed 19.10.2024, https://www.nato.int/cps/en/natohq/news_212039.htm
[11] World Energy Scenarios Composing Energy Futures to 2050, Accessed 18.10.2024, https://www.worldenergy.org/assets/downloads/World-Energy-Scenarios_Composing-energy-futures-to-2050_Full-report1.pdf

also resilient to climate change. It involves minimizing environmental impact while maintaining energy systems that are socially acceptable and capable of adapting to changing environmental conditions.[12]

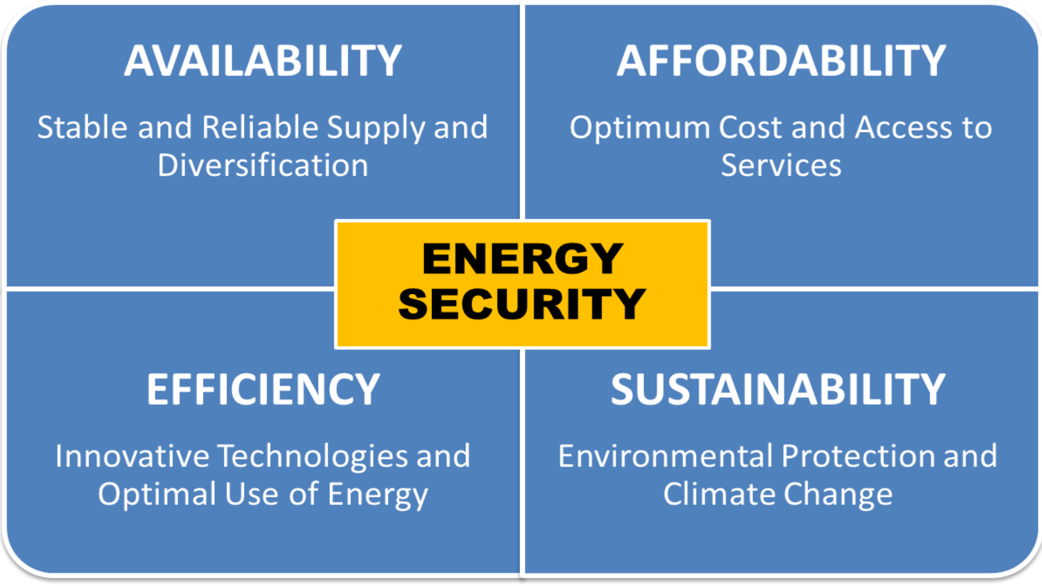

Figure 1. Key Terms Defining Energy Security

The definition of Energy Security in the NATO Operational Energy Concept (draft) highlights the importance of a stable and reliable supply of necessary energy forms and quantities, enabling NATO's capabilities, operational effectiveness, and resilience. Importantly, from NATO's perspective, energy is not just a commodity; rather, it is a critical capability enabler for its core tasks and military operations. NATO is committed to ensuring secure, resilient, and sustainable energy supplies for its military forces.[13]

Energy Security and Maritime Security Interconnection

Energy Security and Maritime Security are deeply interconnected, as the maritime environments play a pivotal role in global energy supply. With water covering 70% of the Earth's surface, approximately 80% of the global population residing within a 100-mile radius of coastlines, and about 90% of global trade conducted through maritime routes[14], the importance of maritime domains is clear. Additionally, over 99% of the world's digital data is transmitted via submarine cables[15], underscoring the critical role of maritime infrastructure in the digital age.

[12] NATO Website, Accessed 19.10.2024, https://www.nato.int/cps/en/natohq/topics_91048.htm
[13] Washington Summit Declaration (2024), https://www.nato.int/cps/en/natohq/official_texts_227678.htm
[14] Alliance Maritime Strategy, Accessed 24.09.2024, NATO Website, https://www.nato.int/cps/en/natohq/official_texts_75615.htm
[15] NATO Website, Accessed 14.10.2024, https://www.nato.int/docu/review/articles/2024/08/28/reinforcing-resilience-natos-role-in-enhanced-security-for-critical-undersea-infrastructure/

Moreover, as shown in Figure 2, recent statistics indicate that despite numerous initiatives promoting green and renewable energy, we still rely heavily on fossil fuels, with over 80% of our energy coming from oil, coal, and natural gas.[16] Since supply and demand are rarely in the same location, exploring and transporting fossil resources to various global destinations is essential. In this context, maritime transportation, along with pipelines, remains the most cost-effective means of achieving this.

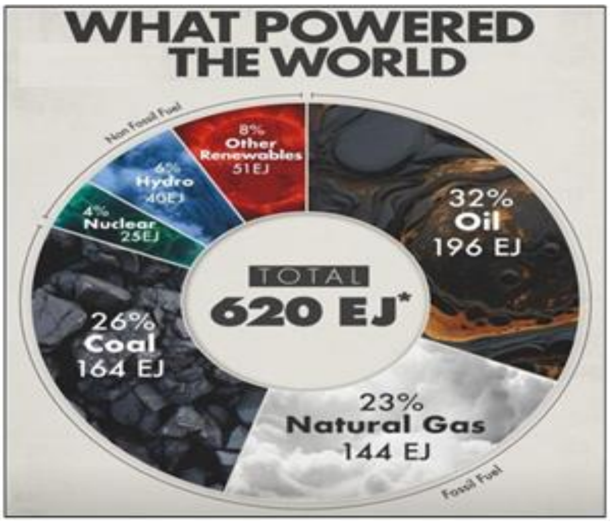

Figure 2. Review of Energy 2024, Energy Institute[17]

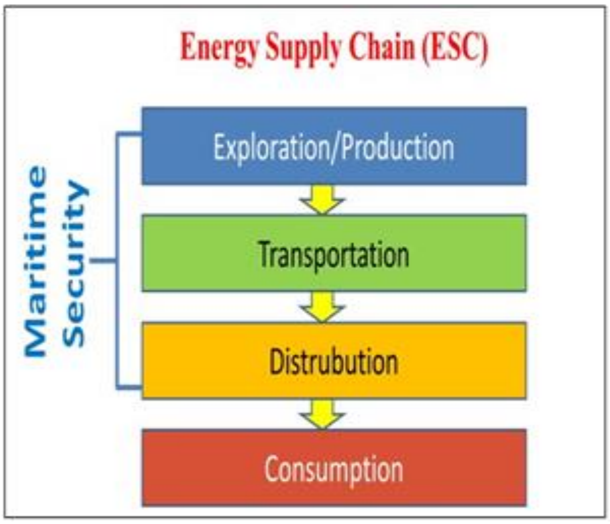

Figure 3. Energy Supply Chain Steps[18]

The **energy supply chain** involves the transformation of natural resources, raw materials, and components into finished products delivered to end consumers. As shown in Figure 3, this chain consists of four key steps, with the exploration/production, transportation and distribution steps[19], being closely connected to maritime security, which is crucial for ensuring the reliability and integrity of energy supplies. The maritime domain and its routes are primary channels for transporting and producing oil, gas, and other energy products, making their security essential for maintaining global energy stability.

