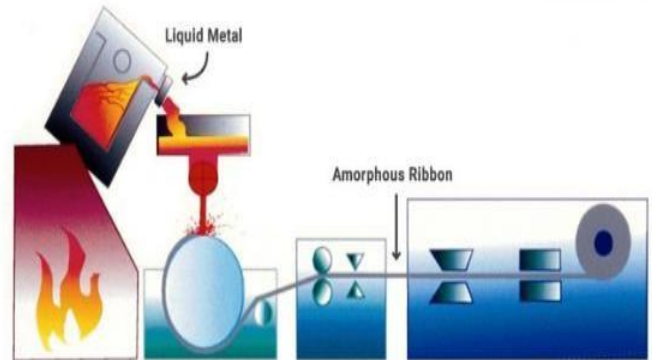


Increasing Transformer Efficiency & Reducing U.S. Carbon Footprint

Metglas, Inc. is a United States company with manufacturing facilities in Conway, South Carolina. Employing 146 people, we produce amorphous steel—a special class of material used in Distribution Transformers, Aerospace and Defense Industry.

AMORPHOUS STEEL

- Invented in the early 1970s to reduce transformer electric energy loss, **amorphous steel reduces transformer no-load losses by at least 60%.**
- Next generation of Metglas amorphous alloys are available today that reduce losses even further.
- **Metglas Amorphous Steel transformers are comparable in weight and size** to its silicon steel counterparts at today's DOE minimum efficiency standards.
- Unlike conventional transformers, **savings are realized over the lifetime of an amorphous steel transformer** through a reduction in heat generation and reduction in electricity loss. This saves the customer in electricity costs!!



U.S. TRANSFORMER PURCHASING

- Prior to the late 1980's, most electric utilities purchased transformers based on a **Total Ownership Cost (TOC)**, meaning the cost of operating these transformers were taken into account and not purchased strictly on the upfront price.
- Deregulation in 1992 slashed U.S. demand for energy efficient transformers, which, at the time, accounted for about 10% of new transformer installations.
- Today, **approximately 2% of transformers are made from amorphous steel in the U.S.**—despite new alloy development and process improvements, which have reduced significantly the size, weight, and cost of amorphous transformers.

TAKING ACTION

- Metglas is **doubling current capacity by June 2023** and targeting additional capacity to achieve total domestic capacity of **45,000 MT** in the next 24 months.
- **Proposed DOE 2023** Distribution Transformer Efficiency standards will bring the **U.S. up to global efficiency standards seen in other major economies**, and Metglas stands ready to support this transition.

TRANSFORMER (IN) EFFICIENCY

- In the U.S., **electricity generation activity** is the **second biggest contributor to greenhouse gas emissions (28%).**
- Currently, 75% of US electricity is generated in large central power stations, with the balance being renewables, before being transmitted/distributed to end users (residential, commercial, and industrial entities).
- **6% of generated electricity is lost during the delivery** process
- **Non-amorphous steel transformers** account for **about half of lost energy.**

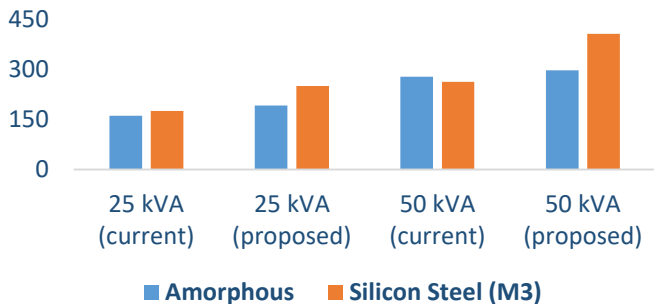
“DOE estimates that the proposed standards, if finalized, would reduce U.S. CO2 emissions by 340 million metric tons over the next 30 years—an amount roughly equal to the annual emissions of 90 coal-fired power plants.” (Quoted from energy.gov)

After pioneering this energy-efficient technology, the United States has left it to other nations to reap its cost and environmental benefits.

METGLAS EFFICIENCY

- Metglas's electrical steel possesses excellent magnetic properties that result in at least a 60% reduction in no-load losses compared to conventional electrical silicon steel material. (Report by Bonneville Power Administration, 2022)
- Department of Energy (DOE)'s 2021 review of the country's 42 million distribution transformers found amorphous transformers to be **“Best in Class.”**

Transformer Core Weight (lbs.) for common sizes



AMORPHOUS TRANSFORMER CORE WEIGHT

- Proposed DOE Distribution Transformer Efficiency standards-2023 versus the 2016 efficiency standards -will necessitate a very small increase in core weight.
- Amorphous core size/weight comparatively is stable at higher efficiency levels compared to M3 silicon steel that cannot achieve higher efficiency in current size (but other silicon steel grades are more capable).
- Metglas has continued to increase its capabilities by releasing a 3rd generation of amorphous alloy with higher magnetic capacity and reduced core weight.
- These improvements lead to lower core loss versus previous generations and improved mechanical ductility.

SUPPLY OF AMORPHOUS CORES

- Amorphous cores are supplied through transformer core suppliers or vertically integrated transformer manufacturers.
- New core makers are coming and existing ones are expanding capacity.
- Capital equipment required to form Amorphous Cores is readily available from multiple suppliers and relatively inexpensive.

Metglas is ready to work with transformer OEMs and open to any opportunity to talk to utilities to explain the value amorphous based transformers will deliver to their customers.

MARKET LANDSCAPE

- Production of amorphous steel by other producers demonstrates that there are no IP impediments.
- 65% of Canada’s transformers use amorphous cores, which is supplied by multiple producers, and has helped Canada achieve an equivalent of Level 4 efficiency standard.
- Higher grades of silicon steel exist from many manufacturers that can meet the proposed DOE 2023 Distribution Standards and stacked core applications.

OTHER COUNTRIES USE AMORPHOUS TRANSFORMERS EXTENSIVELY

Canada	Philippines
China	Mexico
India	Vietnam
Singapore	Bangladesh

Current Transformer Supply Situation

- Inability of transformer manufacturers to procure silicon steel, due to capacity constraints at current producers, has utilities waiting up to 2 years for transformer deliveries.
- Right now at Metglas there is available capacity for Amorphous and one way to resolve supply limitations on silicon steel is to convert current transformer designs to Amorphous cores.**
- Metglas also has the capability to produce transformer cores in our facility in Conway, SC and serve as a vertically integrated supplier for transformer **manufacturers**.

AMORPHOUS TRANSFORMERS ARE RELIABLE

- Amorphous transformers have been on the US grid since 1982, this is **not new technology**.
- Amorphous transformers currently account for about 65% of **Canada’s transformers (first installation mid 1980’s)** and significant share in both **India (first installation 1994)** and **China (first installation in 1997)**.
- About **22 million Amorphous transformers are operating globally**, with an additional 1 million transformers coming online every year.

Metglas® , Inc.
Conway SC 29526

Tel: (843)349-6800
Email: metglas@metglas.com