

# **Saudi Arabia HVDC Transmission Market By Technology (Line Commutated Converter (LCC), Voltage Source Converter (VSC)), By Component (Converter Stations, Transmission Cables, Transformers, Switchgear), By End-User (Utility, Industrial, Commercial, Residential), By Region, Competition, Forecast and Opportunities, 2019-2029F**

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## **Abstracts**

Saudi Arabia HVDC Transmission Market was valued at USD 319.84 million in 2023 and is expected to reach USD 455.71 million by 2029 with a CAGR of 5.92% during the forecast period. Saudi Arabia HVDC Transmission refers to the use of High Voltage Direct Current (HVDC) technology to transmit electrical power across long distances with minimal losses and enhanced efficiency. This technology contrasts with traditional Alternating Current (AC) systems by using direct current for the transmission of electricity, which is particularly advantageous for long-distance and high-capacity power transfer. The market for HVDC transmission in Saudi Arabia is set to rise significantly due to several driving factors. As the country continues to diversify its energy mix and integrate substantial renewable energy sources, such as solar and wind, HVDC technology becomes crucial for efficiently transmitting electricity from remote generation sites to major consumption centers. The technology's ability to reduce transmission losses and stabilize the grid makes it an ideal solution for the country's vast and growing energy infrastructure. Additionally, HVDC systems offer better control and flexibility in managing power flow and integrating diverse energy sources, which aligns with Saudi Arabia's Vision 2030 goals of modernizing the energy sector and enhancing grid reliability. The expansion of HVDC projects, including new transmission lines and converter stations, will support the country's development of a robust and efficient energy network. Furthermore, the increasing demand for electricity driven by population

growth and industrial expansion, coupled with the need to connect isolated power grids, will fuel the market's growth. Investments in HVDC technology not only address these challenges but also contribute to achieving the country's sustainability and energy efficiency targets. Overall, the Saudi Arabia HVDC Transmission Market is poised for growth as it supports the nation's transition to a more reliable, efficient, and renewable energy infrastructure.

## Key Market Drivers

### Integration of Renewable Energy Sources

The integration of renewable energy sources is a significant driver for the Saudi Arabia High Voltage Direct Current Transmission Market. As Saudi Arabia advances towards diversifying its energy mix, the integration of substantial amounts of renewable energy, such as solar and wind power, has become a central focus. Renewable energy projects are often located in remote areas, where natural resources are abundant but far from major consumption centers. Traditional Alternating Current transmission systems face challenges in efficiently transmitting power over long distances due to high transmission losses and stability issues. High Voltage Direct Current technology offers a solution by enabling efficient and reliable transmission of electricity over long distances with minimal losses. This capability is crucial for connecting remote renewable energy sources with urban and industrial centers where the electricity is needed. Additionally, HVDC systems provide greater flexibility in managing power flow and integrating diverse energy sources, which is essential for maintaining grid stability and reliability as the proportion of intermittent renewable energy increases. The Saudi Vision 2030 plan emphasizes the importance of sustainable energy development and aims to increase the share of renewable energy in the national energy mix. The implementation of HVDC technology aligns with these objectives by facilitating the efficient transmission of renewable energy, supporting the country's transition to a greener and more sustainable energy infrastructure. As renewable energy projects continue to expand, the demand for HVDC transmission systems is expected to grow, driving the market forward.

### Enhancement of Grid Reliability and Stability

The enhancement of grid reliability and stability is another crucial driver for the Saudi Arabia High Voltage Direct Current Transmission Market. As the country's energy infrastructure evolves and expands, maintaining a stable and reliable grid becomes increasingly important. High Voltage Direct Current technology offers several advantages in this regard, including improved control over power flow and better

management of electrical disturbances. HVDC systems can stabilize the grid by isolating disturbances and preventing them from affecting the entire network. This capability is particularly valuable in large and complex grids where balancing supply and demand can be challenging. Furthermore, HVDC systems enable the interconnection of asynchronous power grids, allowing different regions or countries with varying grid characteristics to operate harmoniously together. This interconnection can enhance overall grid stability and reliability by providing additional flexibility and redundancy. In Saudi Arabia, the growing demand for electricity and the expansion of energy infrastructure necessitate advanced technologies that can ensure consistent and reliable power supply. HVDC technology addresses these needs by offering superior performance in managing power flows and mitigating grid disruptions. The increased focus on grid reliability and stability, driven by both technological advancements and the need to support a growing and dynamic energy market, is expected to propel the demand for HVDC transmission systems in the region.

### Support for Economic and Industrial Growth

Support for economic and industrial growth is a key driver for the Saudi Arabia High Voltage Direct Current Transmission Market. As Saudi Arabia undergoes significant economic diversification and industrial expansion, there is a growing need for robust and efficient energy infrastructure to support this growth. High Voltage Direct Current technology provides a reliable solution for transmitting large amounts of electricity over long distances, which is essential for powering industrial facilities, commercial enterprises, and residential areas. The development of new industrial zones, economic hubs, and urban centers requires a dependable and high-capacity energy transmission system to meet the increased demand for electricity. HVDC systems offer several benefits in this context, including enhanced transmission capacity, reduced energy losses, and improved grid stability. These advantages are crucial for supporting large-scale industrial operations and ensuring that energy supply meets the demands of a growing economy. Additionally, the integration of HVDC technology aligns with Saudi Arabia's Vision 2030 objectives, which aim to foster economic growth and development through the modernization of infrastructure and the promotion of sustainable energy practices. By facilitating the efficient transmission of electricity to key economic and industrial areas, HVDC technology plays a vital role in supporting the country's economic ambitions and driving market growth.

