Collaboration is Key to Maintaining a Strong North American Energy System

by **Ron Harper**

Ron Harper is the President & CEO of JFE Shoji Power Canada (JSC), a Burlington-based company that is an integral part of the North American supply chain for electrical steel components for power generation equipment, motors, power and distribution transformers, and specialized magnetic equipment. Ron has worked in manufacturing for over 40 years, mostly in senior leadership positions in marketing, engineering, operations and general management. He has been with JSC since 1995 and has held the role of President & CEO since 2008. Ron has served on several industry and community boards for the past fifteen years. He is a current member of the Transformer Manufacturing Association of America and has previously served on the Association for Manufacturing Excellence Executive Committee (including as Chairman) and the Centre for Skills Development and Training in Canada. Ron regularly advises on government policies and initiatives with Next Generation Manufacturing and Canadian Manufacturers & Exporters, along with sustainability and clean electrical energy policies. Ron is also a leading member of the strategic initiative for People Centric Leadership. This movement is intended to educate leaders to engage and lead teams in a manner to maximize job satisfaction and fulfillment, while creating significant value in business.

Trade barriers threaten critical electrical steel supply chains

North American consumption of electrical energy is expected to grow by more than 50% in the next 25 years, driven by the clean energy transformation, the rise of electric transportation, and the rapid expansion of AI and data center infrastructure. This unprecedented demand highlights the urgency of modernizing and expanding our electrical grid. At the same time, 70% of the North American grid's core infrastructure is reaching its end of life and in need of replacement.

Critical minerals of the future, such as cobalt and nickel, have received a lot of attention, but an equally vital material deserves urgent focus: **grain oriented electrical steel (GOES)**. GOES is the magnetic backbone of transformers and power generation equipment, enabling grid reliability and energy efficiency. Yet, it is increasingly constrained by rising demand, limited domestic production and insufficient investments in new global capacity.

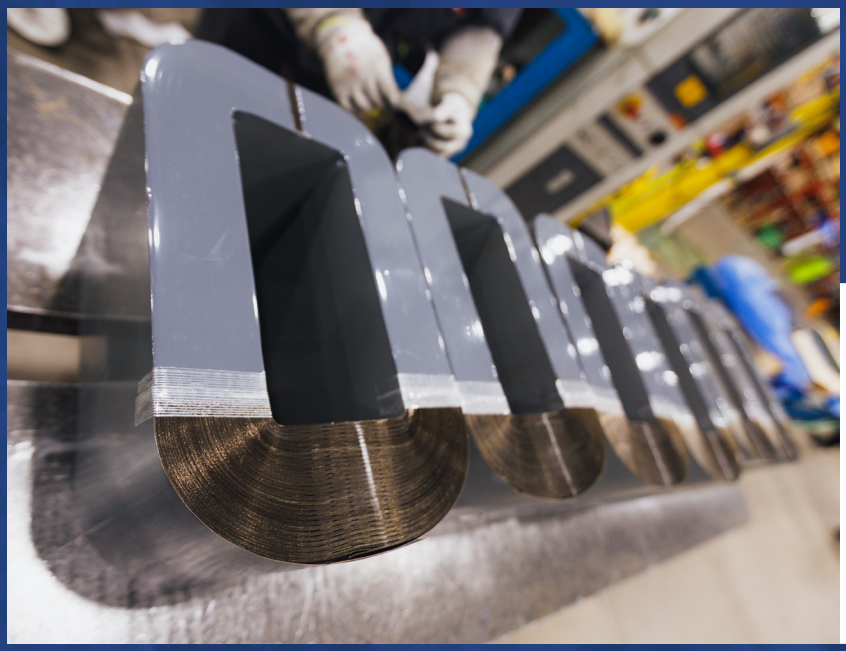
Any trade disruption or barriers (like tariffs) create additional vulnerabilities and obstacles to growth in supply. These factors, combined with the expected growth in electrical demand, are having tangible tightening impacts. It's a formula for massive demand growth and potential scarcity of resources. To meet these challenges, industry players—from materials to manufacturing—must collaborate to ensure long-term growth, supply chain resilience, and the ability to scale production.