In addition, as illustrated in Figure 4, maritime critical energy infrastructure has experienced significant growth and transformation in recent decades. One notable development is the increased deployment of energy production facilities within the sea, evident in the expansion of larger offshore wind farms[20] and oilfields, which incorporate various underwater elements such as offshore substations and power cables.

[16] The Guardian Website, Accessed 14.10.2024, https://www.theguardian.com/environment/article/2024/jun/20/fossil-fuel-use-reaches-global-record-despite-clean-energy-growth
[17] Statistical Review of World Energy 2024, Accessed 14.10.2024, https://www.energyinst.org/statistical-review
[18] Maritime Counter-Terrorism Course, 9 October 2024, Energy Security in the Maritime Environment.
[19] **Exploration and Production** - Technology to discover new resources and extract or bring them to the surface. **Transportation** - The geographic separation of supply and demand makes the transportation of energy products vital for maintaining a steady and affordable supply of energy resources.
Distribution - Delivering energy products to consumers efficiently.
[20] Christian BUEGER, Offshore Wind Energy and Maritime Security, Accessed 18.10.2024 https://bueger.info/wind-energy-security/

Additionally, underwater pipelines have become the most cost-effective, secure, and efficient method for transporting oil and gas[21], leading to a global increase in investments in this area.

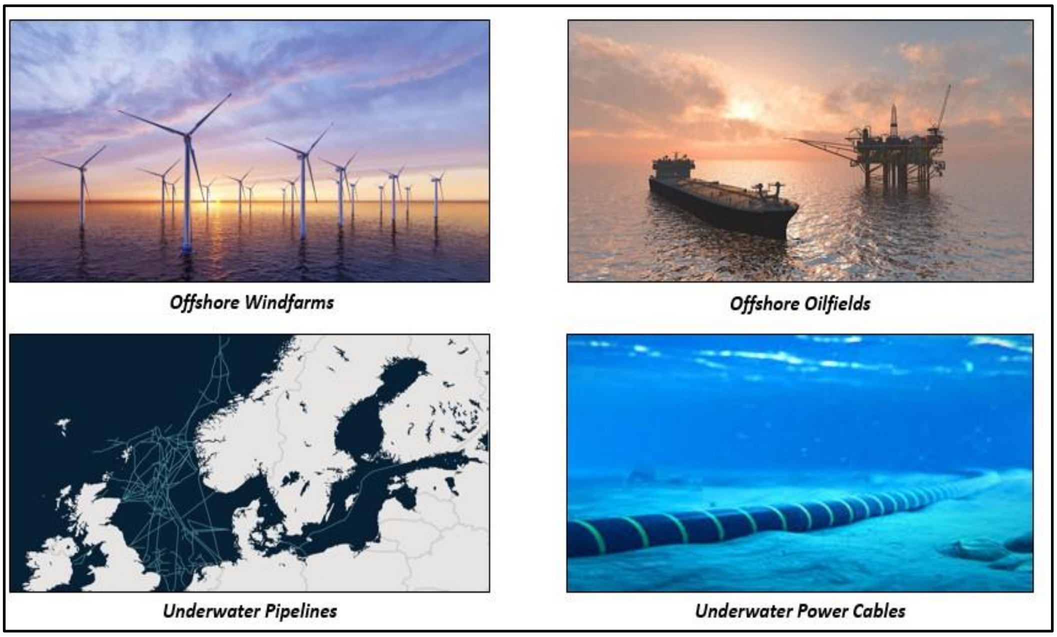

Figure 4. Maritime Counter-Terrorism Course 2024 (Energy Security in the Maritime Environment) [22]

However, these advancements have also attracted the interest of adversaries who understand the strategic importance of targeting such valuable assets. Particularly, the Nord Stream pipeline explosions on September 26, 2022, captured significant attention and offered valuable lessons regarding this new threat vector, centred on underwater energy infrastructure.[23] Following these explosions, NATO has highlighted the vulnerability of critical underwater infrastructures (CUI) and has taken substantial measures to protect them,[24] The Vilnius Summit on July 11, 2023, declared that the threat to critical undersea infrastructure is real and evolving.[25] On October 8, 2023, the Baltic Connector gas pipeline incident once again underscored the susceptibility of underwater infrastructure. It is widely recognized that the issue is highly intricate, encompassing a diverse array of stakeholders, such as governments, armed forces, private companies, and academia, all operating within a complex and demanding maritime domain. Besides the collective efforts of NATO, individual nations have also undertaken

---

[21] Science Direct Website, Accessed 19.10.2024, https://www.sciencedirect.com/topics/engineering/submarine-pipeline
[22] European Atlas of the Seas Website and Allianz Commercial Website, Accessed 18.10.2024, https://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas/ and https://commercial.allianz.com/
[23] CDR H. Ceyhun TURE, Why is Critical Underwater Infrastructure the Target, NATO ENSEC COE 2024.
[24] NATO Website, Accessed 14.10.2024, https://www.nato.int/cps/en/natolive/news_211919.htm
[25] Vilnius Summit Communiqué (2023), https://www.nato.int/cps/en/natohq/official_texts_217320.htm

diverse initiatives, investing in seabed warfare[26] and innovative underwater surveillance technologies.[27]-[28]-[29]

Unlike their land-based counterparts, maritime infrastructure faces unique challenges, such as harsh weather conditions, vast distances, and the complex three-dimensional marine environment. Some of this infrastructure is transnational, often linking multiple countries, which introduces maritime legal complexities. This complexity highlights the importance of enhanced maritime domain awareness to ensure the protection and maintenance of critical maritime energy infrastructure against various threats, which we will examine in the next section.

