ASSESSMENT AND STRATEGIC APPROACHES FOR THE CRGO STEEL SECTOR: ENHANCING QUALITY AND COMPLIANCE WITHIN INDIA

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ABSTRACT

The objective of this report is to conduct a thorough doctrinal legal analysis, examining the existing domestic laws, regulations, and policies in India with respect to CRGO steel. This analysis will be conducted in comparison to legal frameworks in other jurisdictions, shedding light on the significant transformer failure rates in India and the prevalent shortage of CRGO steel. To gain a comprehensive understanding, we will also explore the global landscape, scrutinizing legal frameworks in other countries and assessing their alignment with WTO Agreements, including the GATT, Agreement on TBT, among others.

In addition to the global perspective, this report will delve into the intricate details of India's domestic laws and regulations, aiming to provide a holistic view of the policies governing the steel industry within the country. Through this analytical exercise, our objective is to uncover the regulatory, structural, and administrative factors contributing to the increasing deficit of CRGO steel and the persistent issue of substandard steel passing quality checks for use in transformers.

The Report achieves this in four sections:

1. **Legal Analysis of Domestic Laws on CRGO Industry in India:** Conduct a comprehensive legal analysis of the domestic laws, regulations, and policies pertaining to the CRGO industry in India, examining their scope, applicability, and any legal nuances.
2. **Impact Assessment of Indian Regulations on CRGO Industry:** Evaluate the influence of India's domestic laws and regulations on the CRGO industry, identifying regulatory, structural, and administrative factors that may contribute to sectoral challenges. Explore potential impacts on the industry's growth and performance.
3. **Demand Analysis and Quality Maintenance Recommendations:** Analyse the current demand for CRGO steel in India, taking into consideration various domestic initiatives as well. Provide recommendations on best practices for maintaining the quality of imported CRGO steel, drawing insights from global practices and standards to enhance industry quality control.
4. **Legal Scrutiny of QCOs and Environmental Rules:** Conduct an in-depth legal analysis of QCO related to CRGO steel in India, specifically assessing their consistency with the TBT Agreement of the WTO. Investigate the legal implications of QCOs and explore the existing regulatory standards and environmental rules governing the CRGO industry in India, with a comparative analysis of quality maintenance methods employed by developed countries, emphasizing the impact on Indian enterprises.

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TABLE OF ABBREVIATIONS

Abbreviation	Full Form
AC	Alternating Current
BCD	Basic Customs Duty
BIS	Bureau of Indian Standards
CEA	Central Electricity Authority
CEPA	Comprehensive Economic Partnership Agreement
CKM	Circuit Kilometers
CMTI	Central Manufacturing Technology Institute
CPCB	Central Pollution Control Board
CPRI	Central Power Research Institute
CREP	Corporate Responsibility for Environment Protection
CRGO	Cold Rolled Grain Oriented
DIN	Deutsches Institut für Normun
EPA	Environment Protection Act
EV	Electric Vehicle
FTA	Free Trade Agreement
FTP	Foreign Trade Policy
GATT	General Agreement on Tariffs and Trade, 1994
GtG	Gate to Gate
GW	Gigawatts
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
JIS	Japanese Industrial Standards
JSG	Joint Study Group
JV	Joint Venture
KS	Korean Industrial Standards
KVCA	Korean Venture Capital Association
MFN	Most Favoured Nation
MOEF & CC	Ministry of Environment & Forest
MoP	Ministry of Power
MoU	Memorandum of Understanding
MSS	Ministry of SMEs and Startups
NAPCC	National Action Plan for Climate Change
NITI	National Institution for Transforming India
NLMK	Novolipetsk Steel
NMEEE	National Mission for Enhanced Energy Efficiency
NSP	National Steel Policy
NTF	National Task Force
OEM	Original Equipment Manufacturers
PLI	Production Linked Incentive
PTA	Perform Achieve & Trade

QCO	Quality Control Order
R&M	Renovation & Modernization
SAC	Standardization Administration of China
SEC	Specific Energy Consumption
SDF	Steel Development Fund
SEB	State Electricity Boards
SPS	Sanitary and Phytosanitary Measures
SuMPO	Sustainable Management Promotion Organisation
TBT	Technical Barriers to Trade
VDE	Verband der Elektrotechnik

RESEARCH OBJECTIVES & QUESTIONS

The objective of this report is to conduct a thorough doctrinal legal analysis, examining the existing domestic laws, regulations, and policies in India with respect to CRGO steel. This analysis will be conducted in comparison to legal frameworks in other jurisdictions, shedding light on the significant transformer failure rates in India and the prevalent shortage of CRGO steel. To gain a comprehensive understanding, we will also explore the global landscape, scrutinizing legal frameworks in other countries and assessing their alignment with WTO Agreements, including the GATT, Agreement on TBT, among others.

In addition to the global perspective, this report will delve into the intricate details of India's domestic laws and regulations, aiming to provide a holistic view of the policies governing the steel industry within the country. Through this analytical exercise, our objective is to uncover the regulatory, structural, and administrative factors contributing to the increasing deficit of CRGO steel and the persistent issue of substandard steel passing quality checks for use in transformers.

The Report achieves this in four sections:

1. **Legal Analysis of Domestic Laws on CRGO Industry in India:** Conduct a comprehensive legal analysis of the domestic laws, regulations, and policies pertaining to the CRGO industry in India, examining their scope, applicability, and any legal nuances.
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3. **Demand Analysis and Quality Maintenance Recommendations:** Analyse the current demand for CRGO steel in India, taking into consideration various domestic initiatives as well. Provide recommendations on best practices for maintaining the quality of imported CRGO steel, drawing insights from global practices and standards to enhance industry quality control.
4. **Legal Scrutiny of QCOs and Environmental Rules:** Conduct an in-depth legal analysis of QCO related to CRGO steel in India, specifically assessing their consistency with the TBT Agreement of the WTO. Investigate the legal implications of QCOs and explore the existing regulatory standards and environmental rules governing the CRGO industry in India, with a comparative analysis of quality maintenance methods employed by developed countries, emphasizing the impact on Indian enterprises.

The research question are as follows:

I. Provide a comprehensive overview of CRGO industry, globally as well as India.
II. Provide the current regulatory standards, including environmental rules, that govern the manufacture and use of CRGO steel in India, as well as the import and trade policies that govern CRGO steel in India, and how these policies impact the operations of Indian enterprises that use this material.

III. Provide best practices that India can adopt to limit CRGO scarcity, and ways in which India can maintain quality of the CRGO imported.

IV. Provide a comprehensive legal analysis of the QCOs in India? Kindly provide WTO-consistency of QCOs in CRGO steel, primarily their consistency with the TBT Agreement of the WTO.

I. A COMPREHENSIVE OVERVIEW OF THE CRGO INDUSTRY

A. Introduction

As discussed in the introduction, this paper delves into a comprehensive examination of the CRGO steel industry. This sector plays a critical role in enhancing the efficiency of transformers, particularly through the incorporation of silicon into iron. Here, we aim to analyse various facets of the CRGO industry, including its global overview, market dynamics, impact of COVID-19, emerging trends, and future challenges.

B. Global Overview of the CRGO Industry

1. Preliminary Information

CRGO steel, introduced in the 1940s, swiftly replaced hot-rolled steels as the preferred material for transformer cores due to its enhanced magnetic properties. It involves precise manufacturing techniques that incorporate silicon into iron, resulting in improved electrical and magnetic characteristics.

2. Global Grain-Oriented Silicon Steel: Market Definition, Market Size, and Growth

Grain-oriented silicon steel, also known as electrical steel, is renowned for its high silicon content, which enhances electrical resistivity and reduces eddy current losses. This segment of steel is crucial for manufacturing energy-efficient transformers and motors. The global CRGO steel market is witnessing steady growth, driven by increasing energy consumption, urbanization, and infrastructure development.

3. Impact of COVID-19 Pandemic

The COVID-19 pandemic disrupted CRGO steel supply chains, leading to manufacturing shutdowns and decreased demand for power generators. However, the industry is gradually recovering as countries focus on renewable energy initiatives and infrastructure development.

4. Changing Trends in the Global Markets

Shifts in market trends indicate a transition towards more efficient products like HiB and amorphous steel. Geographically, Asia Pacific, especially countries like India and China, is expected to drive market growth due to increasing electricity demand and infrastructure development.

C. Analysis of the CRGO Steel Industry

1. On the Basis of Application

The transformer segment dominates CRGO steel consumption due to rising energy demand globally. Electric motors are also emerging as a significant application area, particularly with the growing adoption of electric vehicles.

2. On the Basis of Thickness

CRGO steel comes in various thicknesses, catering to different applications. Thicknesses ranging from 0.23 mm to 0.35 mm and above find applications in transformers, generators, and high-power systems.

3. On the Basis of Product Type

The market offers conventional, high magnetic strength, and domain refinement CRGO steel. Conventional CRGO steel remains dominant, especially in applications requiring energy efficiency and reduced core losses.

D. Key Developments in the CRGO Steel Industry

The industry is witnessing significant investments and partnerships to meet growing demand. Companies like ArcelorMittal, JFE Steel Corporation, and POSCO are expanding their production capacities and improving product quality to align with energy efficiency goals.

E. Challenges Facing the CRGO Steel Industry

Challenges include market saturation in developed regions, the growing popularity of amorphous steel, and price fluctuations in the steel market. However, strategic initiatives and regulatory frameworks are being implemented to address these challenges.

