

Sustainable Energy Solutions for Military Mission Systems

Market and Technology Forecast to 2032



MARKET
FORECAST

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1 Introduction

1.1 Scope

This market study offers detailed analysis of the global sustainable energy for military mission system market for two reference years and over the next eight years. The markets volumes are determined, market dynamics, industry, technological development, and government programs are analysed.

In particular, it provides an in-depth analysis of the following:

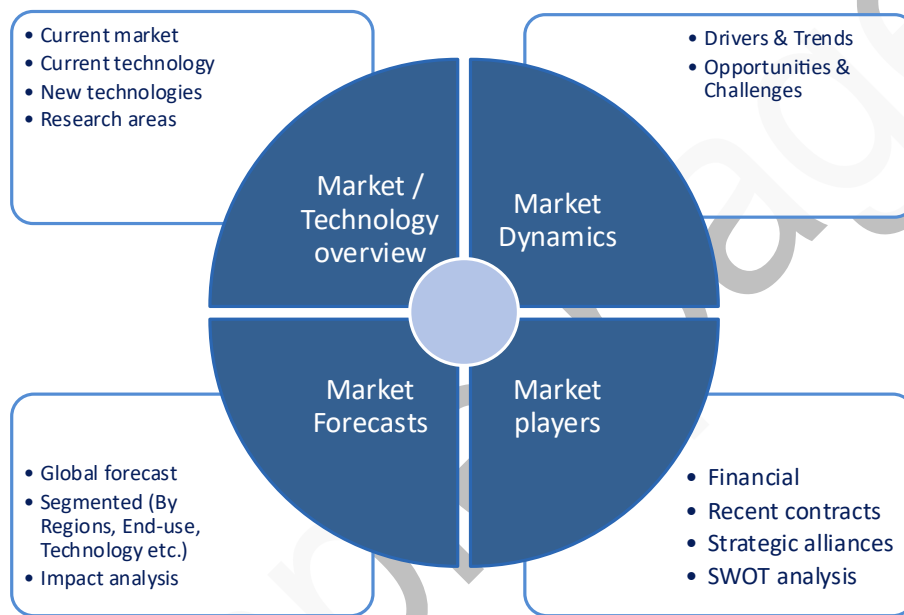
- **Overview:** Snapshot of the sustainable energy technology in the military mission system market during 2024-2032, including highlights of the demand drivers, trends, and challenges. It also provides a snapshot of the spending with respect to regions as well as segments and sheds light on the emergence of new technologies.
- **Market Dynamics:** Insights into the technological developments in the sustainable energy market and a detailed analysis of the changing preferences of governments around the world. It also analyses changing industry structure trends and the challenges faced by the industry participants.
- **Segment Analysis:** Insights into the various systems market from a segmental perspective and a detailed analysis of factors influencing the market for each segment.
- **Regional Review:** Insights into modernization patterns and budgetary allocation for top countries within a region.
- **Regional Analysis:** Insights into the systems market from a regional perspective and a detailed analysis of factors influencing the market for each region.
- **Impact Analysis:** Analysis on how certain events will impact the sustainable energy market. This will give you an indication on which factors are important for the forecast.
- **Key Program Analysis:** Details of the top programs in each segment expected to be executed during the forecast period.
- **Competitive landscape Analysis:** Analysis of competitive landscape of this industry. It provides an overview of key companies, together with insights such as key alliances, strategic initiatives, and a SWOT analysis.



1.2 Methodology

The Market Forecast team that researched, analysed, and wrote this report, combines a range of skills and talents in all relevant areas, including defence-, aerospace-, space-, and aviation technology, economics, politics and policymaking, business, and general intelligence, as well as industry/market research and analysis.

In general, our market studies consist of four main parts: analysis of the market and technologies, the analysis of the market dynamics (current and future factors that will have an impact on the market seize), the market forecasts, and the key companies in the respective market.



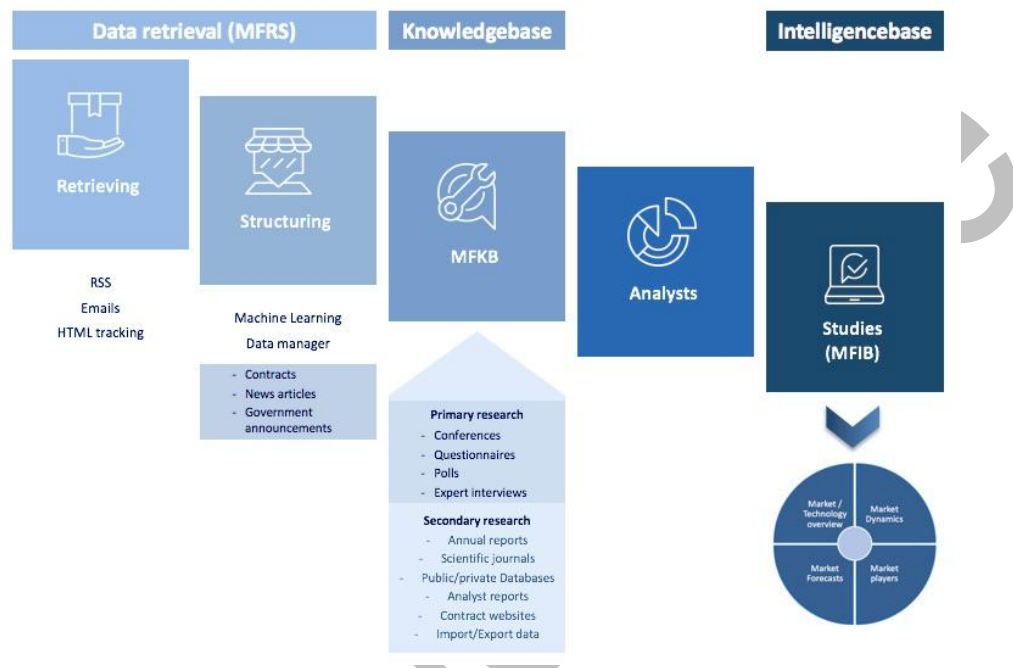
The Market Forecast methodology uses market-tailored approaches to assess the impact of new technologies, major socioeconomic or political events, or force structures in creating trends and new opportunities, or the needs generated by the existing inventories according to a capabilities-based approach. In most cases, we can base our forecast on data triangulation of requirements-, production-, and trends data, with each one of them weighing differently, depending on the market characteristics.