Threats to Maritime Energy Security

The security of maritime energy supply faces a diverse array of threats that can disrupt the critical flow of resources. Key threats include; sabotage and terrorist attacks, cyber-attacks, piracy and armed robbery, regional conflict and instability, natural disasters, technical failures and accidents.[30] This section provides brief information on how these threats can affect energy security in the maritime environment.

Sabotage and Terrorist Attacks: Terrorist organizations and adversaries often employ innovative methods to target maritime energy infrastructure and shipping, aiming to cause maximum disruption. The presence of hostile actors and the use of grey zone tactics can pose significant threats to maritime energy security. Maritime improvised explosive devices (M-IEDs) remain among the most cost-effective methods used by adversaries, including drifting M-IEDs, suicide-borne M-IEDs, remotely controlled M-IEDs, M-IEDs at harbours and anchorages, drone/UAV attacks in the maritime domain, and underwater IEDs.[31] The effects of these attacks and explosions can result in various destructive outcomes, such as damage to maritime critical energy infrastructures, ships, and disruptions to maritime

[26] Seabed Warfare: NATO and EU Member State Responses, Accessed 14.10.2024, https://euro-sd.com/2023/04/articles/30719/seabed-warfare-nato-and-eu-member-state-responses
[27] Naval Technology Website, Accessed 14.10.2024, https://www.naval-technology.com/projects/saildrone-explorer-unmanned-surface-vessel-usv-usa/
[28] Breaking Defense Website, STM NETA 300 Unmanned Autonomous Underwater Vehicle, Accessed 30.10.2024, https://breakingdefense.com/2024/10/turkish-firm-stm-unveils-indigenous-unmanned-autonomous-underwater-vehicle/
[29] Navalnews Website, ASELSAN & Sefine Shipyard MARLIN USV and Orca XLUUV, Accessed 30.10.2024, https://www.navalnews.com/naval-news/2022/09/marlin-usv-meet-turkiyes-latest-drone-ship/ https://www.navalnews.com/naval-news/2022/05/here-is-our-first-look-at-the-us-navys-orca-xluuv/
[30] MARSEC COE Maritime Counter-Terrorism Course, 9 October 2024, Energy Security in the Maritime Environment.
[31] CDR H. Ceyhun TURE, Maritime Improvised Explosive Device (M-IED) Threat to Energy Security, NATO ENSEC COE, 2023.

operations.[32] Figures 5 and 6 illustrate some examples of M-IED attacks on oil tankers, which play a crucial role in maritime energy transportation.

Figure 5. Suicide Borne M-IED Attack on an Oil Tanker[33]

Figure 6. Maritime Drone Attack on an Oil Tanker[34]

When examining these types of threats, it is crucial to recognize the timeline and decision-making processes. As depicted in Figure 7, every attack typically begins with decisions made by international leadership approximately six months to one year in advance. This phase is followed by international support, financial backing, and supply stages. To address this threat, international intelligence sharing and cooperation between relevant state ministries (e.g., Ministry of the Interior, Ministry of Economics, intelligence services) are essential. In brief, we should focus on disrupting the supply chain illustrated in this figure, which means stopping terrorists during the international, financial support, or supply phases.

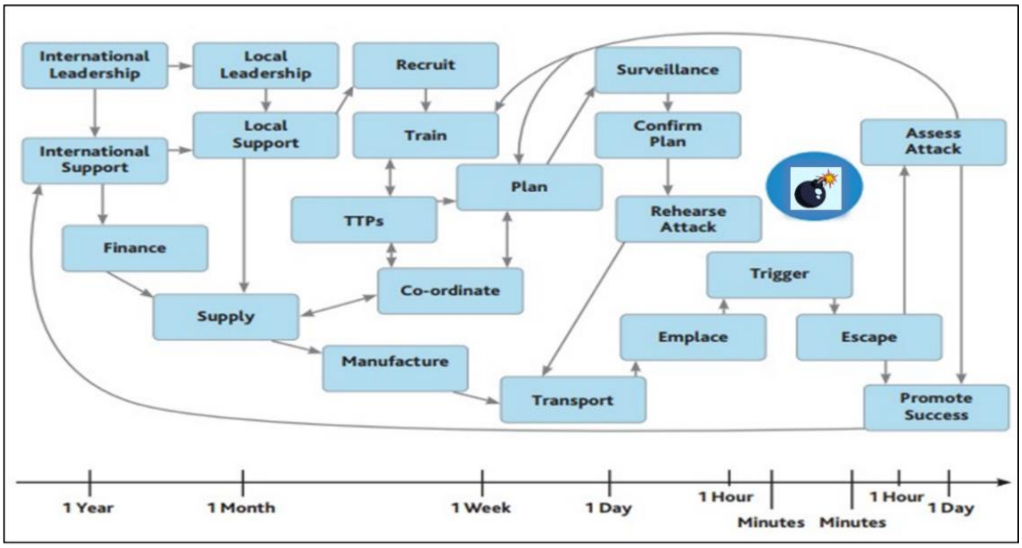

Figure 7. Activities Which Take Place Before and After Attack[35]

---

[32] H.Ceyhun TÜRE, Examination of Vibration Values Based on Underwater Detonations in Various Depths, Istanbul Okan University Master Thesis, 2015.
[33] The Guardian Website, Accessed 8 Oct 2024, https://www.theguardian.com/world/2002/oct/17/yemen.france
[34] The Washington Post Website, Accessed 10 October 2024, https://www.washingtonpost.com/politics/2021/08/19/last-month-three-drones-attacked-an-israeli-tanker-heres-why-thats-something-new/
[35] Allied Joint Doctrine For Countering Improvised Explosive Devices, AJP-3.15.