Collaboration within the industry and active engagement from government officials would enable the level of growth needed. Protectionism and tariffs add significant strain and cost, and they inhibit the open flow of critical materials and components from partners around the world. At a time when we need to be accelerating investments in the supply chains and capacity to build critical electrical equipment like transformers, tariff disruption is creating punishing added cost and disruption.

While global supply chains have supported North America's energy needs for decades, today's grid transformation calls for a more resilient, multi-partner ecosystem — one that builds local capacity while strengthening ties with trusted partners in Japan, Europe, and beyond.

The inputs necessary for high-performing electrical grid components

Two materials will shape the backbone of the future electrical grid: **grain oriented electrical steel (GOES)** and **Amorphous Metal (AM)**. Each offers distinct advantages, and together they form a complementary path forward.



Amorphous Transformer Cores

Photo: JFE Shoji Power Canada

GOES is a key material for distribution transformers and is essential for medium- and high-voltage transformers that power transmission infrastructure. Modern transformers demand high-performance materials that can support tighter winding, higher energy density, and reduced losses. Its magnetic properties enable highly efficient energy flow, and its role is irreplaceable in large-scale power systems.

AM, with its ultra-low core losses, is ideal for highly efficient distribution transformers, especially in urban and residential areas where load variability is high. Canadian utilities have led the way in AM adoption, demonstrating successful integration over the past decade.

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Technical trends driving demand for GOES and AM

The technical evolution of transformer cores using these key materials are driving growing expectations around efficiency, reliability, and sustainability. Utilities across North America are raising standards to improve energy efficiency. The U.S. Department of Energy (DOE) has introduced new regulations which prioritize high efficiency GOES grades, and these are set to take effect by 2029. These changes require power transformer manufacturers to use thinner steel (0.23 and 0.20mm) and pursue lower core loss (down to 0.65 W/kg).

GOES grades have evolved from conventional levels to advanced Hi-B and laser scribed versions that offer superior magnetic properties and reduced energy loss.

Leading global producers have invested heavily in recent years on the hard journey to make these unique materials more electrically efficient. High performance grades of GOES will be crucial as utilities look to cut operating costs and reduce carbon emissions across their networks.

As a result, GOES producers are now focused on creating steels with uniform grain orientation and thinner gauges, notably as low as 0.20mm thickness, and these thinner steels are becoming the standard for power transformers. Thinner material reduces eddy current losses, helping utilities meet stricter DOE efficiency regulations. Steel mills are also investing in R&D to refine laser technologies that control grain boundaries, enabling even higher performance.

AM has a disordered atomic structure that enables even lower core losses. Canadian utilities have demonstrated successful integration across urban and rural networks over the last decade. Today, more than 50% of new distribution transformers in Canada use amorphous metal as its core material.

A U.S.-based company, Metglas, is planning to double its capacity as it responds to growing demand, and as OEMs convert designs to support new DOE efficiency standards by 2029. AM is projected to make up as much as 30 per cent of the market for distribution transformers in the U.S. within the next five years. However, tariffs and the ongoing market uncertainty and lack of commitment is potentially delaying investments.

Applying Noise Reducing Epoxy on a Power Transformer Core

Electrical steel shortages and the impact on transformer manufacturing

The transformer supply chain is under strain. Lead times for power transformers have increased in some cases to beyond five years, as utilities scramble to secure production slots and de-risk supply chains. Risky supply chains inhibit growth and expansion investments from transformer OEMs.

This is a complicated challenge: there is a need to fulfill the growing demand for electrical equipment, while also providing the incentives to local businesses and manufacturers of electrical transformers.

North America's electrical grid modernization depends on a resilient and diversified supply of GOES, much of which is currently sourced through trusted international partners. It is critical to foster open, predictable markets that encourage local investment while deepening strategic collaboration with global producers who share a commitment to innovation, sustainability, and grid reliability. A balanced strategy that expands both GOES and AM capacity—leveraging domestic strengths and international expertise—is the most sustainable path forward. Policymakers and utilities should promote the smart integration of both materials, ensuring they are used in the most effective applications to meet future energy demands.