Unique to the defence and aerospace market is the availability of a considerable amount of information on government requirements and plans. When this information (requirements data) is available then it weighs more in market-sizing. However, when there is a scarcity of information, then the analysts will rely on trends which are based on data collected during reference years in combination with market factors, like drivers and inhibitors.

In our data structuring process, we define *programmes* for countries where we combine the requirements data from governments (customers) and production data from companies to one data set. This data set is the basis for further analysis based on *trends*. The *programmes* will in general be similar to the programmes that the defence organisations have in a country to fulfil a certain requirement, but they also could be

fictitious *programs* when the requirement is not official or when it's about a civil *program*.

Since data is the fuel of forecasting, we have developed a proprietary knowledgebase and forecast tool: MF Knowledgebase (MFKB). This is part of a platform that contains a Data Retrieval" module (MFRS) and the Intelligencebase (MFIB). The MFIB is used by our customers to access the studies.



Processing data in a structured manner in combination with expert procedures and skilled analysts leads to the best possible predictions, but not all the quantitative information is available for reason of protection and confidentiality, therefore forecasts, even the best-researched ones, are still exactly that - forecasts. Only the future will judge their accuracy. You should read our analysis and conclusions with an open mind and realize that unpredictable events could impact the market.

Impact Analysis

In addition to the main market forecast, we discuss and analyse relevant scenarios to show what the impact of certain events is on the market. The focus is on describing cases and explaining what their impact on the market is. Where the main market forecast is based on a combination of traceable data and trends from predictable *forecast factors* so does the *Impact Analysis* which considers disruptive scenarios that are less like to happen, but with great impact if they do, such as a geopolitical event or a financial crisis reducing the availability of funding. These events are less likely, but still feasible and therefore of interest to understand the market.

1.3 Who will benefit from this study?

Business Leaders & Business Developers

Business Leaders and Business Developers can use this report to identify and pursue new business opportunities, build, and sustain connections with existing clients, enter strategic partnerships, and devise other plans to boost profits and market share. The report will also help them align their proposals and pitches with the environmental and operational goals of their customers and partners in the defence sector.

Military Mission Systems Manufacturers

This report will help mission system manufacturers understand the current and future demand for renewable and efficient sources of power for their products and services, as well as the opportunities and challenges to innovate and compete in this market. The report will also help them align their solutions with the environmental and operational goals of their customers and partners in the defence sector.

Defence Policymakers

Defence policymakers will benefit from this report by acquiring knowledge and evidence to inform and align their defence strategies, budgets, and regulations with the national and international climate goals, as well as to foster collaboration and coordination among different stakeholders in the defence sector and beyond.

Sample pages



interoperability. Military mission systems are constantly evolving to adapt to the changing threats and technologies. The most important mission systems are:

- **Radar and Sensor:** Radar and sensor are devices that detect and measure the position, movement, and characteristics of objects, such as enemy aircraft, ships, or vehicles. They use radio waves, infrared, or other types of electromagnetic radiation to send and receive signals. Radar and sensor systems are extremely essential for surveillance, target acquisition, reconnaissance, and navigation.

These systems can use renewable energy sources, such as solar, wind, or hydro, to power their operations and reduce their dependence on fossil fuels. Renewable energy can also enhance the resilience and reliability of these systems, especially in remote or harsh environments, where fuel supply lines may be disrupted or vulnerable. French defence major THALES has already started rolling out solar powered radar stations in the civilian sector. Situated at Calama in the Atacama Desert, this is the first radar system of its kind to feature solar panels. These same solar powered radar stations can be used by the military as well.