### Key Market Challenges

#### High Initial Capital Investment

One of the significant challenges facing the Saudi Arabia High Voltage Direct Current Transmission Market is the high initial capital investment required for the implementation of HVDC systems. The development of High Voltage Direct Current infrastructure involves substantial upfront costs, including expenses related to the construction of converter stations, installation of transmission cables, and procurement of specialized equipment. These costs can be a barrier for many stakeholders, especially when compared to traditional Alternating Current systems, which typically have lower initial capital requirements. The complexity of HVDC technology, including the need for advanced converter stations that convert direct current to alternating current and vice versa, further drives up the costs. Additionally, the installation of underground or submarine cables required for certain HVDC projects can significantly increase expenses. For a country like Saudi Arabia, which is heavily investing in expanding and modernizing its energy infrastructure, the high cost of HVDC technology poses a financial challenge that must be carefully managed. To address this issue, stakeholders need to explore innovative financing mechanisms, such as public-private partnerships, and assess the long-term benefits of HVDC technology, including reduced transmission losses and enhanced grid reliability, to justify the initial investment. Ensuring that the economic benefits outweigh the upfront costs is crucial for encouraging broader adoption of HVDC systems and overcoming this financial hurdle.

### Technical Complexity and Integration Challenges

The technical complexity and integration challenges associated with High Voltage Direct Current systems present another significant obstacle for the Saudi Arabia HVDC Transmission Market. HVDC technology involves intricate and sophisticated components, including high-voltage converter stations, control systems, and advanced protection mechanisms. The integration of these systems into existing Alternating Current grids requires specialized knowledge and expertise, as HVDC systems operate differently from traditional power transmission methods. The process of connecting HVDC systems with existing grid infrastructure can be technically demanding, involving complex engineering solutions to ensure compatibility and seamless operation. Additionally, the operation and maintenance of HVDC systems require specialized skills and training, which can be a limitation in regions where such expertise is scarce. In Saudi Arabia, the successful deployment of HVDC technology depends on overcoming these technical challenges, including addressing issues related to system interoperability, grid stability, and operational efficiency. Developing local expertise, investing in training programs, and fostering collaboration with international technology providers are essential steps to manage these challenges effectively. By addressing the

technical complexities and ensuring smooth integration with existing infrastructure, the Saudi Arabia HVDC Transmission Market can advance and realize the full potential of this technology.

## Key Market Trends

### Increased Adoption of Voltage Source Converter Technology

The increasing adoption of Voltage Source Converter technology is a prominent trend in the Saudi Arabia High Voltage Direct Current Transmission Market. Voltage Source Converters represent a significant advancement in HVDC technology, offering greater flexibility and efficiency in power transmission. Unlike traditional Line Commutated Converters, Voltage Source Converters use semiconductor devices to convert direct current to alternating current and vice versa, providing enhanced control over power flows and improved performance in integrating renewable energy sources. This technology enables the connection of asynchronous power grids, facilitating the integration of diverse energy sources and enhancing overall grid stability. In Saudi Arabia, where there is a growing emphasis on incorporating renewable energy into the national grid, Voltage Source Converter technology is becoming increasingly attractive. It allows for more efficient transmission of power from remote renewable energy projects to major consumption centers, supporting the country's goals of diversifying its energy mix and reducing reliance on fossil fuels. The adoption of this advanced technology is also driven by its ability to improve the reliability and flexibility of the grid, which is essential for meeting the demands of a rapidly evolving energy landscape. As Saudi Arabia continues to invest in modernizing its energy infrastructure, the use of Voltage Source Converter technology is expected to play a key role in shaping the future of the HVDC transmission market in the region.

### Expansion of Cross-Border HVDC Interconnections

The expansion of cross-border High Voltage Direct Current interconnections is another significant trend in the Saudi Arabia High Voltage Direct Current Transmission Market. As Saudi Arabia seeks to enhance its energy security and integrate more effectively with neighboring countries, the development of HVDC interconnections across borders is becoming increasingly important. Cross-border HVDC links facilitate the transfer of electricity between different national grids, allowing for the sharing of resources and the balancing of supply and demand across regions. This trend is driven by the need to optimize energy resources, reduce reliance on localized generation, and enhance grid stability and reliability. For Saudi Arabia, cross-border HVDC interconnections offer

opportunities to export excess electricity generated from renewable sources to neighboring countries, contributing to regional energy cooperation and economic integration. Additionally, these interconnections can provide backup power during emergencies and support the development of a more resilient and interconnected regional grid. The expansion of cross-border HVDC projects aligns with Saudi Arabia's Vision 2030 objectives of fostering regional collaboration and enhancing the efficiency of energy infrastructure. As the country continues to pursue these objectives, the growth of cross-border HVDC interconnections is expected to be a key trend in the evolving HVDC transmission market.