Electrical transformers have many components, and OEMs are working diligently to secure supply chains to support the expected growth in the next five years. However, all transformer manufacturing hinges on a steady supply of electrical steels. This niche electrical steel is dominated by production in China, and the current supply is at risk with growing worldwide demand.

Photo: JFE Shoji Power Canada

North America's challenge is not to decouple from the global supply chain, but rather to de-risk and balance it.

Chinese mills represent about 60% of the total global supply, followed by Japan, South Korea, and India. Cleveland-Cliffs is the only North American producer, but its output represents a modest portion of total global production today. Chinese production of GOES was negligible 20 years ago, but as they have electrified their country over the past 25 years, they invested heavily in this foundational material.

Global demand for GOES has grown by 10% annually over the past five years, with the most efficient grades for our modern grid growing by 25% annually. This trend is expected to continue and likely increase based on the need for new electrical equipment, and the need to create efficient electrical energy systems.

There is also a lack of planned mill expansions outside of Asia currently. JFE Steel/JSW have an expansion project underway in India, but no new commitments have been made to expand production of GOES in North America or Europe.

Today, North American production of GOES is roughly 50% of what is required domestically, and with increased demand, that rate will decline without capacity expansion.

Geopolitical factors play into the conversation; as our supply chain, manufacturing and electrical grid expansion and renewal should not become over reliant on an unfriendly dominating supply source.

Global collaboration over protectionism

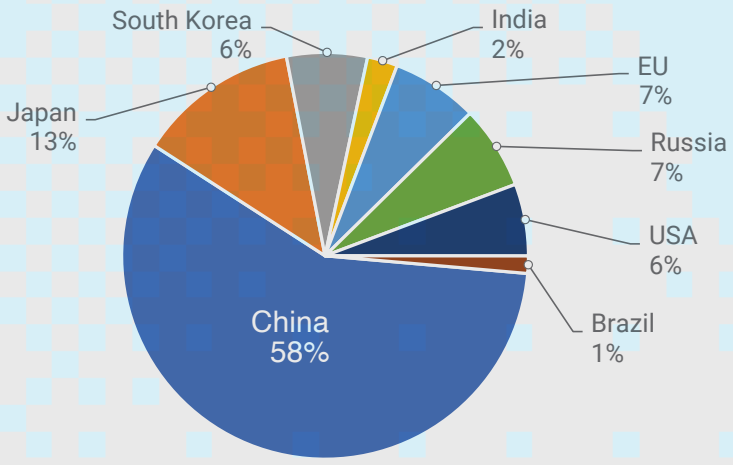
GOES is a specialized, capital-intensive material produced by only a handful of companies globally. Asian producers, most notably Japanese manufacturers, play a critical role in maintaining the global supply of high-performance grades needed for modern energy systems. Japan is a leader in advanced steel technologies and industry innovation. Expanded relationships, continued investments and collaboration with global partners will be essential.

Even if supply constraints are not being felt today, we must anticipate and invest to avoid this possibility.

The global supply of GOES

GOES is difficult to produce and extremely capital intensive, which is one reason why the market has only ten or so key global producers. It was originally developed by Armco (now Cleveland-Cliffs) its technical performance has been significantly enhanced by several global steel companies since then.

In 2024, global production of GOES totaled approximately 4.4 million metric tons, with 80% of supply coming from Asian producers.



Global Production Estimates of GOES

North America's challenge is not to decouple from the global supply chain, but rather to de-risk and balance it.

A healthy ecosystem would require industry partners to:

- Strengthen domestic production capacity for GOES and AM materials
- Deepen ties with trusted and diversified international GOES partners, and eliminate trade barriers
- Set clear standards and transparency for imports to ensure that our grid is being supported by domestic and friendly international partners
- Build supply chain resilience—from material inputs like electrical steel to component production to transformer manufacturing—through local capacity supported by global ties
- Invest in workforce development throughout the entire industry

Rather than broad trade barriers, a surgical approach that ensures critical imports are aligned with ethical standards, reliable global partnerships, and real market needs will support both supply security and international cooperation.