Cyber-Attacks: As illustrated in Figure 8, the energy sector has become a prime target for cyber-attacks, posing significant risks to the security and stability of supply routes. This threat is equally present in the maritime environment, where the number of reported cyber incidents and attacks has risen dramatically over the years[36] due to the digitalization of operational technology and fleet management, increasing vulnerability. A cyber-attack in this context could compromise critical systems, including vessel communication, navigation, cargo handling, and engine control. Such disruptions could severely impact energy flow, resulting in substantial economic and operational challenges.[37]

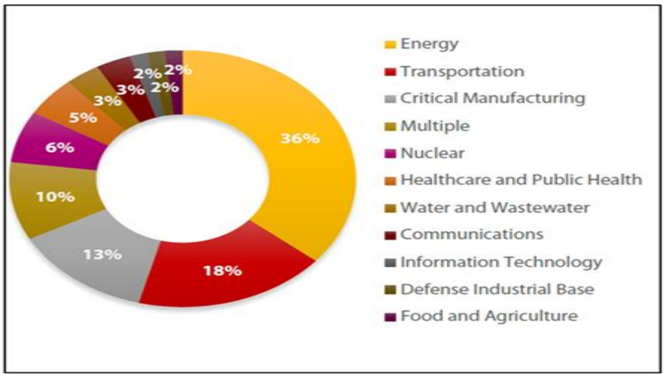

Figure 8. Cyber Attacks by State Actors[38]

Piracy and Armed Robbery: Piracy and armed robbery still pose significant challenges, as illustrated in Figure 9, directly threatening maritime shipping and energy security in several regions. The violent nature of these attacks; expose crew members to serious risks and can lead to substantial losses, including threats to human life and damage to property. These activities can result in vessel seizures or operational delays, disrupting energy supply chains and increasing overall costs, with impacts felt throughout the shipping industry and beyond.

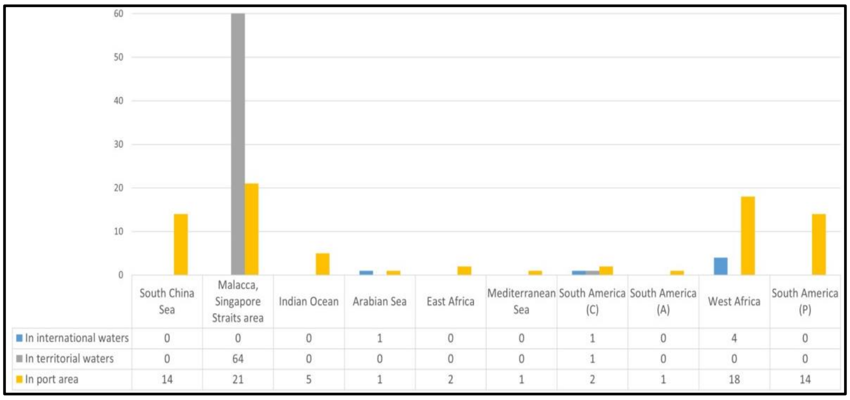

Figure 9. Piracy and Armed Robbery Attempted or Committed (2023) [39]

[36] Christian BUEGER, Timothy EDMUNDS, Jan STOCKBRUEGGER, A Comprehensive Assessment of Global Maritime Security, The United Nations Institute for Disarmament Research (UNIDIR), 2024.
[37] Offshore Energy Website, Accessed 10 October 2024, https://www.offshore-energy.biz/maritime-industry-remains-easy-target-for-cyber-attacks-as-ransom-payment-demands-skyrocket/
[38] University of Maryland, Significant Multi-Domain Incidents against Critical Infrastructure (SMICI) Dataset, September 2023.
[39] IMO Annual Report 2023, Reports on Acts of Piracy and Armed Robbery Against Ships, 7 June 2024.

Regional Conflict and Instability: Geopolitical tensions and conflicts can destabilize regions vital for energy transit, especially around maritime chokepoints, as shown in Figure 10. These chokepoints are critical transport routes that enable the flow of substantial trade volumes, serving as essential arteries for global commerce. Due to the scarcity of alternative routes, disruptions can severely impact supply chains, with widespread effects on energy supply, and the global economy.[40]As noted recently, oil prices jumped by 4% after the attacks on vessels off the coast of Yemen. Oil tankers began using the Cape of Good Hope route instead of the Bab al-Mandab Strait, adding thousands of additional nautical miles to their route.[41]

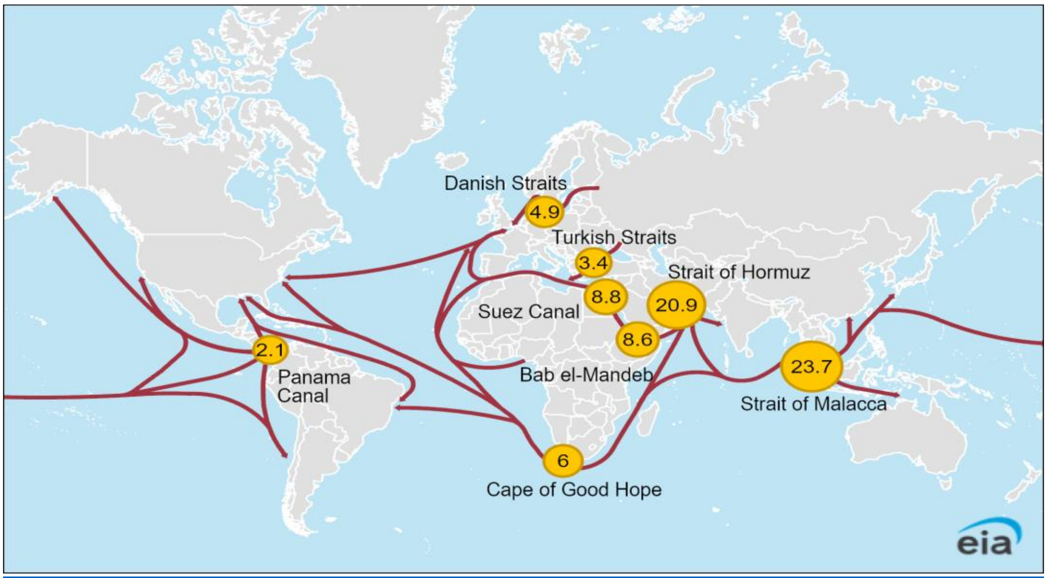

Figure 10. Daily Transit Volumes of Petroleum and Other Liquids through World Maritime Oil Chokepoints 2023[42]

Natural Disasters: Natural disasters, including those linked to climate change, pose significant threats to energy security in the maritime environment by damaging critical infrastructure, especially aging ones, such as offshore platforms, pipelines, and port facilities. These disruptions underscore the urgent need for energy systems that can withstand and recover from such challenges. This issue is especially critical for NATO members and partners, who rely on energy imports transported through transnational pipelines and cables, making it essential to address these environmental risks to safeguard energy security within the alliance.

