

Key Markets to Revert to Centralized Substation Automation Systems in the Future

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Substation automation system (SAS) is a technological package consisting of hardware and software components that helps grid operators monitor as well as control the grid, both locally and remotely.



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A substation automation system (SAS) is, essentially, a technological package consisting of hardware and software components that helps grid operators monitor as well as control the grid, both locally and remotely. These technological solutions provide remote control and monitoring functions to all kinds of substations (ranging from distribution voltage level up to extra high voltage level substations), leading to improved safety and increased reliability and efficiency of the grid.

Substation automation systems are usually deployed by sectors where the availability of energy is of critical importance and the capability to monitor and control the energy flows is imperative; for instance: transmission, distribution, generation, O&G, mining, and data centers, among others. Most of the substation automation systems are installed in the transmission, distribution, and

generation sector whilst mining, O&G, and data centers generate a much less demand at the global level (Figure 1).

There are two types of SAS architectures that are discussed in this article, namely centralized and distributed architecture (Figure 2). In centralized architecture all the protection and control functions are provided by a single device at the substation level, while in the distributed architecture these functions are configured at bay level (substation has multiple bays).

Major Trends in the Key Markets of Substation Automation Systems

Certain key markets of substation automation systems, such as China, India, Germany, Saudi Arabia, the U.S., and Brazil, are of great interest for original equipment manufacturers

(OEMs) around the globe. The annual SAS market for these key countries has a higher share of distributed SAS than centralized SAS (with the U.S. being an exception). However, it is expected that, in the upcoming five years, the situation will change as the market will tilt towards centralized SAS.

China

In China, the demand for centralized substation automation system is expected to significantly increase year-on-year in the next few years. Initially, the utility sector was significantly inclined towards adoption of distributed SAS, but the market is currently moving towards the adoption of centralized SAS. In the oil and gas sector of China for 132 kV substation, distributed SAS is preferred, while centralized SAS is given priority for 10 kV substation. As far as the demand drivers for the SAS market are concerned, it is significant to note that distributed



generation is the major driving factor for the SAS market in China. Additionally, big data, AI, and edge computing is also driving the Chinese SAS market. Moreover, China is observing substantial growth in the EV charging infrastructure, which is also adding to the demand for substation automation systems in the country.

India

In India, the annual market share of distributed SAS is more than that of centralized SAS. At HV level, distributed SAS is more prevalent, while centralized SAS is seen more at MV level. The top three application verticals for distributed SAS are: transmission, distribution, and oil and gas. As per the estimates of Power Technology Research, in the upcoming years these application verticals are expected to move towards centralized SAS. It is

significant to note that India is a cost sensitive market so the technologies that are deployed in the country are greatly influenced by cost.

Currently, microgrid and EV charging infrastructure are the two key reasons for growth in India's substation automation market. Moving forward, renewables along with data centers will be driving the demand for substation automation systems in the country.

Germany

In Germany, the annual market share of distributed SAS is significantly higher than that of centralized SAS. Currently, the demand for centralized SAS is coming from the industry and it is expected that the demand will only intensify in the future. Subsequently, the market share of centralized SAS is expected to increase in the upcoming years in the country.

Power Technology Research has observed that offshore substations in Germany are heavily tilted towards distributed SAS (at present), but the situation is expected to reverse in the upcoming years. Owing to the integration of distributed energy resources with the grid in the country, the demand for SAS in the lower voltage level will ramp up in the next five years. It is also observed that the substantial growth in the EV charging infrastructure is pushing the utilities towards automation of their substations in the country. Furthermore, all the new substations in Germany are expected to be automated.

Saudi Arabia

In Saudi Arabia, distributed SAS have a significant share in the country's annual market, followed by centralized SAS. It is not mandatory for distribution substations in the country to install SAS so most of the substations in the country have the