II. REGULATORY REGIME AND A GLOBAL COMPARATIVE ANALYSIS OF THE CRGO STEEL INDUSTRY

A. Introduction

This section explores the regulatory landscape governing CRGO steel production and use, comparing India's approach with international standards. It aims to highlight the impact of regulations on Indian enterprises and provide insights into global practices for maintaining CRGO steel quality.

B. Overview of the CRGO Steel Industry in India

Despite significant demand, India faces challenges in domestically producing CRGO steel. The use of scrap CRGO persists due to technical complexities and high production costs. However,

regulatory interventions, such as BIS certification requirements, aim to improve quality control and reduce reliance on scrap CRGO.

C. Evolution of India's Regulatory Regime and Impact on CRGO Industry

Recent regulatory changes have spurred partnerships and investments in CRGO steel manufacturing in India. Joint ventures between companies like JSW Steel and JFE Steel Corporation are poised to enhance domestic production capacity and meet growing demand.

D. National Steel Policy, 2017

India's National Steel Policy 2017 is highlighted as a strategic initiative aiming to augment the country's crude steel capacity to 300 million tons by 2030-31, with a parallel increase in per capita steel consumption. The policy identifies CRGO, along with other specialized steels, as critical for high-end applications, hence necessitating concerted efforts to reduce import dependence through indigenous production and technological collaborations.

E. Quality Control Orders

Quality Control Orders are underscored, mandating BIS licensing for imported steel products, ensuring adherence to established standards, and necessitating compliance checks through the TCQCO Portal. Environmental regulations are also rigorously enforced, with the steel industry operating under the mandates of the EPA, backed by measures from the Ministry of Steel (MoS) and Pollution Control Boards to oversee the implementation of pollution control mechanisms and the adherence to environmental norms.

F. Energy Management

Energy management is addressed through initiatives like CREP and NAPCC, setting targets for energy savings and enhanced efficiency, with specific focus on the steel industry's role in the PAT scheme. These collective efforts have yielded a notable increase in India's steel production capacity and consumption, aligning with the government's infrastructural and developmental objectives. Trade policies are explored, revealing India's shifting status from a net exporter to a potential net importer of steel, reflective of the dynamic global steel trade landscape. Indian enterprises' responses to import duties and trade measures are examined, suggesting an inclination towards advocating for increased protectionism and prioritizing domestic production.

G. Global Policy

The paper culminates with a comparative analysis of international practices, particularly those of Japan, South Korea, and Germany. It draws parallels between their quality maintenance standards, such as ISO and IEC certifications, and domestic standards like JIS, KS, and DIN, to India's approaches and regulations. The analysis suggests that while India's standards are broadly aligned with international practices, there remains a spectrum of opportunities for further development and integration into the global steel quality paradigm.

III. MITIGATE CRGO SCARCITY & ENSURE QUALITY

This section of the research paper addresses the critical shortage of CRGO steel in India despite its significant global production. Currently, India's reliance on imports, despite being a major producer, underscores the need for strategic solutions to ensure a stable supply chain and uphold quality standards. Additionally, the paper explores cost-saving practices involving scrap CRGO and its implications on transformer efficiency and manufacturing expenses.

A. Limiting Scarcity

1. Encouraging Domestic Production

Policy support is crucial to counter the decline in CRGO steel production, including establishing a fund for SMEs and offering tax breaks to foreign companies. Enhancing schemes like the PLI Specialty Steel Promotion Scheme and leveraging local raw materials are vital for driving innovation and cost-effectiveness.

2. Strengthen Research and Development

Establishing a high-level R&D committee, akin to MAHIR, is crucial for advancing Indigenous CRGO technology and overseeing various strategies like creating a technology fund for Electrical Equipment manufacturers. Encouraging R&D in the Electrical Equipment sector and establishing product development centers are also vital, drawing from examples in Eastern Europe and domestic initiatives like the SDF to boost CRGO steel production.

3. Negotiating Technology Transfer Agreements

To boost CRGO steel production in India, consider joint ventures with foreign manufacturers like JSW Steel and Japan's JFE for quality enhancement. Government incentives, including tax breaks and financial aid for R&D, are essential, along with sustained support and streamlined IP protection. In trade negotiations with the EU, prioritize standard harmonization and secure data hub establishment for improved market access.

4. Improving the Quality of Raw Products

The government should set national guidelines for sustainable raw materials, promoting innovation and market growth. For instance, the PLI scheme, with specific allocations for CRGO, ensures domestic production through the Specialty Steel Promotion Scheme. Strategies like "Development Contracts" and establishing specialized entities for SEBs can enhance raw material quality and project efficiency.

5. Reduce Import Tariff

To alleviate CRGO scarcity, India reduced import tariffs in 2017 by half, down to 5%, on key steel grades like hot rolled coils and cold-rolled Magnesium Oxide coated steel. This aims to enhance accessibility and affordability of CRGO raw materials for domestic industries, crucial for transformer production and electromagnetic applications, ensuring a sustainable supply chain.

B. Quality of CRGO Steel

1. Dual Quality Check

Implementing a dual quality check system with a Transformer Quality Check Officer and minimum selling prices for transformers is proposed to address subpar CRGO steel in India, reducing failures and distribution costs. Recent government initiatives with over 58 QCOs aim to regulate products, stimulating domestic industry growth. Targeted subsidies could encourage compliance, promoting market competition for high-quality CRGO more affordably.

2. Establishment of a Public Private Partnership

Proposing a Public-Private Partnership involving the government, electricity boards, and private firms to boost domestic CRGO production and reduce import reliance. The PPP would offer government incentives and tax breaks for private investment, with electricity boards committing to annual purchases. Benefits include carbon footprint reduction, job creation, and progress towards climate goals. Enhancing PPP success involves prioritizing innovation through R&D for eco-friendly production methods, fostering collaboration, and making CRGO more affordable via subsidies or financing mechanisms.

3. Variable Contract

Proposing variable contracts to address concerns about sub-par CRGO quality, replacing fixed-price contracts. Variable contracts adjust prices to balance fluctuating costs, reducing project risks and allowing for lower bid values. While price hikes may squeeze margins, shared cost burdens with buyers can create a win-win situation, fostering constructive dialogue and focusing on project execution.

4. Testing, Inspection Technologies & Certification Infrastructure

Propose a National Execution Body to enhance capital goods industry testing and certification infrastructure, promoting private sector investment and collaboration with institutions like IGCAR and MIDHANI. Encourage one-time registration for lamination suppliers by Electricity Boards to ensure certified facilities, mirroring Japan's approach, which could improve transformer quality and reduce distribution losses.

IV. LEGAL ANALYSIS OF THE QCOS IN INDIA WITH A FOCUS ON CRGO STEEL AND THEIR CONSISTENCY WITH THE TBT AGREEMENT OF THE WTO

Mr. Piyush Goyal emphasized the importance of quality control measures like QCOs administered by the BIS, aiming to enhance product quality, reduce wastage, and ensure consumer safety, applicable to both foreign and domestic industries in India.

A. Purpose of Application of QCOs

To ensure border protection & protect the domestic manufacturing, QCOs enforce technical standards to limit cheap and sub-standard imports, safeguarding consumer health and domestic manufacturing competitiveness. Further, BIS, empowered by the BIS Act 2016, oversees Standardization, Conformity Assessment, and Quality Assurance, dictating product components and issuance of QCOs.

B. Applicability of QCOs on Imported and Exported Goods

QCOs apply *equally* to both domestic and imported goods, ensuring compliance with Indian Standards and BIS certification. Import Policy's General Note 2(A) and Appendix III list products mandating BIS certification, including CRGO steel.

C. Legal Framework and Definitions

1. Relevant Terms under BIS Act 2016:

- Section 2(17) defines quality standards for goods, including those for CRGO steel, with obligations across the supply chain.
- Section 2(20) grants licenses for using Standard Marks on compliant goods.
- Section 12 and 15 empowers BIS to establish schemes, marks, and impose restrictions on non-certified goods.

2. BIS Provisions on Standard Mark:

Section 14, 16, and 17 authorizes compulsory use of Standard Marks, preventing non-compliant imports and sales without the Standard Mark, ensuring adherence to set standards.

C. QCOS vis-à-vis India's Commitments at WTO

1. Compliance with Domestic Laws and International Commitments:

As per the FTF Clause, import compliance with domestic laws and standards, including BIS's QCOs, is mandatory. Further, the TBT Agreement emphasizes on non-discriminatory technical regulations to avoid trade obstacles, ensuring fairness, and mutual recognition of standards.

2. Alignment of QCOs with TBT Agreement Requirements:

Under the "Technical Regulation & Conformity Assessment", QCOs qualify as technical *regulations* under TBT Agreement, subject to non-discrimination and trade-restrictiveness

principles. Further, India's QCOs on CRGO steel also pass the three-pronged legal test and fulfil legitimate policy objectives without unnecessary trade restrictions.

E. Key Requirements for Technical Regulations under TBT Agreement:

The principle of Non-discrimination requires that the QCOs must treat imported products equally to domestic ones and those from other countries, which is adhered to by India. Further, the measure of Trade Restrictiveness requires that QCOs should not be more trade-restrictive than necessary to achieve legitimate objectives, ensuring proper assessment and necessity, which India complies with.

F. Concerns of Foreign Countries & Justification for QCOs:

Foreign nations express concerns about certification delays under QCOs, impacting bilateral trade.

