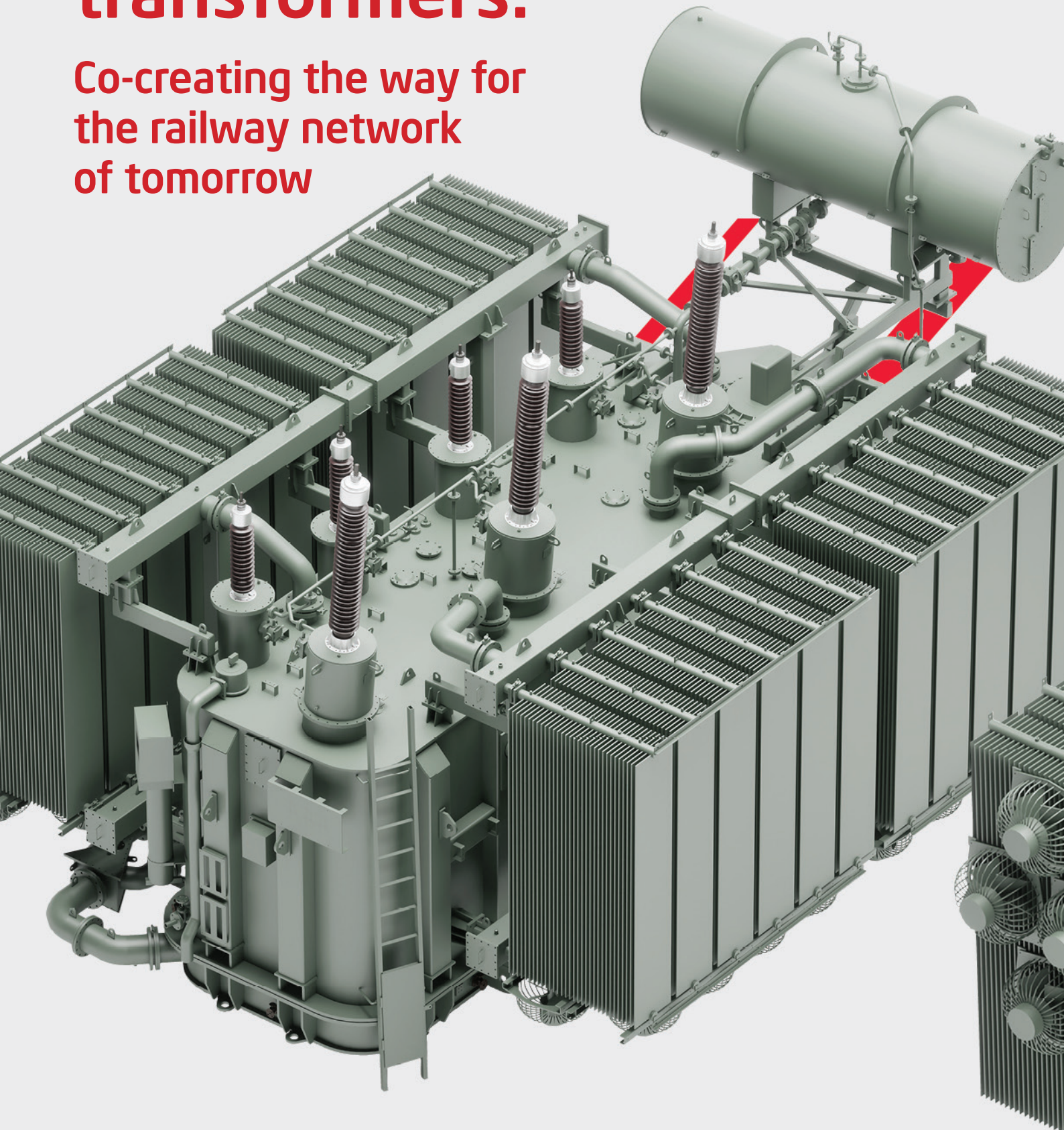