### Focus on Technological Innovations and Efficiency

A notable trend in the Saudi Arabia High Voltage Direct Current Transmission Market is the growing focus on technological innovations and improvements in efficiency. As the demand for more efficient and reliable power transmission solutions increases, stakeholders are investing in research and development to advance HVDC technology. Innovations in semiconductor materials, power electronics, and control systems are driving enhancements in the performance and efficiency of HVDC systems. These technological advancements aim to reduce transmission losses, increase capacity, and improve the overall reliability of HVDC infrastructure. In Saudi Arabia, the emphasis on technological innovation aligns with the country's broader goals of modernizing its energy sector and achieving greater sustainability. The development of advanced HVDC technologies, such as high-efficiency converters and state-of-the-art monitoring and control systems, supports the efficient integration of renewable energy sources and enhances the capability of the national grid. Additionally, the focus on efficiency extends to the optimization of existing HVDC systems, with ongoing efforts to enhance their performance and reduce operational costs. As Saudi Arabia continues to prioritize the modernization of its energy infrastructure, the trend towards technological innovation and improved efficiency in HVDC transmission is expected to play a crucial role in shaping the future of the market.

### Segmental Insights

#### Technology Insights

In 2023, the Line Commutated Converter segment dominated the Saudi Arabia High Voltage Direct Current Transmission Market and is expected to maintain its dominance throughout the forecast period. Line Commutated Converters have been the traditional choice for high-capacity direct current transmission due to their proven reliability and

efficiency in handling large amounts of power over long distances. This technology, which utilizes thyristor-based systems for converting direct current to alternating current and vice versa, is well-established and widely used in existing high voltage direct current projects around the world, including in Saudi Arabia. The advantages of Line Commutated Converters include their robustness, lower cost for high-capacity installations, and ability to handle large-scale energy transfers effectively. Given Saudi Arabia's extensive energy infrastructure and ongoing investments in expanding and modernizing its grid, the continued preference for Line Commutated Converters is driven by their cost-effectiveness and capacity to support large-scale power transmission needs. While Voltage Source Converters offer advanced features such as greater flexibility and better integration with renewable energy sources, the established track record and economic benefits of Line Commutated Converters ensure their continued dominance in the Saudi Arabian market. As the country focuses on enhancing its energy infrastructure and meeting growing power demands, the Line Commutated Converter segment is anticipated to remain the leading technology choice due to its reliability, cost-efficiency, and capacity to support the national energy grid's requirements.

## Regional Insights

In 2023, the Eastern Province dominated the Saudi Arabia High Voltage Direct Current Transmission Market and is projected to maintain its leading position throughout the forecast period. The Eastern Province, home to major oil and gas production facilities and key industrial hubs, represents a critical area for energy infrastructure development. This region's dominance is driven by its significant role in the country's energy sector, including the concentration of large-scale power generation and processing facilities. As Saudi Arabia continues to invest in expanding and modernizing its energy infrastructure, the Eastern Province is central to these efforts due to its strategic importance in supporting both local and national energy needs. The development of high voltage direct current transmission systems in this region is essential for efficiently transporting electricity from remote generation sites to major consumption centers, including industrial areas and urban centers. Additionally, the Eastern Province's ongoing investments in new energy projects and infrastructure upgrades further drive the demand for advanced transmission technologies, including high voltage direct current systems. The region's established role as an energy hub, coupled with its continued focus on infrastructure development and modernization, ensures that it will remain the dominant market segment in the Saudi Arabian high voltage direct current transmission sector. As the country seeks to enhance its energy transmission capabilities and support growing energy demands, the Eastern Province will continue to be at the

forefront of high voltage direct current market activities.

### Key Market Players

ABB Ltd

Siemens Energy AG

General Electric Company

Schneider Electric SE

Mitsubishi Electric Corporation

Hitachi Energy Ltd

NR Electric Co., Ltd

Toshiba Energy Systems & Solutions Corporation

Sungrow Power Supply Co., Ltd

AESC Group Ltd

### Report Scope:

In this report, the Saudi Arabia HVDC Transmission Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

Saudi Arabia HVDC Transmission Market, By Technology:

Line Commutated Converter (LCC)

Voltage Source Converter (VSC)

Saudi Arabia HVDC Transmission Market, By Component:



Converter Stations

Transmission Cables

Transformers

Switchgear

Saudi Arabia HVDC Transmission Market, By End-user:

Utility

Industrial

Commercial

Residential

Saudi Arabia HVDC Transmission Market, By Region:

Riyadh

Makkah

Madinah

Jeddah

Tabuk

Eastern Province

Rest of Saudi Arabia

Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Saudi Arabia HVDC Transmission Market.

*Saudi Arabia HVDC Transmission Market By Technology (Line Commutated Converter (LCC), Voltage Source Converter...*

### Available Customizations:

Saudi Arabia HVDC Transmission Market report with the given market data, TechSci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

#### Company Information

Detailed analysis and profiling of additional market players (up to five).

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