G. Consequences of Non-Compliance under BIS Act:

Non-compliance with BIS Act provisions incurs fines, imprisonment, and consumer compensation, ensuring adherence to standards and regulations.

H. Court Precedents Upholding QCOS in India:

Indian courts have time and again upheld QCOs, recognizing them as necessary for public welfare and safety, backed by legislative authority and policy objectives.

INTRODUCTION

In the quest to enhance the resilience and efficiency of India's power infrastructure, the role of CRGO steel emerges as critically strategic. This research project delves into the complexities and nuances of the CRGO steel industry, with a keen focus on its multifaceted applications in the core of power and distribution transformers. The properties of CRGO steel—ranging from high magnetic permeability, reduced excitation currents and lower inductions, to diminished hysteresis and eddy current losses—place it at the heart of transformer reliability and design excellence. Yet, despite its indispensable role, India confronts a disconcerting transformer failure rate that starkly overshadows the global average—a dilemma rooted in the utilization of sub-standard transformer quality.

Addressing this pressing concern, the Indian government's imposition of QCOs between 2011-2015 marked a stringent response aimed at curbing the influx of non-prime CRGO, including scraps and mill rejects. This legislative move, driven by domestic industry advocacy, targeted specific CRGO classifications under Harmonized System Codes HS-8504 and 7204. Nevertheless, the expected outcomes of these QCOs on import regulation did not materialize fully, as substandard CRGO continued to seep through customs clearances nationwide, including Special Economic Zones (SEZs). The ensuing scarcity in 2020 triggered industry-wide trepidation, revealing both the fragility and the critical opportunities within the CRGO market, particularly under the banner of the Atmanirbhar Bharat (Self-Reliant India) initiative.

Set against this backdrop, this research project unfolds across multiple dimensions:

Part I of the report attempts to deal with the global overview of the CRGO Steel industry. It comprehensively covers the primary aspects regarding its manufacture, market definition, size, and prospective growth. This part also briefly touches upon the impact of Covid-19 on the CRGO industry as well along with the changing trends in the global CRGO market. This Part also provides an analysis of the industry on the basis of application, thickness and product type. It addresses the recent key developments in the industry and then concludes with the possible challenges and hurdles in its growth in the future.

Part II examines the multifaceted landscape of the CRGO steel industry within India, highlighting the sector's pivotal role in the transformer industry against a backdrop of import reliance and manufacturing challenges. This segment further explores the global supply constraints, technological complexities associated with CRGO production, and the government's initiatives to mandate the use of prime grade CRGO through QCOs and standardization efforts. It delves into consumption patterns, emphasizing the critical importance of CRGO in energy-efficient applications and the potential for significant market growth driven by the global push towards renewable energy sources. The analysis concludes with a discussion on various other developed countries and their export policies surrounding CRGO and other steel grades.

Part III of the report examines how India can address CRGO scarcity and maintain imported CRGO quality. It starts by identifying current system loopholes and proposing solutions, such as

promoting domestic production and reducing import tariffs. Recommendations for improving CRGO quality include rigorous checks, public-private partnerships, variable contracts, and establishing inspection infrastructure. This comprehensive approach aims to enhance CRGO quality in India.

Part IV of the report aims to highlight that the Indian government issued QCOs, and thereby mandated the use of ISI marks on steel and steel products, so as to ensure enhancement of the overall quality of life of the Indian population. Moreover, India's QCOs, are adhering to the WTO requirements, hence, are not trade-restrictive. In fact, they are necessary for fulfilling legitimate objectives, safeguarding consumer interests, and ensuring adherence to international trade standards.

As discussed in the Introduction, Part I of the paper attempts to analyse with the global overview of the CRGO industry. It comprehensively covers the primary aspects regarding its manufacture, market definition, size, and prospective growth. This part also briefly touches upon the impact of Covid-19 on the CRGO industry as well along with the changing trends in the global CRGO market. This Part also provides an analysis of the industry on the basis of application, thickness and product type. It addresses the recent key developments in the industry and then concludes with the possible challenges and hurdles in its growth in the future.

A. GLOBAL OVERVIEW OF THE CRGO INDUSTRY

1. Preliminary Information

CRGO is a material primarily employed in the core of transformers to enhance their magnetic properties.[1] By carefully incorporating silicon (Si) into iron (Fe) through specific manufacturing techniques, the magnetic and electrical characteristics of iron can be greatly improved, resulting in a robust magnetic core for transformers and other electrical devices.[2]

CRGO steel was initially introduced in the 1940s for use in transformer cores. Its adoption was rapid, and by the 1950s, it had already replaced the earlier hot-rolled steels. The production of CRGO Steel witnessed a significant increase, and by 1995, it had gained widespread acceptance on a global scale, quickly becoming the standard choice for transformer cores.[3]

2. Global Grain-Oriented Silicon Steel: Market Definition, Market Size and Growth

Silicon steel, also known as electrical steel, is a type of soft magnetic material employed in electric power transformers, generators, and motors. It is distinguished by its elevated silicon content, typically around 3.2% by mass. This high silicon content enhances the electrical resistivity of iron, effectively diminishing eddy current losses. Grain-Oriented Silicon Steel, designed for stationary applications like transformers, possesses a well-defined crystallographic orientation, which contributes to its exceptional magnetic properties.[4]

In Grain-Oriented Silicon Steel, the Goss orientation, a specific crystallographic alignment, is deliberately engineered to minimize magnetic losses in electrical transformers. This product can be described as an alloy of iron and silicon, renowned for its capacity to offer minimal core losses in electrical transformers. It is often regarded as the most energy-efficient type of steel

[1] Georgina Roberts, *CRGO: Cold-Rolled Grain Oriented Steel*, BOWERS ELECTRICAL LTD. (May 31, 2022) https://www.bowerselec.co.uk/insights/crgo-cold-rolled-grain-oriented-steel/ [hereinafter "Roberts"]
[2] Electrical4U, *Cold-Rolled Grain Oriented Silicon Steel,* ELECTRICAL4U https://www.electrical4u.com/cold-rolled-grain-oriented-silicon-steel/
[3] Roberts, *supra* note 1.
[4] Yasuyuki Hayakawa, *Electrical Steels, in* ENCYCLOPAEDIA OF MATERIALS: METALS AND ALLOYS (2022) https://www.sciencedirect.com/topics/materials-science/electrical-steel

and is extensively employed as the core material in power transformers. Consequently, this material is commonly referred to as transformer steel globally.[5]

The worldwide CRGO steel market holds a crucial position within the electrical steel industry, primarily propelled by the increasing need for energy-efficient electrical transformers and motors. The market's sustained growth is fuelled by rising electricity consumption, urbanization, and ongoing infrastructure development. Additionally, investments in renewable energy initiatives, which necessitate efficient transformers, further impact the growth of this market.

The global grain oriented electrical steel market is anticipated to observe steady growth over the coming years. Favourable regulatory policies are playing a vital role in the growth of the market.[6] Utility regulators have been focusing on ways to augment energy efficiency and reduce losses in transformers. Increasing focus on energy conservation, reduction in carbon dioxide emission, and life-cycle costing are estimated to spur the growth of the market over the coming years.[7]

The global grain oriented electrical steel market size is projected to grow from $12.47 billion in 2023 to $18.81 billion by 2030, at a cumulative annual growth rate of 6.0% during the forecast period. Grain oriented electrical steel is a significant material employed in fabricating energy-efficient transformers and huge, high-performance generators. Primarily found in the form of wound, laminated, or punched sheets, it is a vital core material for power transformers, distribution transformers, and small transformers.[8]

Increasing demand for electricity, especially in developing countries such as India, Indonesia, and Vietnam, is likely to positively influence the market.[9] With rapid urbanization and growing population, these counties are poised to bolster the need for expansion in transmission capacities. For instance, the NITI added nearly 51,000 CKM of transmission from 2016 to 2017.[10] Thus, steady growth in the transmission network is projected to play an important role in product demand.

3. Impact of COVID-19 Pandemic

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[5] Allied Market Research, Grain-oriented Silicon Steel Market: Size, Share, Competitive Landscape and Trend Analysis Report by Type (0.23 mm, 0.27 mm, 0.30 mm, 0.35 mm, Others) and by Application (Transformer, Electric Motors, Generator, Others): Global Opportunity Analysis and Industry Forecast, 2023-2032 https://www.alliedmarketresearch.com/grain-oriented-silicon-steel-market-A15922

[6] *Infra* Part II.