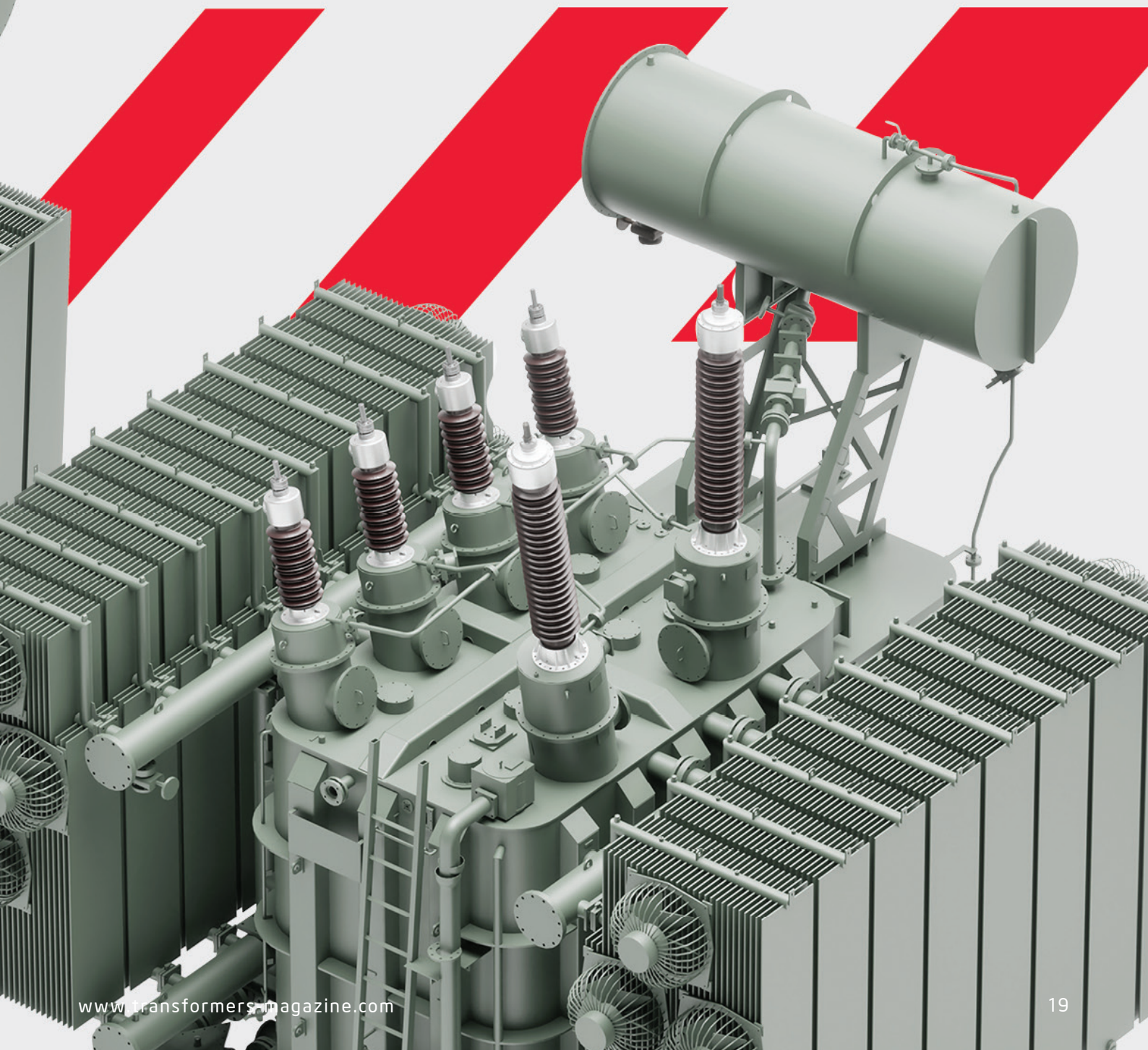