Figure 6: Solar powered radar system



Source: THALES

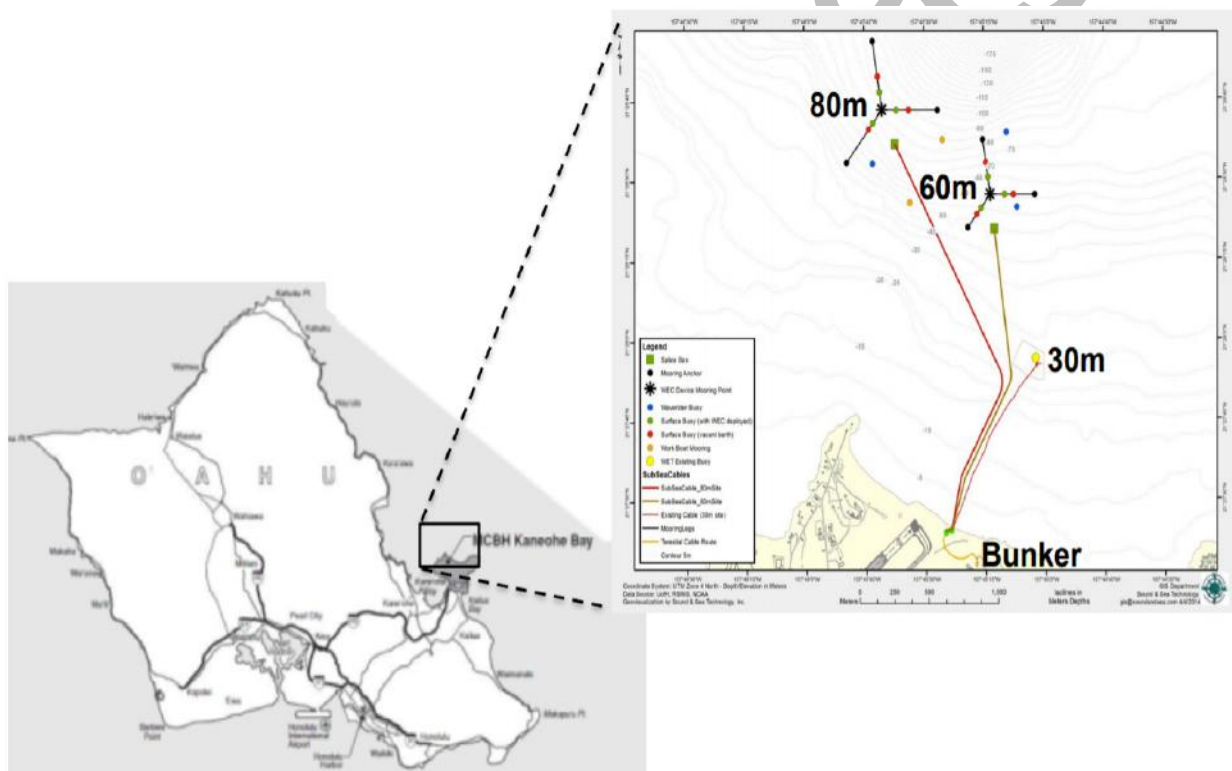
- **Communication Device:** These devices enable the transmission and reception of information, such as voice, data, or images, between different locations or platforms. Communication devices use various methods, such as radio, satellite, optical, or wire, to establish and maintain secure and reliable

- Tidal Power

The ocean's relentless dance of tides holds untapped potential. Tidal barrages, like dams for the tide, capture this energy, converting the ebb and flow into electricity. While still in its early stages, it's a promising player in the clean energy game.

The U.S. Navy's Wave Energy Test Site (WETS), the United States' first grid-connected wave energy test site, was expanded to three test berths in 2015. Through a cooperative effort between the Navy and the US Department of Energy (DOE), with the support of Hawai'i Natural Energy Institute and the Hawai'i National Marine Renewable Energy Center, WETS hosts companies seeking to test their pre-commercial WEC devices in an operational setting, enabling them to advance their device transition readiness level. Several devices have already been tested.¹⁰

Figure 14: U.S. Navy Wave Energy Test Site Mōkapu Peninsula, Marine Corps Base Hawaii