[7] Grand View Research, Grain Oriented Electrical Steel Market Size, Share & Trends Analysis Report By End-Use, Regional Outlook, Competitive Strategies, And Segment Forecasts, 2019 To 2025 [hereinafter "Grand View Research"]
https://www.grandviewresearch.com/industry-analysis/grain-oriented-electrical-steel-goes-market

[8] Market Research Report, Grain Oriented Electrical Steel Market Size, Share & COVID-19 Impact Analysis, By Product Type, By Thickness, By Application, and Regional Forecast, 2023-2030 https://www.fortunebusinessinsights.com/grain-oriented-electrical-steel-market-104116 [hereinafter "Market Research Report"]

[9] Global Grain-Oriented Silicon Steel Market Size By Product (0.23 mm, 0.27 mm, 0.30 mm), By Application (Transformer, Electric Motors), By Geographic Scope And Forecast (2023) https://www.verifiedmarketresearch.com/product/grain-oriented-silicon-steel-market/

[10] *Id.*

Since December 2019, several countries, including China, India, and the U.S. imposed travel restrictions, limiting the movement of both men and material, significantly disrupting the supply chains of grain oriented electrical steel manufacturers.[11] The emergence of COVID-19 had significantly impacted the revenue generation of several companies. Many countries announced restrictions on raw material transportation, manufacturing facility closures, and movement restrictions since the spread of coronavirus in late 2019, impacting the supply chain of steel manufacturers.[12]

Many steel companies either decreased their production capacity or shut down their production plant during the peak of the virus, which resulted in the supply chain disruption and closure of machinery and steel manufacturing. The demand for power generators was affected as the global lockdown decreased power usage from high-end commercial consumers.[13] The lockdown regulations steered the population to work from home, lowering commercial power consumption and slowing down steel uptake.[14]

4. Changing trends in the Global Markets

CRGO steel represented a large share in the market in 2017. However, the trend is expected to change by 2025, as power regulators opt for more efficient and energy guidelines-conforming products with minimal core losses, which will thereby fuel the demand for HiB and amorphous steel.[15]

Geographically, the grain oriented electrical steel market can be segmented into Europe, Asia Pacific, North America, Central & South America, and Middle East & Africa. Asia Pacific is projected to account for a sizeable share in the market in terms of value as well as volume. Countries such as India and China are anticipated to be significant contributors to the region.[16]Total power capacity in India increased by nearly 77 GW between 2014 and 2017. In addition, the government of India achieved a new milestone by electrifying nearly 13,123 villages during the same period.[17] Thus, steady growth in the power sector of the key countries of the region is estimated to positively influence the industry.

Increasing Demand for EVs Offers Growth Opportunities for the Market

The rising demand for electrical steel from the automotive for application in EV is opening growth opportunities for the market. The automotive industry is redesigning due to numerous factors that aim to increase profit margins and benefit the environment, which leads to increasing demand for EVs. Electrical steel is one of the core magnetic materials in EV traction

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[11] *Id.*
[12] Market Research Report, *supra* note 8.
[13] Direct Materials, *Impact of Covid-19 on Steel and Other Metals*, GEP (May 15, 2020) https://www.gep.com/blog/mind/impact-of-covid-19-on-steel-and-other-metals
[14] *Id.*
[15] Grand View Research, *supra* note 7.
[16] *Id.*
[17] *Id.*

motors, which determines the vehicle's power, and is vital for the efficient performance of EVs. Therefore, high-quality electrical steels are sought by OEM for the growing EV market.[18]

Electrical steel is used in engines, traction motors, high-speed rotors, and electric motors for conventional generators and EVs. The rapidly growing automotive industry has escalated the demand for electric cars as a substitute for petroleum fuel vehicles. This has increased the demand for EVs, propelling the adoption of grain oriented electrical steel.[19]

Growing Product Demand from the Electrical Industry to Fuel Market Growth

The increasing demand for grain oriented electrical steel from power generation applications in emerging economies is driving the grain oriented electrical steel market growth. Growth in urbanization, population, and economic development has surged the construction of metro stations, industrial buildings, and storage units & warehouses where the product is used as transformer steel and lamination steel for electric power distribution.[20]

These infrastructure developments have led to heavy electricity consumption. Growing demand for electrical steels due to their high permeability, lesser core loss, and superior magnetic properties will drive the market during the forecast period. Growing economies are primarily surging the demand for electrical steel as technology and higher efficiency in the power sector and transformer cores have risen.[21]

The product provides high electrical resistivity and decreased hysteresis loss in hermetic motors and AC motors.[22] Government and municipal corporations are investing in local power networks to connect rural areas and growing communities. Furthermore, companies are investing in the setup of power plants and fuel extraction machinery, driving the electrical steel demand from the oil & gas industry. In addition, residential housing schemes offered by the governments have created high product usage to provide electricity through the installations of transformers and power generators.[23] This is anticipated to aid the global market growth.

B. ANALYSIS OF THE CRGO STEEL INDUSTRY

1. On the Basis of Application

Transformer segment accounts for the largest share due to the rising energy consumption in the global market. Based on application, the market is segmented into transformer, power generator, electric motor, and others. The transformer segment accounted for the largest grain oriented

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[18] *Id.*
[19] *Id.*
[20] United States, Department of Energy, Critical Materials Assessment (July, 2023) https://www.energy.gov/sites/default/files/2023-07/doe-critical-material-assessment_07312023.pdf
[21] Electrical Steel Market Report, Markets and Markets https://www.marketsandmarkets.com/Market-Reports/electrical-steel-market-96179524.html
[22] *Id.*
[23] Grain Oriented Electrical Steel Market, Fortune Business Insights https://www.fortunebusinessinsights.com/grain-oriented-electrical-steel-market-104116

electrical steel market share in 2021.[24] The product is mainly suitable for energy-efficient transformers and large, high-performance generators. Used as a laminated, wound, or punched sheet, steel is an essential core material in distribution, power, and small transformers.[25]

Rising energy consumption across the globe is expected to create higher demand for transformers, which are an essential part of the electric infrastructure. This would, in turn, increase the consumption of grain oriented electrical steel used in transformers and drive the segment growth. At the same time, the electric motor segment is expected to grow considerably.[26] Electric motors use electrical steel as laminations.[27] The growing preference for EVs in the automotive industry has raised the demand for electric motors, thereby surging raw materials' consumption.

2. On the basis of thickness

On the basis of thickness, the market is segmented into 0.2 mm and below, 0.23 mm, 0.27 mm, 0.30 mm, and 0.35 mm and above. The 0.23 mm segment accounted for a dominating share in the market.[28] This thickness is commonly deployed in applications such as small transformers, generators, and electric motors. This type of electrical steel is used in small-scale applications, such as manufacturing of small motors, similar to those found in appliances such as refrigerators, washing machines, and air conditioners.[29] Rising demand for such household applications is expected to drive the market growth during the forecast period.

Furthermore, the 0.35 mm and above thickness grain oriented electrical steel is used in applications that require very high magnetic flux densities such as large generators and motors.[30] The steel is used in power distribution systems and other high-power applications. The rising demand for energy across the globe is expected to benefit and drive the segment's growth.

3. On the basis of Product Type

Based on product type, the market is categorized into conventional, high magnetic strength sheets, and domain refinement. The conventional segment dominated the market in 2022 and may continue its dominance up to 2030.[31] The segment covers electrical steel for applications such as transformers, power generators, conventional lamination steel, and industrial induction

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[24] Power Transformers Market, Mordor Intelligence https://www.mordorintelligence.com/industry-reports/power-transformers-market
[25] *Id.*
[26] Grain Oriented Steel Market, Zion Market Research https://www.zionmarketresearch.com/report/grain-oriented-electrical-steel-market
[27] *Id.*
[28] Types of CRGO, World of Steel https://www.worldofsteel.com/pages/types-of-crgo/
[29] Fortune Business Insights, *supra note 23*.
[30] *Id.*
[31] Grain Oriented Electrical Steel Market to Worth USD 81 Billion by 2030, Global News Wire https://www.globenewswire.com/en/news-release/2022/11/24/2561998/0/en/Grain-Oriented-Electrical-Steel-Market-to-Worth-USD-18-81-Billion-by-2030-Grain-Oriented-Electrical-Steel-Industry-CAGR-of-6-0.html

machines. Growing demand for electrical supply due to urbanization and higher dependence on technologies is driving the segment growth.[32]

C. KEY DEVELOPMENTS IN THE CRGO STEEL INDUSTRY

The CRGO steel industry is riding a wave driven by renewable energy and EVs. Demand is rising as countries invest in greener grids and EV infrastructure, both of which rely heavily on CRGO for efficient transformers and motors. In response, manufacturers are prioritizing quality improvements to further reduce energy losses and meet decarbonization goals. Steel companies are also recognizing the potential, with new production facilities being built to meet the growing demand, particularly for high-grade CRGO.

Since the Covid-19 pandemic, the CRGO Steel Industry has been attempting to increase its productive capacity by investing in domestic and offshore locations. Very recently in March, 2022, ArcelorMittal announced an investment of more than USD 295 million to set up a new production unit for electrical steels at the Mardyck manufacturing site in North France. The new industrial unit will have a 200-kiloton production capacity and strengthen the French electro-mobility sector.[33]

Furthermore, about a year earlier to that in March, 2021 JFE Steel Corporation signed a MOU to conduct a viability study with JSW Steel Limited to launch a grain oriented electrical steel sheet-producing and sales joint-venture company in India. The company planned to complete the feasibility study by 2021 and take appropriate steps to set up a JV company.[34]

Nippon Steel announced plans to invest roughly $1 billion in expanding its electrical steel sheet capabilities at two Japanese sites in November 2020. This sequence of capacity and quality-improvement actions will be fully implemented in the first half of 2023, with manufacturing capacity estimated to increase by nearly 40%.[35]

POSCO inked an MOU in May 2019 with the KVCA and the MSS to launch the POSCO Venture Platform. POSCO agreed to invest in R&D initiatives and startups as part of the deal.[36]

Some of the prominent companies operating in the global grain oriented electrical steel market are ArcelorMittal; POSCO; Baosteel Co.; Ltd.; Nippon Steel & Sumitomo Metal Corporation; AK Steel Corporation; and others. Key vendors in the grain oriented electrical steel market are adopting merger strategies to capture emerging markets such as India, Indonesia, and Malaysia.[37]

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[32] *Id.*

[33] Press Release, Aecelormittal Announces Investment of 300 million in Mardyck France to produce electrical steels for industry and electromobility, Arcelormittal https://corporate.arcelormittal.com/media/press-releases/arcelormittal-announces-investment-of-300-million-in-mardyck-france-to-produce-electrical-steels-for-industry-and-electromobility/

[34] JSW Forms Joint Venture with Japan's JFE to produce Electric steel by 2027, Livemint https://www.livemint.com/industry/jsw-forms-joint-venture-with-japan-s-jfe-to-produce-electric-steel-by-2027-11707806064535.html

[35] News, Nipponsteel https://www.nipponsteel.com/en/news/20201106_100.html

[36] Newsroom, POSCO Venture Platform https://newsroom.posco.com/en/posco-venture-platform/

[37] Global News, *supra* note 31.