Hitachi Energy's Scott & V-Connected transformers:

Co-creating the way for
the railway network
of tomorrow



We are witnessing a growing governmental encouragement of train usage as a means of reducing global CO₂ emissions through the promotion of sustainable daily practices



India's railway network is the lifeline of the nation, transporting billions of passengers and countless tons of freight annually

The railway industry is facing significant challenges due to the increasing popularity of trains for both commuting and freight transport, as this represents an environmentally sustainable and convenient solution. From one perspective, we are witnessing a growing governmental encouragement of train usage as a means of reducing global CO₂ emissions through the promotion of sustainable daily practices. However, this has placed increased pressure on rail operators, who are required to electrify more lines with more sustainable solutions than the traditional high-emission diesel engines.

However, real challenges are being raised in many existing rail electrical infrastructures of developing countries, which still use old system configurations and old technology equipment that are outdated and unable to support the rising demand for more frequent and faster

train services. This inefficiency, coupled with rail lines congestion caused by an increased number of passengers, requires substantial investments to modernize or expand the existing infrastructure.

In its mission to support its customers in achieving their sustainability goals and meeting their needs, Hitachi Energy has designed an ideal solution to upgrade its transformers and contribute to creating a stronger and more sustainable railway network.

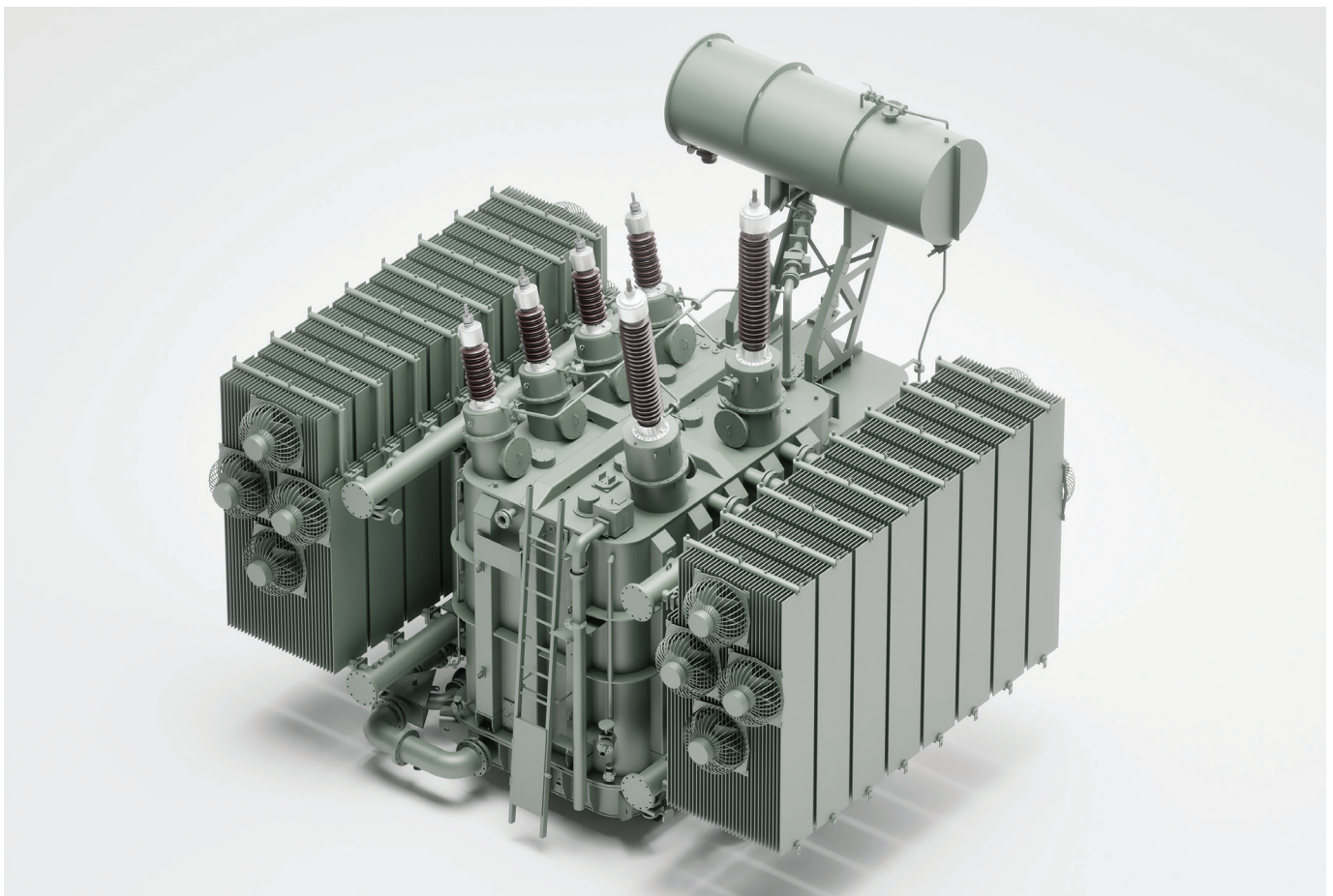
In the pioneering spirit that Hitachi Energy has in its DNA, innovations are often found through collaboration, which is why through a project developed together with Indian Railways, the Scott-connected and V-connected Transformers have been designed and developed to fulfil the specific requirements of the new 2x27 kV system intro-

duced by Indian Railways.