Technical Failures and Accidents: Despite advancements in technology, technical failures and accidents still present considerable risks to global energy supply chains. In addition to frequent accidental damage to underwater cables caused by fishing activities or anchoring, major incidents, such as the Suez Canal blockage by the container ship Ever Given as shown in Figure 11, serve as important reminders of how a single technical or navigational error can have far-reaching consequences. In March

[40] United Nations Conference on Trade and Development, Review of Maritime Transport 2024.
[41] BBC Website, Accessed 10 October 2024, https://www.bbc.com/news/business-67947795
[42] U.S. Energy Information Administration (EIA), World Oil Transit Chokepoints, Updated: 25 June 2024.

2021, one of the world's largest container ships, the Ever Given, crashed into the shore of the Suez Canal due to poor visibility, adverse weather conditions, and navigational error, blocking this vital maritime trade route for six days.[43] This accident not only halted global trade but also underscored the vulnerability of energy supply networks to unforeseen technical challenges, highlighting the need for effective contingency planning and risk mitigation strategies in maritime operations.

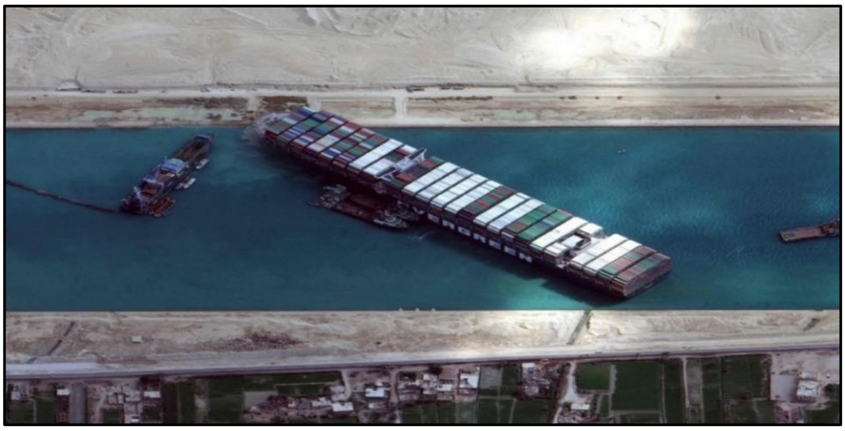

Figure 11. Suez Canal blockage due to Ever Given[44]

Challenges of Energy Security in the Maritime Environment

Maritime energy infrastructure and energy shipping, as illustrated in Figure 12, have become one of the primary targets within the context of maritime security threats. But why is this the case? To understand this, it is essential to consider the unique challenges of energy security in the maritime environment. In this section, we will briefly explore these challenges.

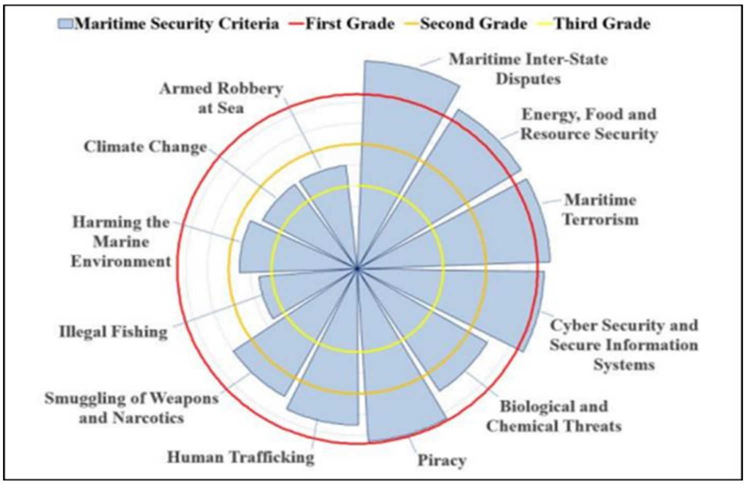

Figure 12. Classification and Frequency of Maritime Security Threat Topics[45]

[43] Reuters Website, Accessed 10 October 2024, https://www.reuters.com/world/europe/ever-given-ship-that-blocked-suez-canal-arrives-rotterdam-2021-07-29/
[44] NY Times Website, Accessed 10 October 2024, https://www.nytimes.com/2021/07/17/world/middleeast/suez-canal-stuck-ship-ever-given.html
[45] Oktay ÇETIN & Mesut Can KÖSEOĞLU, A Study on the Classification of Maritime Security Threat Topics, International Journal of Environment and Geoinformatics (IJEGEO), 2020.

Maximizing Impact Motivation: Adversaries or terrorist groups may target maritime critical energy infrastructure and energy shipping, which can cause significant disruptions in energy supply and influence both energy prices and geopolitical dynamics, creating strong motivations for such actions. Additionally, a well-planned and covert attack can yield considerable advantages, particularly when executed without attribution. With such high motivations, the preparedness, complexity, and frequency of these attacks could also be at a high level.[46]

Vulnerability: The unique characteristics of underwater energy infrastructure, such as restricted mobility, high energy density, and expansive geographic footprint, make these assets particularly vulnerable. The difficulty of securing vast maritime areas adds to the appeal for those seeking to exploit these weaknesses. The expansive nature of maritime infrastructure makes detection and attribution of attacks more challenging, offering opportunities for undetected sabotage. In addition to what is depicted in Figure 13, tankers and offshore vessels are particularly vulnerable to attacks; during the loading/discharging process, at slow speeds in pilotage waters or anchorages, and transiting chokepoints.[47]