D. CHALLENGES FACING THE CRGO STEEL INDUSTRY

1. Stumbling Blocks in US and European Markets

The market is anticipated to experience stumbling blocks in developed regions such as the U.S. and Europe. These regions are estimated to witness relatively slow growth in transmission and energy generation over the coming years.[38] This could be attributed to factors like market saturation, stringent regulations, economic conditions impacting investment, technological transitions, public resistance, and a shift towards prioritizing energy efficiency over expansion. These challenges collectively contribute to a slower pace of development in the energy sector in these well-established regions.[39] Nevertheless, replacement demand is expected to continue rising with an increased focus on high-end quality products. In addition, electricity demand specifically from the utility power sector is observing plateaued trend in the U.S.[40]

2. Popularity of Amorphous Steel

Another key challenge for the growth of the grain oriented electrical steel market is the burgeoning popularity of amorphous steel. The primary challenge for transformer manufacturers is to reduce or minimize core losses. Traditionally, CRGO steel was preferred by transformer manufacturers. However, the ability of amorphous material to minimize core losses by a significant margin as compared to CRGO is projected to augment the demand for amorphous steel. This will, thereby, restrain the growth of the grain oriented electrical steel market.[41]

3. Fluctuations in Prices of Steel

Steel has witnessed price fluctuations on a daily basis. Along with this, the raw materials used for steel production, including coal, scrap steel, and iron have also witnessed price fluctuations. The prices of raw materials are highly unstable considering the laws of supply and demand. Furthermore, production costs impact prices along with storage capacity, affecting the final product price.[42] Further, the production of transformers is relatively on the higher side with a lack of financial ability to earn a return on investment. This, along with the limited availability of energy efficient transformers and increased import costs or tariffs, increase the final cost of the product. In addition, greater environmental and health risks lead to product adoption in the market.[43]

Summary of Issue I

The global CRGO Steel industry is pivotal in enhancing the magnetic properties of transformers

[38] *Id.*
[39] *Id.*
[40] Grand View Research, *supra* note 7.
[41] *Id.*
[42] *Id.*
[43] *Id.*

through the incorporation of silicon into iron. Originally introduced in the 1940s, CRGO quickly replaced hot-rolled steels by the 1950s and became the standard choice for transformer cores globally. The market is driven by the increasing demand for energy-efficient electrical transformers, with a projected growth from $12.47 billion in 2023 to $18.81 billion by 2030.

The COVID-19 pandemic disrupted the industry's supply chains, impacting manufacturers' revenue generation. Changing trends indicate a shift from CRGO steel to more efficient products like HiB and amorphous steel. Geographically, Asia Pacific, especially India and China, is expected to contribute significantly to market value and volume. The industry faces challenges in developed markets, the popularity of amorphous steel, and price fluctuations. Notable developments include investments by companies like ArcelorMittal, JFE Steel Corporation, Nippon Steel, and POSCO. Key players include ArcelorMittal, POSCO, Baosteel Co., Ltd., Nippon Steel & Sumitomo Metal Corporation, and AK Steel Corporation. The industry is also impacted by challenges such as stumbling blocks in the U.S. and European markets and the increasing popularity of amorphous steel.

The Indian overview highlights the struggle to domestically produce CRGO steel despite significant demand, with challenges including the use of scrap CRGO and the technical complexity of the manufacturing process. The recent developments in India involve JVs between JSW Steel and JFE Steel Corporation and NLMK's investment in manufacturing CRGO steel in Maharashtra, aiming to meet 22% of India's current electrical steel needs.

A. INTRODUCTION

In an era where sustainability and advanced technology dictate market trends, the CRGO steel sector is a testament to innovation and environmental stewardship. CRGO steel is crucial for manufacturing transformers and generators, integral to modern electrical grids. This section explores the intricate regulations and environmental policies guiding CRGO steel's production, use, and importation in India, juxtaposed with international practices. By comparing India's approach to quality control and environmental compliance with developed countries' methodologies, we aim to elucidate the operational impact on Indian enterprises and present a global perspective on maintaining CRGO steel's quality, aligning with the NSP 2017 and global environmental standards. This comparative analysis highlights the strategic initiatives and challenges within the Indian steel industry while fostering an understanding of its position in the global market.

B. OVERVIEW OF THE CRGO STEEL INDUSTRY IN INDIA

1. Manufacturing

CRGO steel is a critical input in the transformer industry. However, CRGO has had a very difficult time in the Indian transformer industry—for a variety of reasons. India, for over 50 years, has been trying to produce CRGO steel domestically. However, it has yet to come anywhere close to even trial production. The entire demand, which is estimated at some 3.5 lakh tonnes per year and growing, is met through imports.[44]

In the 1980s, India was confronted with a difficult balance of payment situation. Consequently, the country had to adopt several austerity measures. From being an importer of prime grade CRGO, India was coerced to import scrap (used) CRGO, thereby saving as much as 50% in its CRGO import bill.[45] India then began redesigning transformers, factoring scrap, or rather non-prime, CRGO.[46] This marked the advent of scrap CRGO in India. From what was a step in saving foreign exchange, the use of scrap CRGO then became a wilful exercise and despite several steps to ensure that prime grade CRGO is used, the menace of scrap CRGO still haunts in the Indian transformer industry.[47] Production of CRGO is a technically complex activity,

[44] Pillai, infra.
[45] Arvind Panagariya, India in the 1980's and 1990's: A Triumph of Reforms (IMF Working Paper, WP/04/43) https://www.elibrary.imf.org/view/journals/001/2004/043/article-A001-en.xml
[46] *Id.*
[47] Venugopal Pillai, *CRGO Issues Still Haunt Transformer Industry*, T&D INDIA (Oct. 17, 2018) https://www.tndindia.com/crgo-issues-still-haunt-transformer-industry/ [hereinafter "Pillai"]

involving some 19 intricate manufacturing processes. Globally, there are only around 15 steel mills that produce CRGO, and supply it worldwide.[48]

The use of scrap CRGO is mostly seen in low-voltage distribution transformers, rather than high-voltage power transformers. India has a plethora of manufacturers of distribution transformers, and an alarmingly high proportion of them allegedly use scrap CRGO.[49] With a view to curbing the use of scrap CRGO, the government over the past few years has passed several QCOs that make it mandatory for the use of prime grade CRGO. In fact, the government even made it mandatory for all foreign steel mills to get certification from BIS for CRGO steel.[50]

2. CRGO Steel Consumption & Application

The estimated worldwide capacity and consumption of CRGO steel at around 3.2 to 3.5 million tonnes, per year. China is by far the biggest market, followed by US and India. The consumption in India is estimated at 300,000 tonnes per year.[51] It is important to know that CRGO is not just CRGO; it is divided into top grades and conventional grades. A lot of developments have taken place on the technological front worldwide in improving the quality of CRGO.[52]

Top grade applications are getting more and more important as energy is getting more and more expensive — especially, in Europe. Therefore, the better the material is, the more you can save on energy costs and reduce CO2 emissions. Estimates state that almost 98% of CRGO steel goes into the transformer business. This is the main application. It is the transformer ecosystem that includes transformers and its accessories like rectifiers. The important point that we see in the past 2-3 years are mega trends with respect to climate change and other related issues. This includes e-mobility and the switch to increasing use of renewable energy and less fossil energy.[53]

For the years to come, reports have suggested a six-fold increase in the use of renewable energy worldwide. For this, we will need to install new efficient and smart grids that will need large amounts of CRGO steel.[54] Experts have opined that the Indian market would be the fastest growing in the coming years.[55]

3. Lack of fructification in CRGO Manufacturing in India

Experts have stated that the reason behind the less than satisfactory production advent of CRGO Steel in India is because producing CRGO steel is a very different process. For any other

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[48] Venugopal Pillai, *CRGO Steel is Critical to India's Decarbonisation Goals: Thyssenkrupp Electrical Steel*, T&D INDIA (Mar. 17, 2023) https://www.tndindia.com/crgo-steel-is-critical-to-indias-de-carbonization-goals-thyssenkrupp-electrical-steel/ [hereinafter "Pillai II"]
[49] Pillai, *supra* note 47.
[50] *Infra* Part IV.
[51] Pillai II, *supra* note 48.
[52] *Id.*
[53] *Id.*
[54] *Id.*
[55] *Six-Fold Increase In Renewable Energy Adoption Required*, UNFCCC (Apr. 25, 2018) https://climatechange-theneweconomy.com/six-fold-increase-renewable-energy-adoption-required/

variety of steel, there is a simpler production process in the downstream operations that would typically include – hot rolling, cold rolling, annealing, coating, or galvanizing.[56] However, in CRGO steel, it has multiple extra processing at very high temperatures as well as unique equipment. The steel needs a lot of R&D, competence, and discipline in production. These qualities cannot be built overnight. At the end of it, the production window of parameters of CRGO is very narrow. It needs a lot of engineering and quality control.[57] Investment in CRGO – for per tonne output compared to other flat steel capital expenditure (capex) – is very high. CRGO is not a volume business but about producing niche product with a very high technology for the needs of energy efficiency and decarbonization.[58]