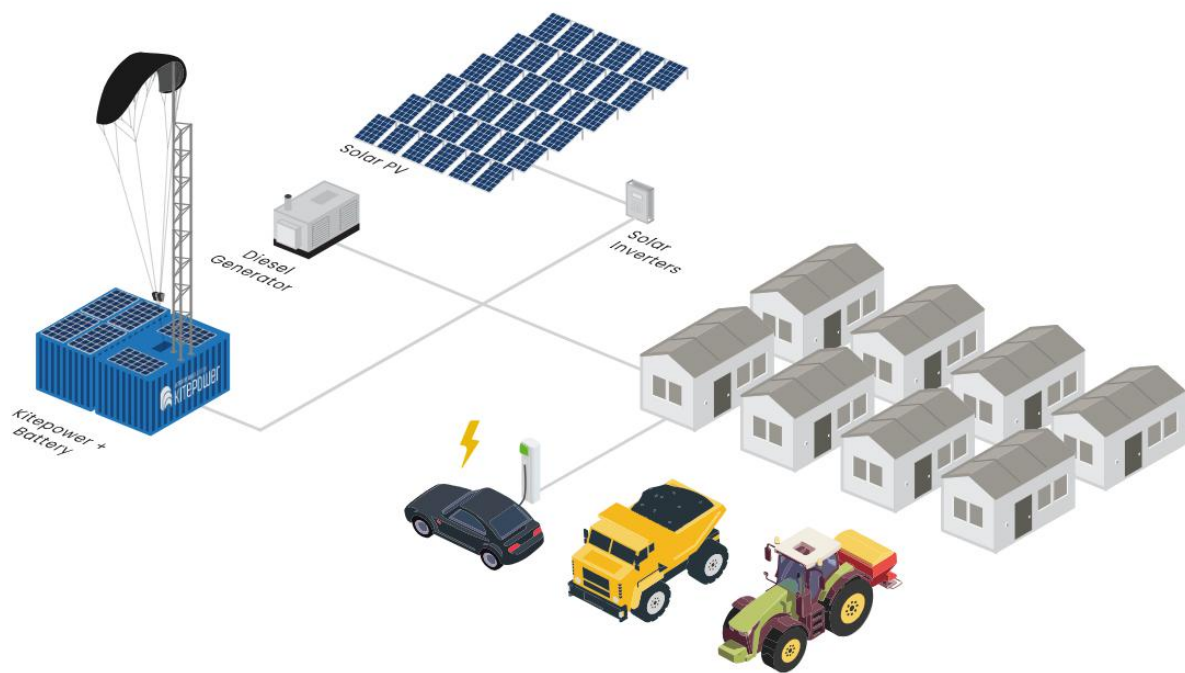
Source: US Navy

- Wind Power

Wind turbines, those elegant giants with twirling blades, tap into the wind's power, transforming it into a reliable source of clean energy. From onshore farms dotting landscapes to offshore giants braving the ocean, wind is a force to be reckoned with.

¹⁰ TETHYS (2023) "U.S. Navy Wave Energy Test Site" Available at: <https://tethys.pnnl.gov/project-sites/us-navy-wave-energy-test-site-wets> Accessed on: 20-Dec-2023

Figure 31: Hawk Battery Energy Storage System seamlessly integrates into established microgrids, powers worksites



Source: Kitepower

phelas

phelas is developing an electricity storage system to use solar and wind power even when the sun is not shining, and the wind is not blowing. Their system Aurora uses a newly developed thermodynamic process to store energy in liquid air. Through this modular, affordable, and sustainable technology, they pave the way towards a 24/7 renewable energy supply worldwide.²¹

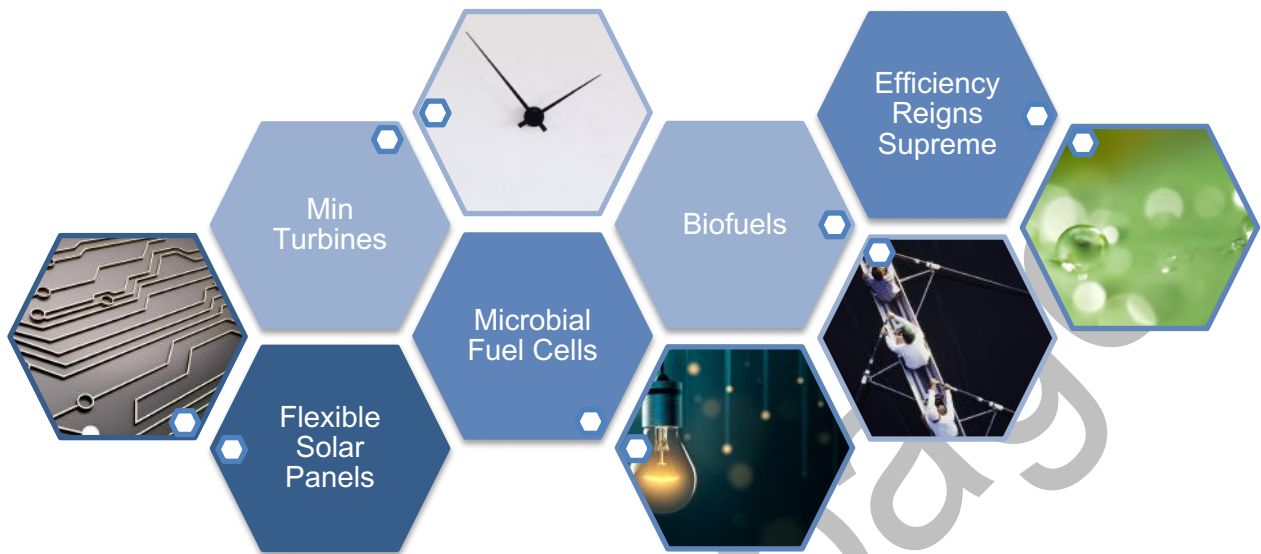
According to phelas “the phelas Aurora is a completely new thermodynamic storage system, that builds on the principles of liquid air energy storage (LAES). We use the strengths of LAES (no harmful materials, reliable components with high TRL, flexibility in scaling power and capacity independently) and adapt that to energy storage requirements. Our proprietary process design includes a custom integrated internal heat management, custom cooling process and drastic simplification of the liquefaction process. We are currently developing the world’s first prototype of a LAES system in modular container design. This makes the system not only highly flexible and transportable, but also suitable for mass production and thus economically viable.”