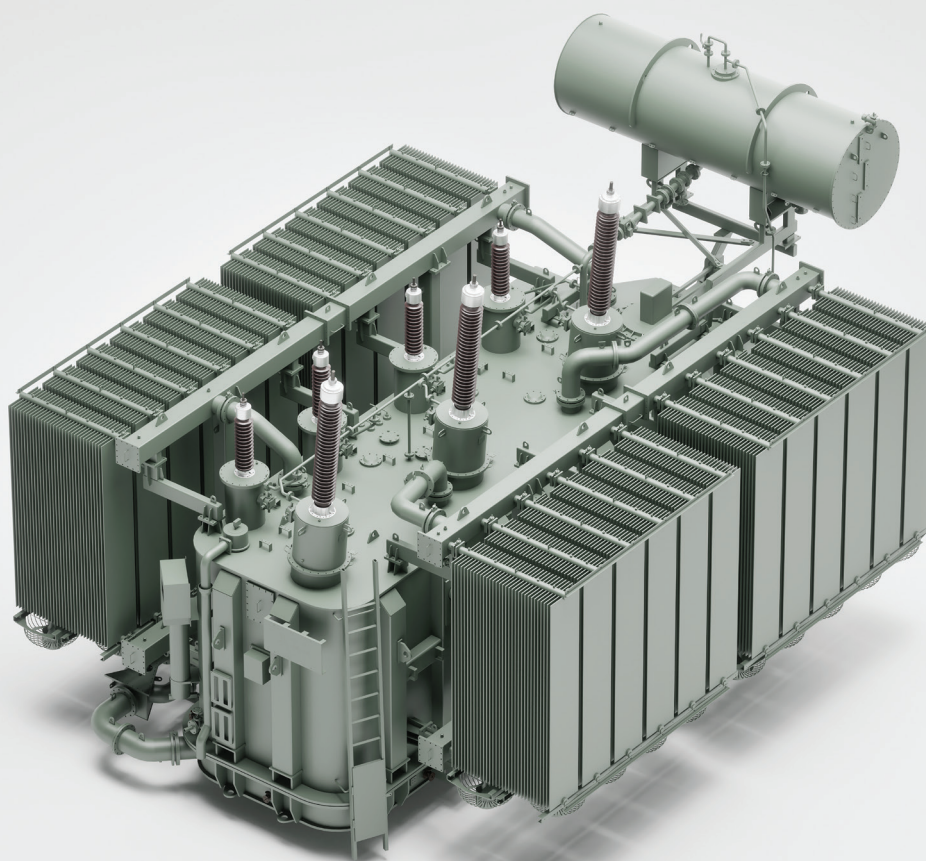
Powering Indian Railway Modernization

India's railway network is the lifeline of the nation, transporting billions of passengers and countless tons of freight annually. As the country continues to grow and develop, the demands placed on this critical infrastructure have intensified. Longer, faster, and more frequent trains are essential to meet the aspirations of a burgeoning economy. However, India's railway network, while extensive, faces significant challenges in meeting the growing demands of a rapidly developing nation.

The traditional single-phase 27.5 kV power supply system, while adequate for earlier needs, is now a hold-up for further development, as increasing train speeds and higher traffic density necessitate substantial consequent increases



V-connected Transformer 60 MVA 132 kV



Scott-connected Transformer 100 MVA 220 kV

To implement this 2x27 kV system, Indian Railways relied on Hitachi Energy's expertise in specialized traction power transformers

in power delivery. The first challenge is to raise the power rating of single-phase transformers while maintaining the 27.5 kV voltage level, which is impractical as it would cause a higher voltage imbalance, leading to significant voltage drops. Secondly, power delivery at this voltage level will result in higher power losses, reduced efficiency, and infrastructure limitations.

Thus, the limitations of the existing system posed clear challenges to the railway network's ability to meet the rising expectations of passengers and freight operators. To address the growing challenges and unlock the full potential of India's railway network, a paradigm shift was required.

Recognizing the limitations of the existing single-phase 27.5 kV system, Indian Railways has made the decision to adopt the innovative approach of directly supplying power to two separate 27 kV rail-

way lines. By doubling the voltage, the 2x27 kV system can deliver significantly higher power levels to trains, enabling increased speeds and capacities without the drawbacks of increasing current in a single-phase system.

To implement this 2x27 kV system, Indian Railways relied on Hitachi Energy's expertise in specialized traction power transformers and together developed the Scott-connected and V-connected Specialty Transformers.