Trade policies must align to create the desired outcomes and incentivize local investments in the whole supply chain, while also drawing on the strength of experienced global partners.

Policies must also recognize that creating raw material and fabricated component production capacity takes time. In the short- and medium-term, reliance on reliable global partners must be maximized while local production has the time to be created.

The history of the North American electrical grid

The North American electrical grid is aging. After major investment and installation in the 1970's, demand for electrical power generation and transmission and distribution equipment stayed relatively flat.

During that time, domestic production gradually declined (particularly in the power transformer sector), and distribution transformer producers relied heavily on growth in housing and weather replacement markets to fuel demand.

But now, about 70% of the core grid infrastructure has reached its end of life and it now requires replacement. The ability to continue to expand and update this infrastructure is a critical issue for North America. Long-term energy storage, broader upgrades to the grid, and resilient supply chains to modernize and expand it are all necessary.

Transformer manufacturing companies are expanding production, but they also need to secure a resilient supply of GOES and AM to do so.

Scaling domestic capacity with purpose

North America must pivot to proactive supply chain planning that prioritizes reliability, ethics, and innovation. A seismic shift in how materials like GOES and AM are produced, sourced, processed, and deployed will be required.

To meet this demand, U.S. and Canadian OEMs must be supported and incentivized to expand transformer manufacturing capacity. Utilities can play a key role too, by aligning procurement practices with North American production capabilities and importing only what is needed to supplement domestic shortfalls.

This approach will:

- Drive investment in local jobs and capacity
- Mitigate reliance on volatile trade flows
- Support national security and grid stability

Incentives could include capital investment grants, tax credits, and workforce development programs to enable OEMs to scale at pace with demand. Public-private partnerships and long-term volume agreements would give manufacturers the confidence to invest and grow.

Building the future grid together

The modernization of the North American electrical grid depends on a resilient, diverse, and transparent supply chain for transformer core materials. The solution is not about choosing between GOES or AM, or domestic versus global—it's about creating a stable and scalable supply chain ecosystem.

This requires:

- Investment in **domestic e-steel, component and transformer production**

Step Lap Core "E" Assembly

Photo: JFE Shoji Power Canada

Wound Distribution Transformer

The solution is not about choosing between GOES or AM, or domestic versus global—it's about creating a stable and scalable supply chain ecosystem.

- Support for the **growth of AM as a dependent material**
- Continued **partnership with trusted global supply partners**
- Clear **trade policies** that encourage ethical, sustainable sourcing
- Collaboration between **industry, utilities and government**

Many North American transformer producers are already investing in expanding domestic manufacturing, showing that the path forward is achievable. But a consistent supply of core materials—and the policies that enable them—must follow.

Metglas is demonstrating the kind of forward-looking investment needed to meet the DOE's ambitious efficiency targets. As demand for high-efficiency transformers grows, continued support for domestic AM innovation and production capacity will be critical to ensuring both energy performance and supply resilience. To support proactive investments in AM production industry partners must commit to the development of this critical supply chain with long term agreements.

Shared responsibility, shared opportunity

Meeting future energy needs, reducing carbon emissions, and safeguarding economic security are shared goals that will require shared responsibility.

If transformer and electrical steel shortages persist, utility projects will be delayed, renewable energy integration will stall, and electrification goals will remain out of reach, or too dependent on dominant production regions outside of North America.

OEMs must build deeper, longer-term relationships across the supply chain. This includes sharing demand forecasts, collaborating on materials development, and committing to longer term volume contracts that reduce market uncertainty. The more aligned both ends of the supply chain are, the more efficiently resources can be allocated and risks mitigated.

Many companies are investing heavily in U.S. manufacturing facilities to meet growing demand and leading the way in expanding the domestic production of transformers.

But a steady supply of GOES and AM material will also be necessary to meet the demand. Relying on a single source or region for critical materials poses significant risks.

The GOES shortage is not just a supply chain issue; it is quickly becoming an economic one.

Leadership and collaboration between industry and policy will be necessary to act.

Power Transformer Core