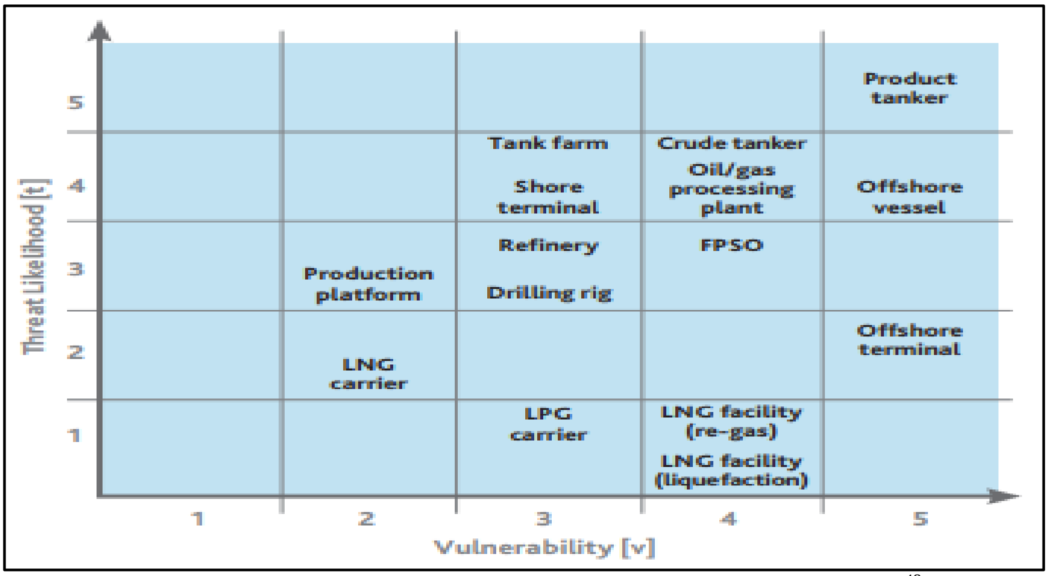

Figure 13. Energy Security at Sea (Vulnerabilities and Threats)[48]

Challenges in Surveillance and Patrolling: Covering vast maritime areas, particularly the underwater domain, presents significant challenges for security forces. Even with advanced satellites, the underwater environment relies heavily on sonar for detection, necessitating sophisticated patrolling strategies to achieve effective coverage. To ensure adequate deterrence and identification of adversaries, enhanced maritime domain awareness (MDA) capabilities are essential. Integrated intelligence, surveillance, and reconnaissance (ISR) technologies, including unmanned surface/underwater vessels,

[46] CDR H. Ceyhun TURE, Why is Critical Underwater Infrastructure the Target, NATO ENSEC COE, 2024.
[47] CDR H. Ceyhun TURE, Why is Critical Underwater Infrastructure the Target, NATO ENSEC COE, 2024.
[48] Ruxandra-Laura Boşilcă, Susana Ferreira, and Barry J. Ryan Routledge Handbook of Maritime Security 2022.

underwater smart cables[49], and AI-enhanced systems, are crucial for monitoring from the seabed to space. NATO's Digital Ocean Initiative exemplifies a notable effort in this area, offering promising solutions to improve surveillance.[50] Figure 14 and 15 present effective examples of unmanned surface vehicles and autonomous underwater vehicles designed for this purpose.

Figure 14. ULAQ-METEKSAN & ARES Shipyard USV[51]

Figure 15. Drone with Autonomous Underwater Vehicle[52]

Collaboration Challenges: The protection of critical maritime energy infrastructure is complicated by coordination issues. During peacetime, the responsibility for these infrastructures largely rests with private companies and national governments. However, private companies, which may be part of international consortia, are not always inclined to collaborate fully with other nations or NATO. Additionally, in times of crisis, these entities may lack the necessary resources, awareness, or ability to respond effectively to emerging threats, necessitating closer coordination among private companies, military forces and other authorities.[53]

Legal Complexities: Many critical maritime energy infrastructures extend beyond national boundaries into international waters, presenting legal challenges. The legal framework governing maritime domains, including the United Nations Convention on the Law of the Sea (UNCLOS 1982) [54] and the SUA-2005 Protocol[55], makes intervention and protection efforts complex, especially in international waters where the principle of freedom of navigation takes top priority. This makes effective cooperation

[49] OPTICS 11 Website, Accessed 16.10.2024, https://optics11.com/blog/securing-the-future-of-maritime-protection-optics11-leads-with-cutting-edge-optical-technology-for-underwater-security/
[50] NATO Website, Accessed 10 October 2024, NATO's Digital Ocean Initiative gets a boost in Portugal, REPMUS 24 Exercise, https://www.nato.int/cps/en/natohq/news_228959.htm?selectedLocale=en
[51] METEKSAN Savunma and ARES Shipyard Website, Accessed 10 October 2024, https://www.ulaq.global/ Participated CORE-23 Baltics TTX (NATO ENSEC COE's Maritime Energy Security Tabletop Exercise)
[52] NATO Website, Accessed 10 October 2024, https://www.nato.int/cps/en/natohq/news_219441.htm
[53] CDR H. Ceyhun TURE, Why is Critical Underwater Infrastructure the Target, NATO ENSEC COE, 2024.
[54] United Nations Convention on the Law of the Sea, Accessed 19 October 2024, https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf
[55] Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation, Accessed 19 October 2024, https://www.rcc.int/swp/download/docs/2%202005-Protocol-To-The-Convention-For-The-Suppression-Of-Unlawful-Acts-Against-The-Safety-Of-Maritime-Navigation.pdf/e2bc4ef1d632a94ab5001aabd3e08f5b.pdf

with neighbouring countries and a shared understanding of these legal frameworks essential to addressing these challenges.

Recommendations and Conclusion

Defining the challenges makes the necessary actions evident. Addressing the complex threats to maritime energy security requires a comprehensive approach. The following recommendations, as summarized in Figure 16, can help nations enhance their energy security in the maritime environment.

Figure 16. 5 Key Elements of Enhancing Energy Security in the Maritime Environment[56]

Prioritization of Critical Energy Infrastructure (CEI): Effective maritime energy security begins with identifying and prioritizing critical energy infrastructures, such as offshore platforms, ports, and shipping lanes. Focusing resources on these critical components ensures targeted protection and enhances overall resilience. Conducting **vulnerability and threat assessments** of risks "whether environmental, geopolitical, or operational" is essential. These assessments guide the development of **mitigation strategies**, including enhanced surveillance, infrastructure hardening, and alternative supply routes.

Enhance Protection Through R&D: Investing in research and development is critical for staying ahead of emerging threats. Technologies such as autonomous surveillance systems, enhanced cybersecurity measures, and physical barriers can improve the security of maritime energy infrastructure and maritime routes. Therefore, enhancing maritime domain awareness capabilities through R&D is essential for ensuring energy security in the maritime environment.

Crisis Management and Emergency Cooperation: Effective crisis management and emergency cooperation frameworks are essential for ensuring swift and coordinated responses to potential disruptions in maritime energy supply chains. Establishing clear communication channels, contingency

[56] MARSEC COE Maritime Counter-Terrorism Course, 9 October 2024, Energy Security in the Maritime Environment.

plans, and cross-border cooperation agreements enables rapid mobilization of resources and assistance during crises. Regular drills and joint exercises among stakeholders help refine response protocols, strengthen interoperability, and build trust, facilitating a more resilient maritime energy security framework.