The improved power quality and efficiency offered by the development of these new transformers will lead to lower energy losses and reduced environmental impact. In fact, the adoption of Hitachi Energy's Scott-Connected and V-Connected Transformers can lead to a 30% reduction in CO₂ emissions associated with transformers. As India strives to achieve its sustainability goals, Hitachi Energy's technology plays a crucial

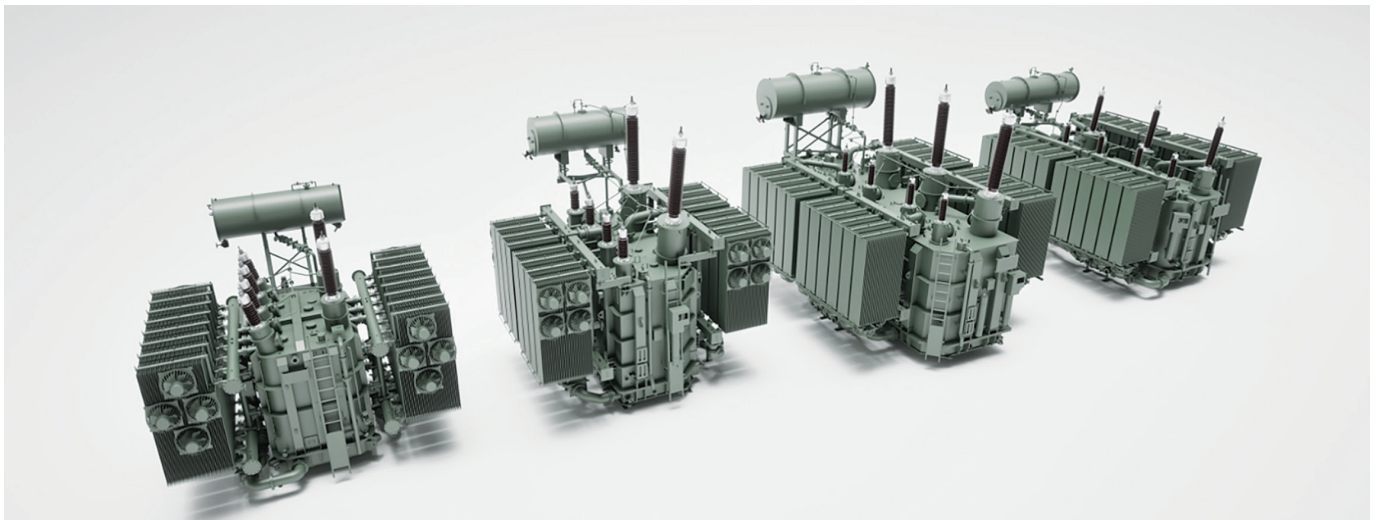
role in building a greener and cleaner rail network.

The benefits of these transformers extend beyond the railway sector. Faster and more reliable freight transportation will boost the economy, while improved passenger services will enhance the overall quality of life for millions of Indians.

Hitachi Energy's Scott-connected and V-connected Specialty Transformers

Hitachi Energy's Scott-connected and V-connected Specialty Transformers have been specifically designed to meet the unique requirements of the 2x27 kV system.

These speciality transformers (Scott & V Connected) meet higher power requirements (for increased speed) along with



Hitachi Energy's Scott-connected and V-connected Specialty Transformers have been specifically designed to meet the unique requirements of the 2x27 kV system

benefits such as better voltage regulation and reduced voltage imbalances in the network compared to conventional single-phase traction power transformers with similar power capacity. Additionally, these transformers also facilitate larger spacing between traction sub-stations (known as TSS) and significantly reduce communication interference.

Testing at the Central Power Research Institute (CPRI) in Bengaluru, a leading Indian accredited testing laboratory, confirmed the transformer's ability to withstand short-circuit faults, a critical safety requirement for railway applications.

By enabling higher power delivery, these technologies will facilitate increased train speeds, reduced journey times, and enhanced passenger capacity. Furthermore, their ability to operate at higher

voltages allows for increased spacing between railway substations that supply power to the train lines. This optimization of electrical rail infrastructure reduces maintenance costs and improves the overall system reliability.

Driving pioneering impact in sustainability and social progress

By addressing the critical challenges faced by the railway sector, Hitachi Energy's Scott-connected and V-connected transformers are driving a new era of rail transportation in India. With a focus on efficiency, reliability, and sustainability, these benefits make Hitachi Energy's Scott-Connected and V-Connected transformers the preferred solution across the globe to meet higher power requirements for rail traction applications.

The improved power efficiency will contribute to the reduction of CO₂ emissions associated with transformers, supporting the global net-zero goals.

Hitachi Energy's solutions are not just about technology; they are about empowering progress and a testament to the power of co-creation and partnership.

At Hitachi Energy, our purpose is to be an advocate for our customers to shape a

more sustainable future together, delivering them real value and measurable positive impact.

An impact that extends beyond the development and delivery of technology assets to the communities where we live and operate as an industry leader, committed to being a responsible and caring corporate citizen. We foster sustainable growth of global communities by partnering with local institutions and governments to bring reliable energy access and infrastructure, fostering economic development and improving quality of life.

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Discover more about
Hitachi Energy's
Scott and V-connected
Transformers



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