²¹ Phelas (2023) “Liquid Air Energy Storage enabling a 100% renewable future” Available at: <https://phelas.com/> Accessed on: 23-Dec-2023

Figure 35: Market Segmentation and Sub Segmentation Military Avionics Market



5.3 Trends



Flexible Solar Panels

Soldiers can shed their heavy generators. Instead tents and backpacks are now being infused with flexible solar panels, whispering watts under the sun. These sun-powered warriors silently feed power to the radio, GPS, or even a medical device. Solar drones glide overhead, their wings buzzing with captured sunlight, relaying intel without disturbing the peace. This is the reality of portable solar panels, making missions lighter, greener, and quieter.

Microbial Fuel Cells

Wastewater is not just waste anymore; it's a power source. Microbial Fuel Cells (MFCs) are tiny bio-factories, using friendly bacteria to turn sewage and even human urine into electricity. Self-sufficient outposts can now be fuelled by their own waste, humming with clean energy. Portable toilets become miniature power stations, providing sanitation and watts in one convenient package. MFCs might not be glamorous, but they're changing the game, one microbe at a time.

Mini Turbines

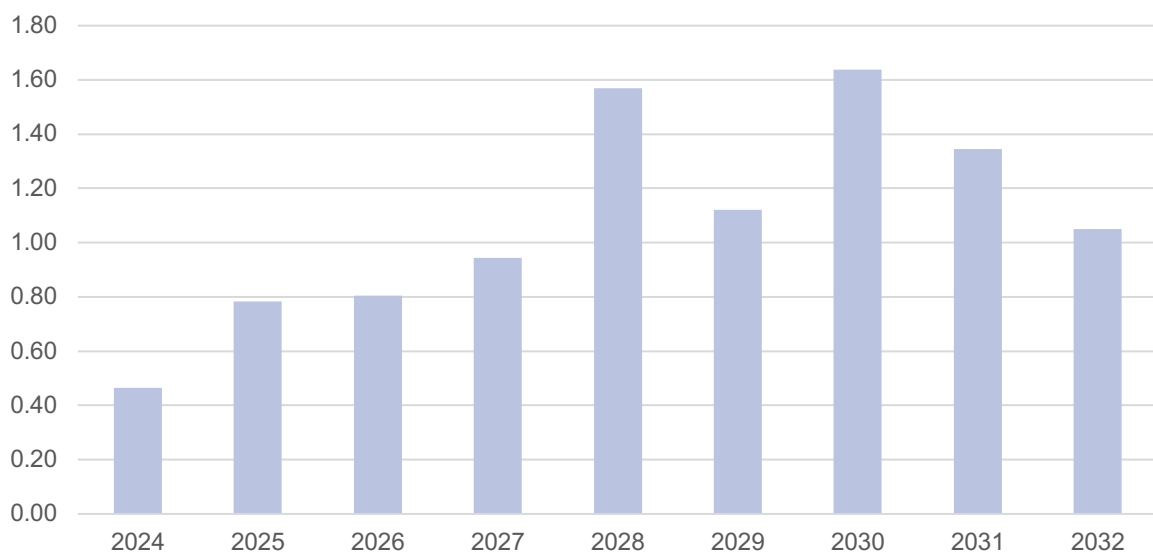
Min Turbines that quietly generate electricity for remote communication relays and sensors across the battlefield. A network of these wind whispers scattered across diverse terrains, are feeding crucial intel back to HQ, all powered by nature's gentle breath. It's clean, discreet, and perfect for those missions where silence is golden.

7.2.5 Middle East and Africa

The region has a small market size and a high growth rate, as it is an emerging market for sustainable energy solutions for military mission systems. MEA faces some challenges in terms of security threats, political conflicts, social unrests, and humanitarian crises.

MEA also has a moderate share of renewable energy sources, as it has varied climate zones and a dependence on oil and gas exports. However, MEA also has a high awareness of the importance of sustainability for military mission systems, as it seeks to diversify its economy, enhance its resilience, and contribute to global climate action.

Figure 53: Global Sustainable Energy Solutions for Military Mission Systems to 2032 by Region – Middle East & Africa [US\$ billion]



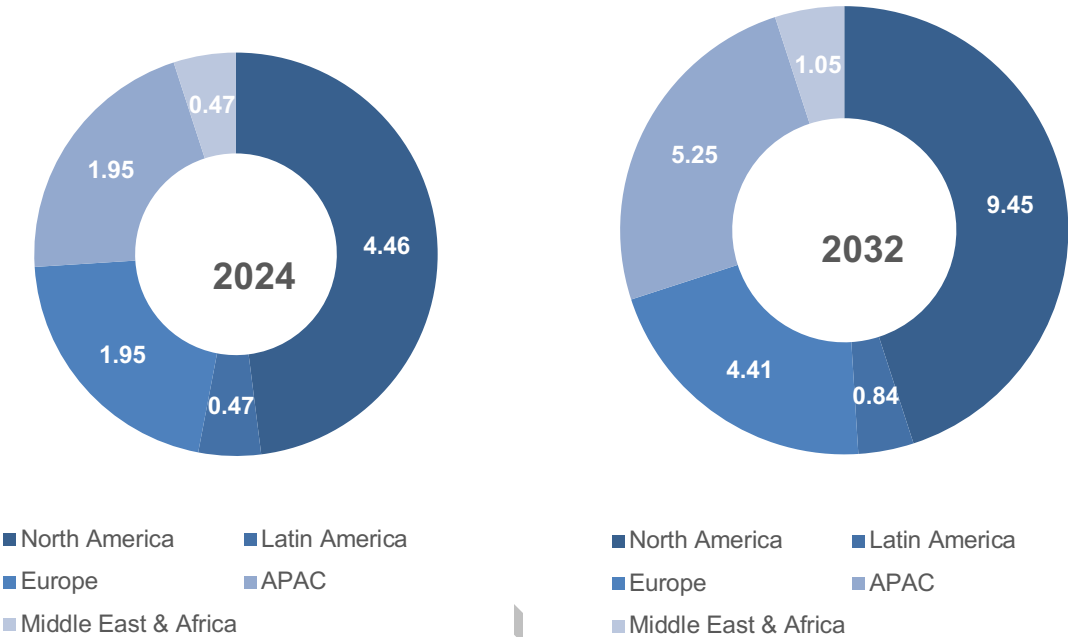
The global market size will increase from US\$9.30 billion in 2024 to US\$21.00 billion in 2032, with a CAGR of 10.72%. This means that the market size will more than double in eight years, indicating a strong demand and growth for sustainable energy solutions in the military sector.