National and Multinational Cooperation: Achieving comprehensive national and multinational cooperation is critical for addressing the complex and interconnected challenges of maritime energy security. This entails fostering partnerships between governments, international organizations, industry associations, and affected communities to share intelligence, coordinate actions, and harmonize regulatory frameworks. Collaborative initiatives can promote information sharing, joint risk assessments, and mutual assistance agreements, laying the foundation for a cohesive global approach to safeguarding maritime energy infrastructure.

Protection & Resilience Planning and Exercise: Creating effective protection and resilience plans for maritime energy infrastructure requires incorporating risk management and mitigation strategies. Exercises test response capabilities, identify vulnerabilities, and improve contingency plans for effective threat mitigation and recovery. In this regard, NATO ENSEC COE's table-top exercises, such as the **Coherent Resilience 2023 Baltic (CORE-23 B) TTX**[57], which focuses on "Maritime Critical Energy Infrastructure Protection" provide excellent opportunities for close cooperation among nations, ministries, private companies, military personnel, and academics.

Figure 17. Coherent Resilience 2023 Baltic TTX

During the **CORE-23 B TTX**, over 120 experts from 12 NATO and partner nations encountered a series of realistic injects designed to simulate potential threats to maritime critical energy infrastructure

[57] NATO ENSEC COE Website, Accessed 10 October 2024, https://www.enseccoe.org/events/table-top-exercise-coherent-resilience-2023-baltic-core-23-b-2/

and shipping in the Baltic region. These injects, as illustrated in Figure 18, included harsh maritime weather conditions, maritime improvised explosive device (M-IED) attacks, drone swarm attacks on offshore substations, unknown underwater pipeline explosions and underwater cable cuts, suspicious ship behaviour, challenges related to maritime law and crisis management. The training audience was divided into four syndicates[58], each showcasing their capabilities in responding to these diverse injects. Throughout the exercise, participants adapted to each scenario, identifying vulnerabilities and gaps in the system while enhancing coordination and response strategies against hybrid threats. They learned from each other's responsibilities, perspectives, and priorities, fostering a collaborative environment. This approach was instrumental in strengthening both national and regional protection and resilience against emerging challenges.

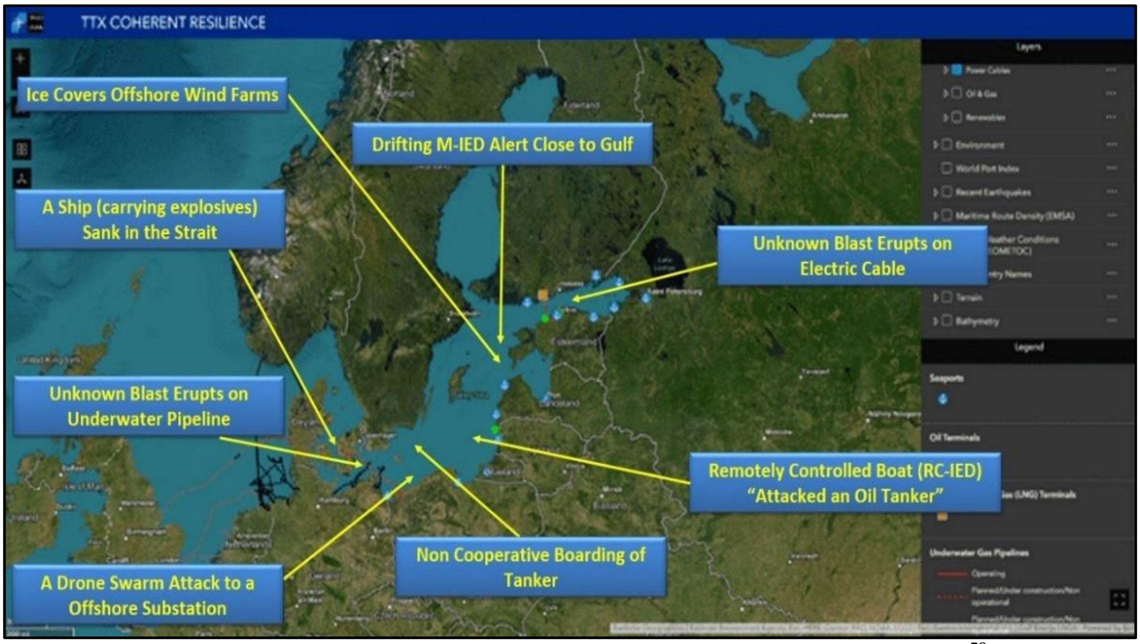

Figure 18. Some of the Injects during Coherent Resilience 2023 Baltic TTX[59]

In conclusion, the integral connection between energy security and maritime security necessitates a coordinated strategy to tackle shared challenges. Beyond maritime energy shipping, critical maritime energy infrastructures like underwater pipelines, offshore wind farms, and underwater cables face growing risks from adversarial actions. Safeguarding these critical infrastructures is essential for maintaining a stable and reliable energy supply. Addressing threats in the maritime environment requires a holistic and adaptable approach, considering its distinctive aspects, including surface, air, underwater, and seabed threats. The primary challenge lies in the ability of adversaries to quickly adapt to protective measures and adjust their tactics. As these threats become more complex, NATO's focus on innovative solutions and strengthened cooperation among nations, industry and academia is crucial to countering these evolving risks.

[58] Critical Energy Infrastructure Protection, Crisis Management, Strategic Communication, and Maritime Law

[59] MARSEC COE Maritime Counter-Terrorism Course, 9 October 2024, Energy Security in the Maritime Environment.