C. EVOLUTION OF INDIA'S REGULATORY REGIME AND IMPACT ON CRGO INDUSTRY

It is very heartening to note that all the 15-odd steel mills globally have secured the mandatory BIS registration and are now supplying only BIS-marked CRGO to India. This has resulted in a significant drop in the use of scrap CRGO. However, there are still instances where scrap CRGO finds its way in distribution transformers.[59] The use of scrap material could also be influenced by the ready availability of recycled CRGO, aligning with environmental considerations and sustainability goals. In specific applications where performance requirements are less stringent or for transformers serving specialized purposes, the cost savings associated with using scrap CRGO may be deemed acceptable.[60]

Earlier, there were sporadic episodes where scrap, and not prime-grade, CRGO was used. This happened inadvertently as there was no way to know if the CRGO was of substandard grade. Now with the BIS certification, this issue has been resolved to a very large extent. However, what persists is the wilful usage of scrap CRGO in spite of the stringent regulatory framework.[61] Due to these regulatory changes, home-grown JSW Steel and JFE Steel Corporation (JFE) of Japan have partnered to set up a JV company in India for manufacturing of CRGO steel. In a regulatory filing, JSW Steel said it "has entered into a JV agreement with JFE on August 2, 2023 for the purposes of establishing a JV company in India for the manufacture and sale of CRGO using industry leading machinery, technical know-how and JFE Steel's energy efficient production technology developed through extensive R&D."[62]On May 22, JSW Steel and JFE had completed the joint feasibility study and had reached agreement to establish a 50:50 JV company to manufacture CRGO in India.

Further, NLMK, intends to manufacture CRGO steel with low magnetic core losses, with a production capacity of 64 KTPA in Maharashtra, India by bringing a larger portion of the value chain to the country and realising cost benefits by mitigating the impact of the current import

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[56] Pillai II, *supra* note 48.
[57] Pillai, *supra* note 47.
[58] *Id.*
[59] *Id.*
[60] *Id.*
[61] *India's small steelmakers concerned about BIS standards*, ARGUS MEDIA (June 12, 2019) https://www.argusmedia.com/en/news/1919932-indias-small-steelmakers-concerned-about-bis-standards
[62] *Id.*

duty (will serve 22% of India's current need for electrical grade of steel). The company has invested $ 85 million and will directly employ 150 highly qualified personnel and 1000+ personnel indirectly.[63] NLMK is one of the world leaders in the production of Electrical Steel and has patented its manufacturing process. Their India facility will be the second in the country to be operated by a foreign company. They intend to expand the product's value in India through additional expansion phases which will depend on the development of the market. Invest India advised the client on locations across Maharashtra, Gujarat and Orissa for market entry and go-to-market strategy. Invest India conducted extensive research and sent detailed site analyses as requested by the client. It also organised meetings with stakeholders, including state government senior officials in all states. Invest India has also assisted the company in active conversations with the Ministry of Steel and BIS in preparation for their operations. The plant's construction has been completed to an 80 per cent level, with expected commissioning in Q3 2022.[64]

D. REGULATORY FRAMEWORK

1. Preliminary Information

In India, CRGO Steel is available in various grades (generally called M3, M4, M5 & M6, Major international standards such as Japanese (JIS), American (ASTM), German (DIN) and British Standards which specify c.r.g.o. grade).

The Specific Grades of Steel in question are as follows -

1. **HS Code 7204** - Tariff Classification of - Ferrous waste and scrap; remelting scrap ingots of iron or steel.
2. **HS Code 8504** - Tariff Classification of - Electrical transformers, static converters (for example, rectifiers) and inductors; parts thereof.

2. Policy Objectives

Accordingly, after a detailed review, the Government has released the NSP 2017, which has laid down the broad roadmap for encouraging long term growth for the Indian steel industry, both on demand and supply sides, by 2030- 31, with a vision to create a technologically advanced and globally competitive steel industry that promotes economic growth.[65] The NSP aims at building a globally competitive industry with a crude steel capacity of 300 MT by 2030-31from present level of 125 million tons per annum MTPA and increase per Capita Steel Consumption to 160 Kgs. by 2030-31 amongst other objectives.[66]

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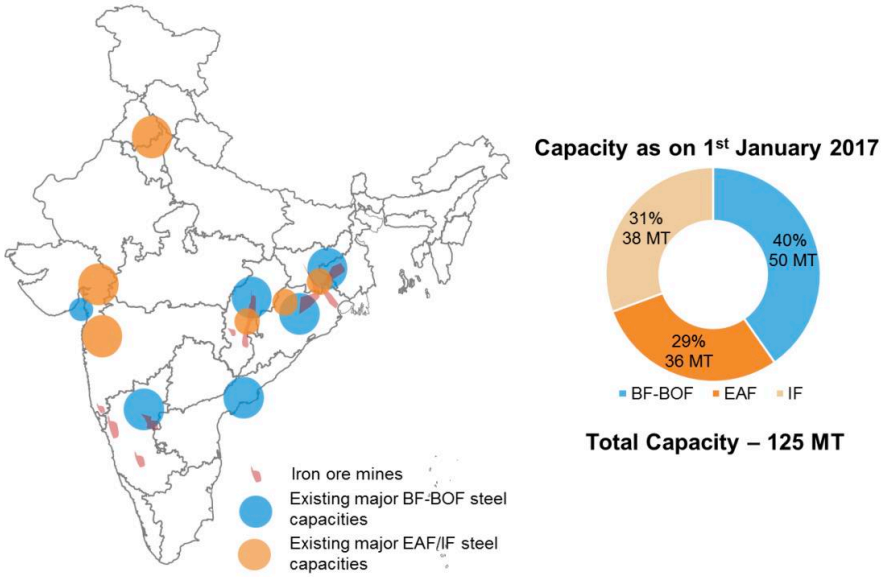
[63] Team India News, *NLMK to manufacture CRGO steel in Maharashtra, covering 20% of India's need for the product*, INVESTINDIA (May 05, 2022) https://www.investindia.gov.in/team-india-news/nlmk-manufacture-crgo-steel-maharashtra-covering-20-indias-need-product#:~:text=NLMK%20intends%20to%20manufacture%20Cold,duty%20(will%20serve%2022%25%20of

[64] *Id.*

[65] *25 Safety Guidelines for Iron & Steel Sector*, MINISTRY OF STEEL, Available at: https://steel.gov.in/sites/default/files/Framework%20Document%20for%20Safety%20Guidelines.pdf.

[66] NATIONAL STEEL POLICY(NSP), 2017, MINISTRY OF STEEL, PART II—SEC. 3(i) Available at: https://steel.gov.in/en/national-steel-policy-nsp-2017 at 22.

Figure 1: Current steel footprint in India



Source: Ministry of Steel, JPC

3. National Steel Policy, 2017 & CRGO

The NSP makes reference to CRGO in two instances. *Firstly,* in Para. 1.8 emphasizes the significant progress made by the Indian steel industry over the last two decades. The industry has successfully developed advanced capabilities, enabling the production of sophisticated steel that meets global standards. This evolution has positioned India to cater to a diverse range of requirements across various end-user industries. Despite these advancements, the analysis underscores a specific focus that is needed. The call for a special effort emphasizes the importance of domestic steel production for high-end applications. The identified sectors CRGO, special steel, and alloys tailored for use in Power equipment, Aerospace, Defense, and nuclear applications. The call for a "special effort" suggests a recognition of the strategic significance of these specialized steel applications and the need for focused initiatives to ensure their domestic production.

> "*Para. 1.8. Over the past two decades, the Indian steel industry has developed capabilities of producing a wide range of sophisticated steel at par with global best practices addressing diverse needs of the end user industries. However, India still needs to make a special effort to domestically produce steel for high end applications, electrical steel (CRGO), special steel and alloys for Power equipment, Aerospace, Defense and Nuclear applications.*"

Secondly, in Para. 4.15.6, which highlights a crucial challenge faced by the Indian steel industry—product development. This challenge has led to a significant reliance on the import of value-added products, such as automotive steel for high-end applications, electrical steel like CRGO, amorphous steel, and special steel and alloys essential for Power Equipment, Aerospace, Defense, and nuclear applications. The proposed solution involves the facilitation of production for these value-added, front-end, and strategically important products. The suggested methods include the acquisition of foreign technology through the establishment of JVs, subsidiaries of foreign companies, or indigenous development. This signals a strategic approach, acknowledging

the necessity of global collaboration to enhance technological capabilities within the Indian steel industry. Moreover, the emphasis on minimizing import dependence underscores the government's commitment to fostering self-sufficiency. The measures proposed align with a broader vision of promoting indigenous innovation and development. This analysis suggests a proactive stance by the Indian steel industry in addressing challenges, outlining strategic pathways for technological advancement and reducing reliance on imports for critical steel products.