The regional market size will also increase for all regions, but at different rates. The highest growth rate will be in APAC, with a CAGR of 13.16%, followed by Europe and MEA, both with a CAGR of 10.72%. The lowest growth rate will be in Latin America, with a CAGR of 7.67%. North America will have a moderate growth rate of 9.83% but will remain the largest market in terms of absolute value.

The reason behind the increase or decrease in the market size and share is related to the level of development, investment, potential, and challenges in the field of sustainable energy solutions for military mission systems in each region, as I explained

in my previous response. I hope this helps you compare the market size in 2024 with the market size in 2032.

Figure 54: Global Sustainable Energy Solutions for Military Mission Systems: Market Size comparison [US\$ Billion]

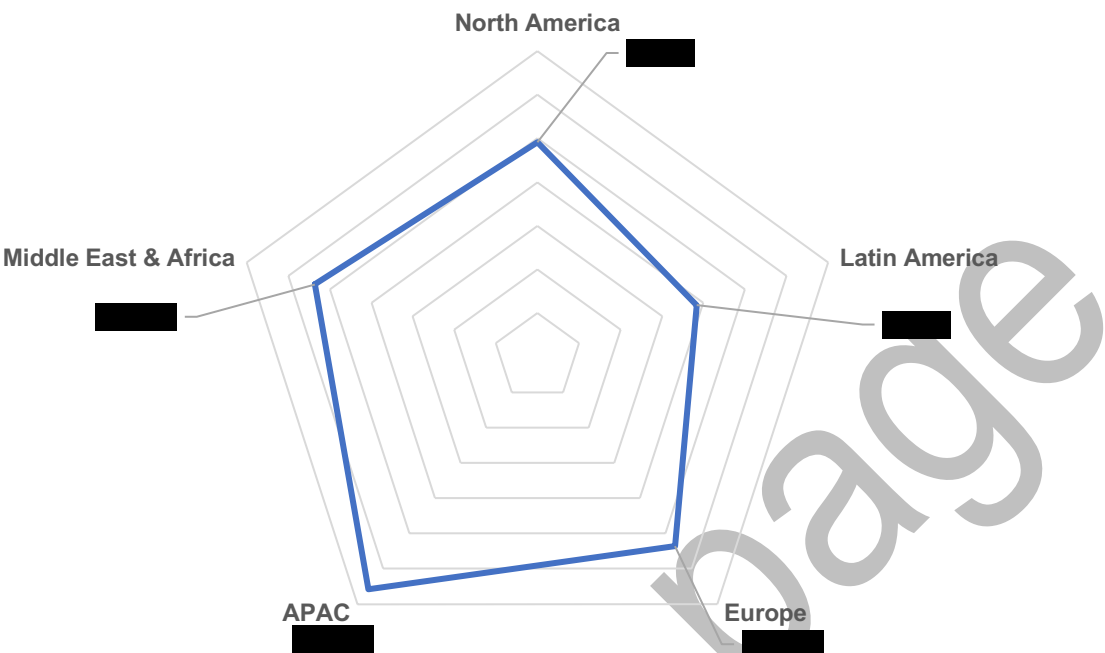


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7.3 Opportunity Analysis

Figure 55: Global Sustainable Energy Solutions for Military Mission Systems: CAGR growth for Regions



A detailed analysis for the APAC and Middle East and Africa regions, two regions with the highest CAGR during the forecast period is as follows:

APAC

The APAC region has a strong potential for growth in the market of sustainable energy solutions for military mission systems. This is because of the following factors:

- The region has a large and diverse military landscape, with countries such as China, India, Japan, South Korea, Australia, and Indonesia having significant defence budgets and modernization plans.
- The region faces various security challenges such as territorial disputes, nuclear proliferation, terrorism, piracy, and natural disasters, which require effective and reliable military capabilities.