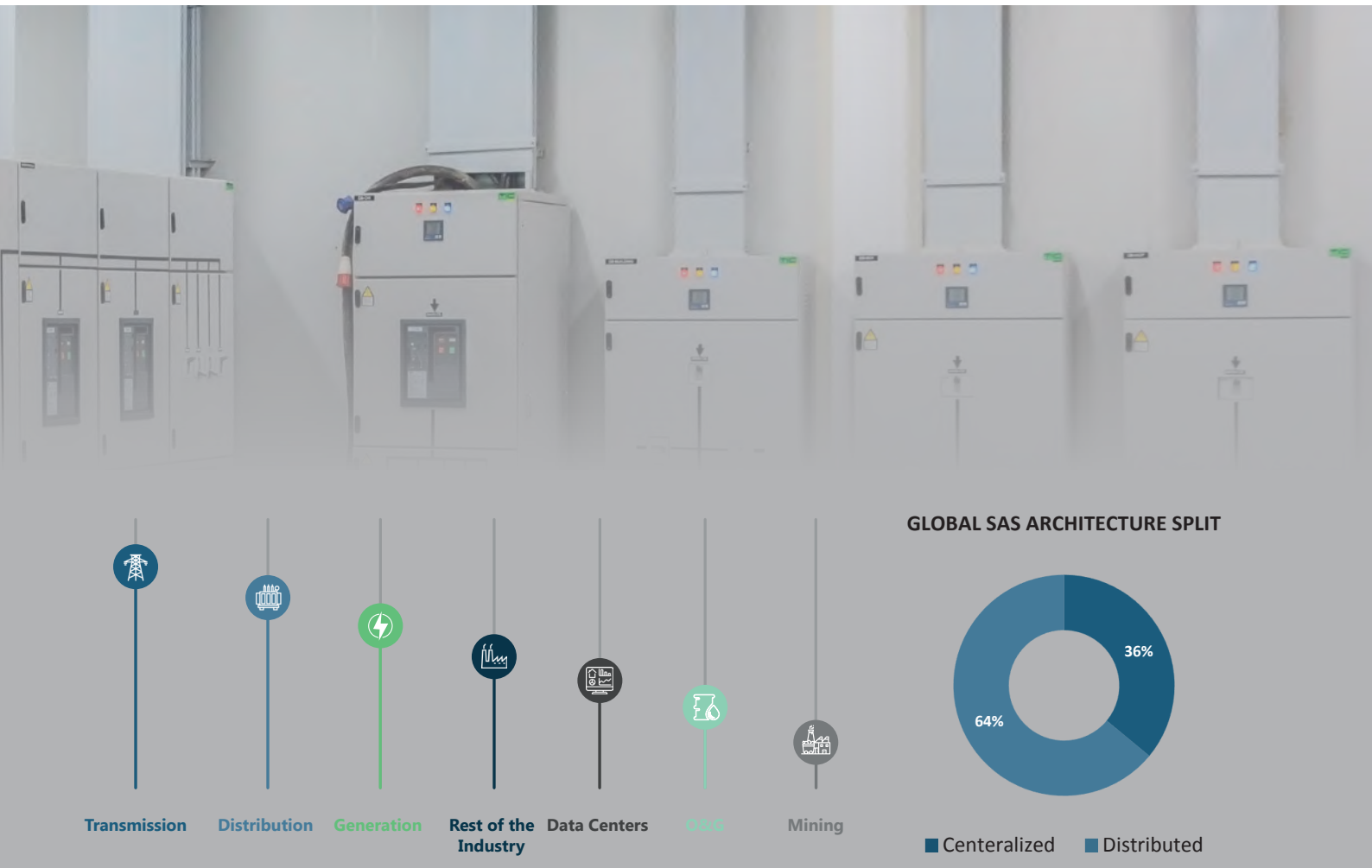


Figure 1. Demand wise ranking of SAS applications. Source: Power Technology Research

Figure 2. Global SAS architecture split. Source: Power Technology Research

conventional RTU-based protection scheme. As per the estimates of Power Technology Research, most of the demand for centralized SAS will be coming from the distribution sector and the industry (especially oil and gas), while the transmission sector will be driving the market for distributed SAS in Saudi Arabia.

As far as the key drivers for the SAS market of Saudi Arabia in general are concerned, major infrastructure projects, like Neom City and the Red Sea City, are one of the main growth drivers for the substation automation market in the Kingdom. In addition, increased grid reliability concerns, the need for better control and command and trend for grid digitalization is also providing a push to the Saudi SAS market.

The U.S. has a significant share of centralized SAS in the annual market compared to distributed SAS. The main demand drivers for the U.S. SAS market are the widespread deployment of electric vehicle charging infrastructure followed by the uptake of renewables in the country.

The U.S.

The U.S., unlike other key SAS markets, has a significant share of centralized SAS in the annual market compared to distributed SAS. In the U.S. centralized SAS are preferred and, in situations where cost is not an issue, redundant centralized SAS are also deployed. In the next few

years, as per the projections of Power Technology Research, the distribution sector as well as small power plants in the country will deploy centralized substation automation systems. As far as the demand drivers for the U.S. SAS market are concerned, the widespread deployment of electric vehicle charging infrastructure followed by the uptake of renewables in the country are driving the market.

Brazil

Nowadays, substation automation solutions are broadly requested in Brazil. The annual market share of distributed SAS in Brazil is slightly above centralized SAS. As per the projections of Power Technology Research for the next five years, the Brazilian market will lean towards centralized SAS



more, mainly due to the increased penetration of renewable energy with the distribution grid, followed by the increased deployment of EV charging infrastructure. Furthermore, the transmission sector is also expected to drive the demand for centralized SAS in the next 5 years.

The digitalization of a substation will be followed by an era of virtualization, where a digital twin of a substation will exist for both control and monitoring purposes. OEMs are very keen to know if the global market will move towards the virtualization of the substations in the future or not.

Looking Ahead

The evolutionary process of a substation is such that in the initial phase, most of the substations move towards the adoption of automation technology, followed by the digitalization of the substation. Digitalization is carried out via IEC-61850, which is an international standard that sets communication protocols for intelligent electronic devices and other equipment (protection, control, and measurement equipment) at a substation. We are currently in the era of digitalization where, along with the integration of the latest technologies with the grid, utilities are moving towards solutions that increase the overall reliability of the system. The digitalization of a substation will be

followed by an era of virtualization, where a digital twin of a substation will exist for both control and monitoring purposes. OEMs are very keen to know if the global market will move towards the virtualization of the substations in the future or not.

Finally, as far as the key markets for substation automation systems are concerned, they are expected to revert to centralized substation automation systems in the coming years, which would lead to an increase in the installed base of centralized SAS. However, the U.S. is an exception as it already has a higher share of centralized SAS as compared to distributed SAS in the annual market; where cost is not a major concern, the deployment of redundant centralized SAS is also observed.