References

1. Allied Joint Doctrine For Countering Improvised Explosive Devices, AJP-3.15.
2. Alliance Maritime Strategy, NATO Website, https://www.nato.int/cps/en/natohq/official_texts_75615.htm
3. Baltic Defence College Operational Level Energy Security Course, 18 March 2024, NATO HQ Climate and Energy Security Section.
4. BBC Website, https://www.bbc.com/news/business-67947795
5. Breaking Defense Website, STM NETA 300 Unmanned Autonomous Underwater Vehicle, https://breakingdefense.com/2024/10/turkish-firm-stm-unveils-indigenous-unmanned-autonomous-underwater-vehicle/
6. Christian BUEGER, Offshore Wind Energy and Maritime Security, https://bueger.info/wind-energy-security/
7. Christian BUEGER, Timothy EDMUNDS, Jan STOCKBRUEGGER, A Comprehensive Assessment of Global Maritime Security, The United Nations Institute for Disarmament Research (UNIDIR), 2024.
8. CDR H.Ceyhun TURE, Maritime Improvised Explosive Device (M-IED) Threat to Energy Security, NATO ENSEC COE, 2023.
9. CDR H. Ceyhun TURE, Why is Critical Underwater Infrastructure the Target, NATO ENSEC COE, 2024.
10. Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation, https://www.rcc.int/swp/download/docs/2%202005-Protocol-To-The-Convention-For-The-Suppression-Of-Unlawful-Acts-Against-The-Safety-Of-Maritime-Navigation.pdf/e2bc4ef1d632a94ab5001aabd3e08f5b.pdf
11. Energy Security: A Critical Concern for Allies and Partners, NATO Website, Julijus GRUBLIAUSKAS & Michael RÜHLE, 2018.
12. European Atlas of the Seas Website and Allianz Commercial Website, https://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas/ and https://commercial.allianz.com/
13. H.Ceyhun TURE, Examination of Vibration Values Based on Underwater Detonations in Various Depths, Istanbul Okan University Master Thesis, 2015.
14. IMO Annual Report 2023, Reports on Acts of Piracy and Armed Robbery Against Ships, 7 June 2024.
15. International Energy Agency (IEA), World Energy Outlook 2024.
16. MARSEC COE Maritime Counter-Terrorism Course, 9 October 2024, Energy Security in the Maritime Environment by CDR H.Ceyhun TURE.
17. METEKSAN Savunma and ARES Shipyard Website, https://www.ulaq.global/ participated CORE-23 Baltics TTX (NATO ENSEC COE’s Maritime Energy Security Tabletop Exercise)
18. NATO 2030, United for a New Era, Analysis and Recommendations of the Reflection Group Appointed by the NATO Secretary General, 2020.
19. NATO ENSEC COE Website, https://www.enseccoe.org/events/table-top-exercise-coherent-resilience-2023-baltic-core-23-b-2/
20. NATO Energy Security, NATO Website, https://www.nato.int/cps/en/natohq/topics_49208.htm
21. NATO MARSEC COE Website, https://www.marseccoe.org/history/
22. NATO Strategic Concept 2022, NATO Website, https://www.nato.int/nato_static_fl2014/assets/pdf/2022/6/pdf/290622-strategic-concept.pdf
23. NATO Website, NATO’s Digital Ocean Initiative gets a boost in Portugal, https://www.nato.int/cps/en/natohq/news_228959.htm?selectedLocale=en
24. NATO Website, https://www.nato.int/cps/en/natohq/news_219441.htm

25. NATO Website, https://www.nato.int/cps/en/natolive/news_211919.htm
26. NATO Website, https://www.nato.int/docu/review/articles/2024/08/28/reinforcing-resilience-natos-role-in-enhanced-security-for-critical-undersea-infrastructure/
27. NATO Website, Accessed 19.10.2024, https://www.nato.int/cps/en/natohq/news_212039.htm
28. NATO Website, Accessed 19.10.2024, https://www.nato.int/cps/en/natohq/topics_91048.htm
29. Naval Technology Website, https://www.naval-technology.com/projects/saildrone-explorer-unmanned-surface-vessel-usv-usa/
30. Navalnews Website, ASELSAN and Sefine Shipyard MARLIN USV and Orca XLUUV, https://www.navalnews.com/naval-news/2022/09/marlin-usv-meet-turkiyes-latest-drone-ship/ https://www.navalnews.com/naval-news/2022/05/here-is-our-first-look-at-the-us-navys-orca-xluuv/
31. NY Times Website, https://www.nytimes.com/2021/07/17/world/middleeast/suez-canal-stuck-ship-ever-given.html
32. Oktay ÇETIN, Mesut Can KÖSEOĞLU, A Study on the Classification of Maritime Security Threat Topics, International Journal of Environment and Geoinformatics (IJEGEO), 2020.
33. Offshore Energy Website, https://www.offshore-energy.biz/maritime-industry-remains-easy-target-for-cyber-attacks-as-ransom-payment-demands-skyrocket/
34. OPTICS 11 Website, https://optics11.com/blog/securing-the-future-of-maritime-protection-optics11-leads-with-cutting-edge-optical-technology-for-underwater-security/
35. Ruxandra-Laura Boşilcă, Susana Ferreira, and Barry J. Ryan, Routledge Handbook of Maritime Security, 2022.
36. Reuters Website, https://www.reuters.com/world/europe/ever-given-ship-that-blocked-suez-canal-arrives-rotterdam-2021-07-29/
37. Science Direct Website, https://www.sciencedirect.com/topics/engineering/submarine-pipeline
38. Seabed Warfare: NATO and EU Member State Responses, https://euro-sd.com/2023/04/articles/30719/seabed-warfare-nato-and-eu-member-state-responses
39. Statistical Review of World Energy 2024, https://www.energyinst.org/statistical-review
40. The Guardian Website, https://www.theguardian.com/world/2002/oct/17/yemen.france
41. The Guardian Website, https://www.theguardian.com/environment/article/2024/jun/20/fossil-fuel-use-reaches-global-record-despite-clean-energy-growth
42. The Washington Post Website, https://www.washingtonpost.com/politics/2021/08/19/last-month-three-drones-attacked-an-israeli-tanker-heres-why-thats-something-new/
43. University of Maryland, Significant Multi-Domain Incidents against Critical Infrastructure (SMICI) Dataset, September 2023.
44. United Nations Conference on Trade and Development, Review of Maritime Transport 2024.
45. United Nations Convention on the Law of the Sea, https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf
46. U.S. Energy Information Administration (EIA), World Oil Transit Chokepoints, Updated: 25 June 2024.
47. Vilnius Summit Communiqué (2023), https://www.nato.int/cps/en/natohq/official_texts_217320.htm
48. Washington Summit Declaration (2024), https://www.nato.int/cps/en/natohq/official_texts_227678.htm
49. World Energy Scenarios Composing Energy Futures to 2050, https://www.worldenergy.org/assets/downloads/World-Energy-Scenarios_Composing-energy-futures-to-2050_Full-report1.pdf