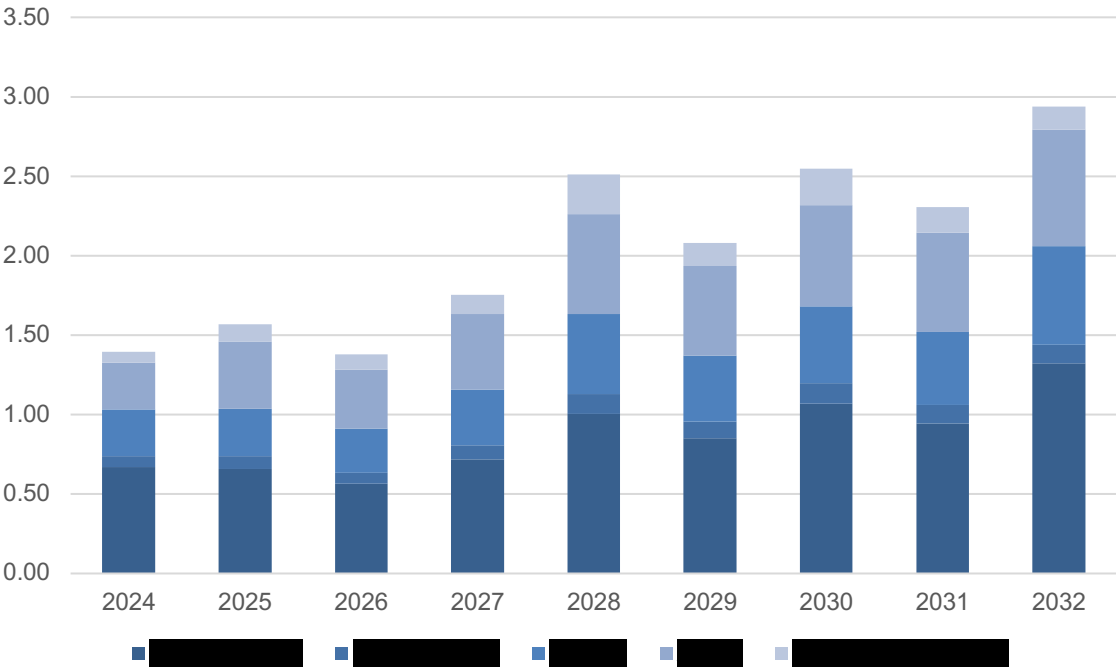
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8.2.2 Communication Device market by Region

Table 12: Communication Device Market [US\$ billion]

	2024	2025	2026	2027	2028	2029	2030	2031	2032	Σ24-32	CAGR 24 - 32
North America	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Latin America	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Europe	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
APAC	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Middle East & Africa	xx	xx	xx	xx	xx	xx	xx	xx	xx	1.33	xx
Total	1.40	xx	xx	xx	xx	xx	xx	xx	xx	18.48	9.77%

Figure 59: Communication Device Market [US\$ billion]



North America, Europe, and APAC are expected to have higher procurement budgets than Latin America and Middle East & Africa in each year of the forecast period. This could be due to several factors, such as:

11.5 Safran

Safran S.A. is a French multinational company that designs, develops, and manufactures aircraft engines, rocket engines as well as various aerospace and defence-related equipment or their components.

11.5.1 Sustainable Energy Solutions - Products and Services

Safran has developed the eRider, a hybrid electric vehicle has an on-board electric generator. eRider is a hybrid, man-driven 4-wheel-drive vehicle that can also be used as a robot has led customers to consider introducing robotics into the armed forces. eRider is part of the Light Strike Vehicle class, i.e. light tactical vehicles used by armed forces for both logistics and operational missions. Therefore, it is a man-driven, multi-mission 4-wheel-drive vehicle with configurable autonomy functions.