"*Para. 4.15.6. Product development is yet another challenge faced by the Indian steel industry which has given rise to import of most of the value-added products like automotive steel for high end applications, electrical steel like CRGO & amorphous steel as well as special steel and alloys for the Power Equipment, Aerospace, Defense and Nuclear applications. Production of these value added, front end, and strategic products will be facilitated through acquisition of foreign technology by setting up of JVs, or subsidiaries of foreign companies or by indigenous development. Measures will also be taken to ensure development of all such special steel and alloys to minimize import dependence.*"

The NSP 2017 and Domestically Manufactured Iron & Steel Products Policy 2017, has led to huge growth in both production and consumption of steel. The per capita consumption has risen from 59 kgs in 2013-14 to 69 kgs in 2017-18. India has produced 103 Million Tonnes of steel in 2017-18 and will soon become the second largest producer of steel in the world in the year 2018.[67] The capacity of steel production has increased from 97 Million Tonnes in 2012-13 to 138 Million Tonnes in 2017-18.[68] The Government of India's emphasis and commitment to building infrastructure, Make-in-India and Smart City Mission has led to the consumption of steel growing dramatically.[69] More than 50% production is in the secondary steel sector comprising of small producers spread across the country employing a large number of people directly or indirectly.[70]

4. Applicable Quality Control Orders on CRGO Steel

a) Circular for all steel importers importing steel without BIS license to mandatorily apply and seek clarification from Ministry of Steel through QCO Portal[71]

The Ministry of Steel has notified Steel and Steel Products (Quality Control) Order under the BIS Act, 2016, which mandates that all steel products imported into the country must have a BIS license and be accompanied by a Mill Test Certificate, marked with ISI and BIS license numbers. To ensure compliance, steel importers must apply for clarification through the TCQCO Portal for each consignment that lacks BIS certification. The Ministry of Steel has a Technical

[67] Panagariya, *supra* note 45.
[68] *Id.*
[69] *Id.*
[70] *Ministry of Steel initiative of Make in Steel - Make in India*, PRESS INFORMATION BUREAU (18-December-2018).
[71] Circular for all steel importers importing steel without BIS license to mandatorily apply and seek clarification from Ministry of Steel through QCO Portal [20/10/2023] Available at: https://steel.gov.in/sites/default/files/Circular.pdf

Committee to examine these applications and determine if the products fall under the Steel QCO.

Steel and Steel Products (Quality Control) Order, 2020[72]

From 31st December, 2020, the goods and articles within the **Stampings/ laminations/ cores of transformers (with or without winding)** section having a 8504 HS Code required BIS standard marked Grain Oriented Electrical Steel Sheet and Strip conforming to IS 3024:2015 or Cold rolled non- oriented electrical steel sheet and strip conforming to IS 648:2006 or Magnetic materials – specification for individual material – Fe based amorphous strip delivered in the semi-processed state conforming to IS 16585: 2016. Prior to this on 03/06/2020, the Stampings/ laminations/ cores of transformers (with or without winding) goods were exempted from the Steel and Steel Products (Quality Control) Order, 2020 from 16th September, 2020.

5. Environmental Framework in India

a) Introduction

The iron and steel industry in India operates under the stringent guidelines of the EPA, alongside the comprehensive Environment Protection Rules & Regulations promulgated by the Ministry of Environment, Forest and Climate Change (MoEF&CC)[73]. Entrepreneurs aspiring to establish new iron and steel plants, or to significantly expand existing ones, must first secure statutory clearances from the relevant Union or State Government authorities, as mandated by the EPA. Subsequently, steel companies are obligated to implement and maintain specific pollution control measures and facilities. They must also ensure their operations adhere strictly to the established standards and norms pertaining to air, water, and noise pollution, as well as the generation and utilization of solid waste. These regulations and standards are rigorously monitored by the Central and State Pollution Control Boards. Moreover, the Ministry of Steel (MOS) plays a crucial role in assisting and facilitating the formulation and amendment of these environmental norms and standards, thereby ensuring that the industry remains compliant with environmental conservation efforts.

b) Energy Management

The **Charter on CREP** is an initiative of MOEF & CC/ CPCB in association with Ministry of Steel and the main/ major steel plants to reduce environment pollution, water consumption, energy consumption, solid waste & hazardous waste management etc as per mutually agreed targets with the purpose to go beyond the compliance of regulatory norms for prevention & control of pollution through various measures including waste minimization, in-plant process control & adoption of clean technologies. A NTF has been formed for implementation of

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[72] Steel and Steel Products (Quality Control) Order, 2020, Available at: https://steel.gov.in/sites/default/files/145%20QCO%20Order.pdf

[73] *Energy and Environment Management in Iron & Steel Sector*, MINISTRY OF STEEL https://steel.gov.in/en/technicalwing/energy-and-environment-management-iron-steel-sector.

CREP recommendations. Ministry of Steel facilitates compliance of CREP action points in association with the steel plants. NTF has recently been reconstituted.[74]

Additionally, the NAPCC has been launched in 2008 to address the Challenge at national level.[75] NAPCC outlines 8 National Missions, one of them being the NMEEE. PAT is the flagship scheme under NMEEE. PAT is a market-based mechanism through certifications of energy savings which could be traded. PAT has become effective from April 2012. The PAT Scheme has so far covered 163 numbers of Iron & Steel Units in India (referred as Designated Consumers). The threshold limit of energy consumption of 20,000 tonnes of oil equivalent (toe) per year has been marked as the cut-off limit criterion for any unit in the iron & steel sector to be identified as designated consumer. The methodology of setting targets for designated consumers is based on reduction of SEC on a GtG basis. The Indian steel industry overall has achieved the targets for reduction in energy consumption in PAT Cycle 1&2.

E. IMPACT OF IMPORT AND TRADE POLICIES ON INDIAN ENTERPRISES

1. Overall Trends in CRGO Steel Trade

Overall imports of total finished steel at 5.000 mt, up by 28.0%. India was a net exporter of total finished steel in April-January 2022-23. Volume wise, HR Coil/Strip (1.69 mt) was the item most imported (34% share in total finished steel). Korea (1.841 mt) was the largest import market for India (37% share in total).[76] Overall exports of total finished steel at 5.329 mt, down by 52.2%. Volume wise, HR Coil/Strip (2.66 mt) was the item most exported (40% share in total finished steel). Major share (54%) of such exports was from Alloy/Stainless. Vietnam (0.807 mt) was the largest export market for India.[77]

In **2022/2023 fiscal year (April-March**), India is likely to become a net importer of rolled steel, according to preliminary data from the United Factory Committee of the country. S&P Global informs about it.[78] In the **2021/2022 fiscal year**, the country was a net exporter of rolled steel, having shipped 13.5 million tons abroad, while imports in this period amounted to 4.7 million tons. During 11 months of the 2022/2023 financial year (April 2022 – February 2023) exports of Indian rolled products fell by 52% y/y – to 5.9 million tons, while imports increased by 29.5% y/y – up to 5.59 million tons. Exports in this period steadily decreased, while imports recorded growth from June last year to February 2023.[79]

2. India as the Second Largest Crude Steel Producer

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[74] *Id.*
[75] *Id.*
[76] *Indian Steel Industry: February 2023 – A Trend Report*, (Feb. 6, 2023) https://jpcindiansteel.nic.in/writereaddata/files/Trend%20Report%20February%202023.pdf.
[77] *Id.*
[78] Halina Yermolenko, *India may become a net importer of steel in 2022/2023 fiscal year* (March 30, 2023) https://gmk.center/en/news/india-may-become-a-net-importer-of-steel-in-2022-2023-fiscal-year/#:~:text=In%20the%2011%20months%20of,S%26P%20Global%20informs%20about%20it.
[79] *Id.*

India has secured the position of the world's second-largest producer of crude steel, following China and the EU. Despite facing a setback in a WTO dispute i.e., India — Certain Measures on Imports of Iron and Steel Products over steel import duties, Indian steel companies are turning to the concepts of 'economic nationalism' and their designation as a 'strategic industry.'[80] They aim to influence the government to heighten import barriers, compel automakers (a key consumer) to prioritize locally produced alloy steel, and secure preferential access to the rapidly expanding domestic market.[81]

3. Impact of Import Duties increasing

The government is unlikely to accede to the domestic steel sector's request for an anti-predatory measure against imports in the form of a hike in basic customs duty (BCD) on steel imports or the imposition of an extra safeguard duty on the alloy in the immediate future.[82] Officials are concerned that such intervention might lead to an increase in the cost of this vital alloy within the domestic market. Despite discussions between the steel ministry, commerce ministry, and finance ministry on the matter, the prevailing consensus is that imports have not reached a critical level that warrants immediate government intervention.

4. Indian Steel Producer's Stand

The ISA has presented multiple appeals to the government, urging action against the alleged predatory pricing practices of international steel producers.[83] It has proposed measures, including raising the BCD on flat steel products from the current 7.5% to 12.5% and on long products from 7.5% to 10%.[84] Additionally, the industry body has advocated for a 25% safeguard duty on steel imports from nations with free-trade agreements with India, effectively bypassing the BCD. Such countries constitute over 60% of steel imports into India.[85]

Steel manufacturers assert that foreign producers are flooding the Indian market with excess output, selling at prices lower than those in their home markets. This phenomenon occurs at a time when demand for steel has dwindled in many major consumer countries.