Figure 76: eRider hybrid vehicle



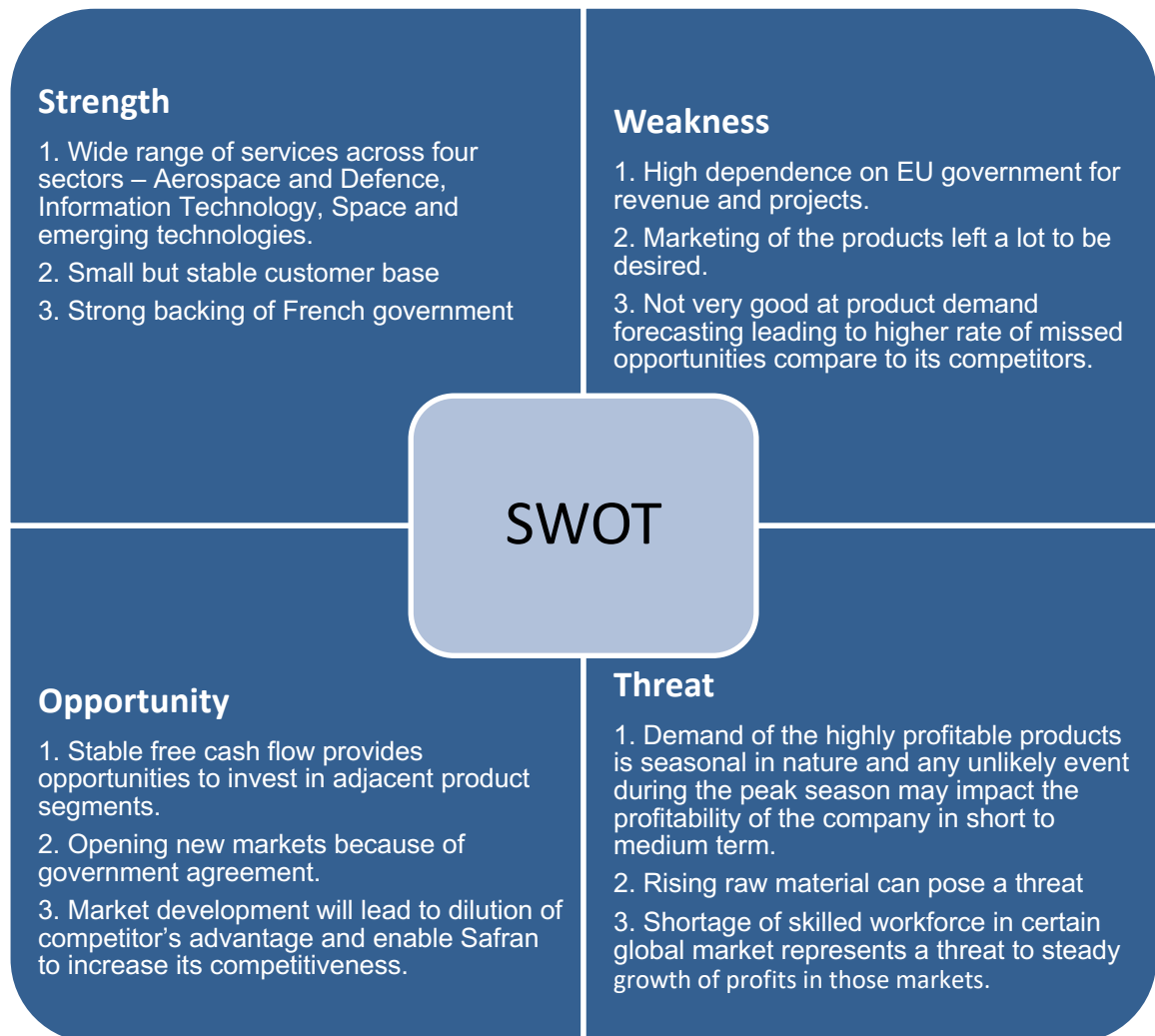
Source: Safran

11.5.2 Recent Developments and Contracts

1st June 2023: Safran signed a Memorandum of Understanding with Advent Technologies Holdings, Inc., a leader in the fuel cell and hydrogen technology sectors based in Boston, to jointly advance the development of next-generation high-temperature proton exchange membrane (HT-PEM) fuel cell technology, specifically for the aerospace sector. HT-PEM enables more efficient heat management versus low



temperature-PEM (LT-PEM). It is more adapted for applications requiring high amounts of power combined with strong integration constraints such as aviation.



Safran

13 About Market Forecast

13.1 General

Market Forecast provides intelligence studies on the Defence and Aerospace market to private and public sector organizations.

Our studies display opportunities to expand in existing markets or to develop new markets and support you in developing your market strategy.

To be able to make important business decisions you require reliable market forecasts and intelligence. Market Forecast reports provide information on stakeholders, customer requirements/potential, current inventory, available products, industry analysis, expert views and technological developments. Our research is based on a structured, consistent, and detailed research approach performed by experienced analysts.

Details on our standard research methodology are available as download on our website.

Market Forecast is a brand of the private owned company ASD Media BV and is located in Amsterdam, The Netherlands, Europe. The company exists for over fifteen years and has a long history on market research, computer models, and online products.

In our philosophy, the quality of the analyst is key for our product. Besides the unquestionable required market and analytical skills of our analysts we invest in the development of data collection and analysis technology to offer market research that is cost-effective, of high quality, up to date and instantly available.

New technology in combination with solid analyst expertise forms market intelligence that creates your competitive advantage.

13.2 Contact us

If you have any queries about this study, or would like any further information, please contact us at: contact@marketforecast.com

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1019HD Amsterdam
The Netherlands



Appendix A: Companies Mentioned

ABB Ltd

Acciona Energy

Airbus

Air Company

Alstom S.A

Arquus

BAE Systems

Boeing

City Labs

CPFL Energia SA

CropEnergies AG

Edge Autonomy

ENEL Green Power SPA

Enexor BioEnergy

Fervo Energy

First Solar

GCL Poly

General Electric

Green Plains

Guodian Technology & Environment Group Corp Ltd

Hanergy Holding Group Ltd.

Honeywell Energy Solutions

Inox Wind

Jiangsu Akcome Science & Technology Co, Ltd.

Kitepower

Lockheed Martin



Matrix Industries

Motech Industries

New A.G.E

NextEra Energy Inc

Pacific Ethanol Inc

phelas

Renewable Energy Systems

Rheinmetall AG

Robotic Research LLC

Safran

Siemens Gamesa Renewable Energy

Solar Path Sun Solutions

Volvo Penta

Sample page



Appendix B: Abbreviations

CPP - Clean Power Plan

DOD - Department of Defense

DOE - Department of Energy

PLA - People's Liberation Army

PPA - Power Purchase Agreements

PV Array - Photovoltaic Array

WtE - Waste to Energy

Sample page



Battlespace Technologies

General

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