5. Impact of the Trade Policy

India has introduced a five-year anti-dumping duty on certain Chinese steel imports, a measure reported by Reuters as steel imports from China surged by 62% between April and July 2023,

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[80] Ritesh Singh, *The cost of protecting steel: India's steel industry is a standing example of how protectionism harms the economy*, THE TIMES OF INDIA (March 7, 2019) https://timesofindia.indiatimes.com/blogs/toi-edit-page/the-cost-of-protecting-steel-indias-steel-industry-is-a-standing-example-of-how-protectionism-harms-the-economy/.
[81] *Id.*
[82] Nehal Chaliawala, *Steel cos seek import duty hike to counter dumping*, ECON. TIMES (Jan. 31, 2023) https://economictimes.indiatimes.com/industry/indl-goods/svs/steel/steel-cos-seek-import-duty-hike-to-counter-dumping/articleshow/97461454.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.
[83] Nehal Chaliawala, *Govt not keen on imposing higher import duty on steel*, ECON. TIMES (Apr. 28, 2023) https://economictimes.indiatimes.com/industry/indl-goods/svs/steel/govt-not-keen-on-imposing-higher-import-duty-on-steel/articleshow/99825136.cms.
[84] *Id.*
[85] *Id.*

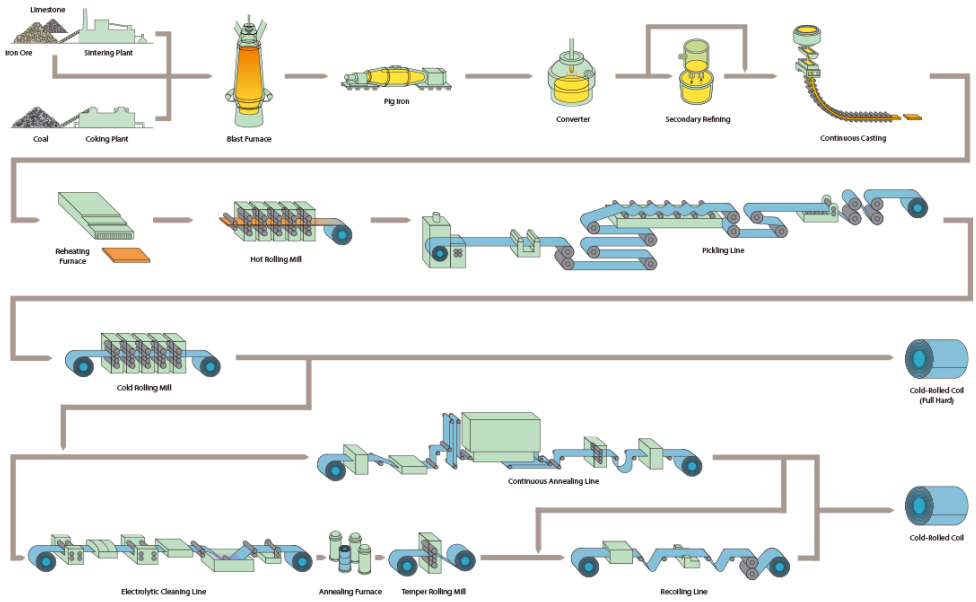
compared to the same period the previous year.[86] In this timeframe, China exported 0.6 million metric tons of steel, surpassing South Korea as the top steel exporter to India. Concurrently, in the United States, the current administration under President Biden has resolved to maintain the elevated import tariffs on Indian steel and aluminium products, initially instituted by the previous Trump administration. The US stance is that the higher duties will remain in place until the "fundamental issue" of global excess capacity and the practices leading to it are effectively addressed.[87]

F. CRGO STEEL TRADE IN DEVELOPED COUNTRIES & MARKET COMPETITORS

After analysing the Indian steel sector intricacies with due emphasis on CRGO Steel production and noting that Grain oriented steel being a sophisticated, high-tech material used to produce transformers and large, high-performance generators. This section analyses the quality of CRGO steel of other developed countries and compares them with India's quality standards. The part delves into a comparative analysis of the international standards with the domestic specifications of steel productions in these major steel producing countries.

1. Japan

In Japan, the Nippon Steel Corporation and JFW Steel Corporation have a long history of producing high-quality CRGO steel. The Nippon Steel Corporation uses the following process to ensure manufacturing of cold-rolled steel sheets.



[86] Sounak Mukhopadhyay, *India clamps down on Chinese steel, enacts 5-year anti-dumping duty as import rises 62%*, MINT (Sept. 12, 2023) https://www.livemint.com/news/india/india-clamps-down-on-chinese-steel-enacts-5-year-anti-dumping-duty-as-import-rises-62-11694483592968.html.

[87] Amiti Sen, *Higher import duty on Indian steel, aluminium to stay till the issue of excess capacity addressed: US*, BUSINESS LINE (Jan. 17, 2023) https://www.thehindubusinessline.com/markets/commodities/address-excess-capacity-to-end-higher-import-duties-on-indian-steel-aluminium-us-official/article66386486.ece#:~:text=The%20Biden%2Dled%20US%20government,US%20government%20official%20has%20said.

Fig 1.2: Nippon Corporation's cold-rolled steel manufacturing process[88]

a) International standards

For the quality maintenance of CRGO steel on the global front, Japan uses the standards prescribed in the ISO and IEC.

Japan ensures regular compliance with the ISO regulations, specifically ISO 14025[89] which is the international standard for tin plate, tin-free steel and laminated steel sheets. Moreover, ISO 20915 allows mention of environmental impacts of the steel produced either during production process or recycling.[90] ISO 6929 provides electrotechnical standardisation of steel in its various types and forms.[91] An ISO 9001 certification may indicate a commitment to quality control.[92] IEC 60404-8-7 cover the magnetic properties and measurement methods for CRGO steel.[93]

Additionally, steel manufacturing companies have obtained the EcoLeaf Ecolabel certified by the SuMPO.[94]

Domestic standards

JIS provide specifications for various products, including CRGO steel. The JIS standard for CRGO steel is outlined in the document JIS C 2552:2011, titled "*Method of test for the magnetic properties of grain-oriented electrical steel strip and sheet by means of an Epstein frame*".[95] This standard defines the test methods and requirements for the magnetic properties of grain-oriented electrical steel used in transformers and other electrical equipment.

Key points covered by JIS C 2552:2006 include:

a) Test Equipment: The standard specifies the use of an Epstein frame for measuring the magnetic properties of CRGO steel, including core loss and magnetic induction.
b) Test Conditions: The document outlines the testing conditions, including the frequency and magnetic field strength at which the measurements should be made.
c) Sample Preparation: It provides guidance on the preparation of CRGO steel samples, including the required dimensions and surface conditions.
d) Measurement of Core Loss: The standard details the procedure for measuring the core loss (iron loss) of CRGO steel under specified conditions.

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[88] Steel Sheets, Manufacturing Process, NIPPON STEEL, https://www.nipponsteel.com/en/product/sheet/process/.
[89] *Environmental labels and declarations*, ISO 14025:2006, https://www.iso.org/standard/38131.html.
[90] *Life cycle inventory calculation*, ISO 20915:2018, https://www.iso.org/standard/69447.html.
[91] *Id.*
[92] *Quality Management System*, ISO 9001:2015, https://www.iso.org/standard/62085.html.
[93] *International Electrotechnical Commission*, IEC 60404-8-7:2020, https://webstore.iec.ch/publication/63884.
[94] *Nippon Steel Obtained Ecoleaf Environmental Product Declaration for Rail Products*, NIPPON STEEL CORP. (Oct. 17, 2022) https://www.nipponsteel.com/en/news/20221017_100.html.
[95] *Cold rolled non-oriented electrical steel strip and sheet*, JIS C 2552:2014, JAPANESE STANDARDS ASSOCIATION, https://global.ihs.com/doc_detail.cfm?document_name=JIS%20C%202552&item_s_key=00269085.

e) Measurement of Magnetic Induction: It describes the method for measuring the magnetic induction (magnetic flux density) of CRGO steel.
f) Reporting: JIS C 2552:2006 specifies the format for reporting test results, ensuring consistency and clarity in presenting the magnetic properties of the material.

2. South Korea

South Korea is home to several top manufacturers of CRGO steel, which is used in electrical transformer production and other electrical applications. These manufacturers are known for their high-quality standards and stringent quality control measures. There has been an increase in Indian imports of iron and steel from Korea from USD 169 in 2009-10 million to USD 278 million in 2014-15.[96] The following table symbolises India's imports of iron and steel from Korea:

Table: India's imports of iron and steel from Korea[97]

Product Codes	Description	India's Imports from Korea (in US$ million)					
		2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
7204	Ferrous waste and scrap; remelting scrap ingots	16.54	84.17	60.57	46.45	38.4	71.23

A JSG Report on the CEPA between India and Korea stated that the key strengths of Korea lie in its world-class broadband infrastructure and ideal test-bed technology innovation. India's strengths, on the other hand, are in her highly-skilled human resources and world-class IT industry.[98]

Pohang Iron and Steel Company (POSCO) is one of the largest and most well-known steel manufacturers in South Korea.[99] They produce CRGO steel and have a strong reputation for quality control. POSCO India is a wholly owned subsidiary of POSCO Korea. They adhere to both domestic and international quality standards and certifications.

The manufacturing process of CRGO Steel at POSCO is outlined below:[100]

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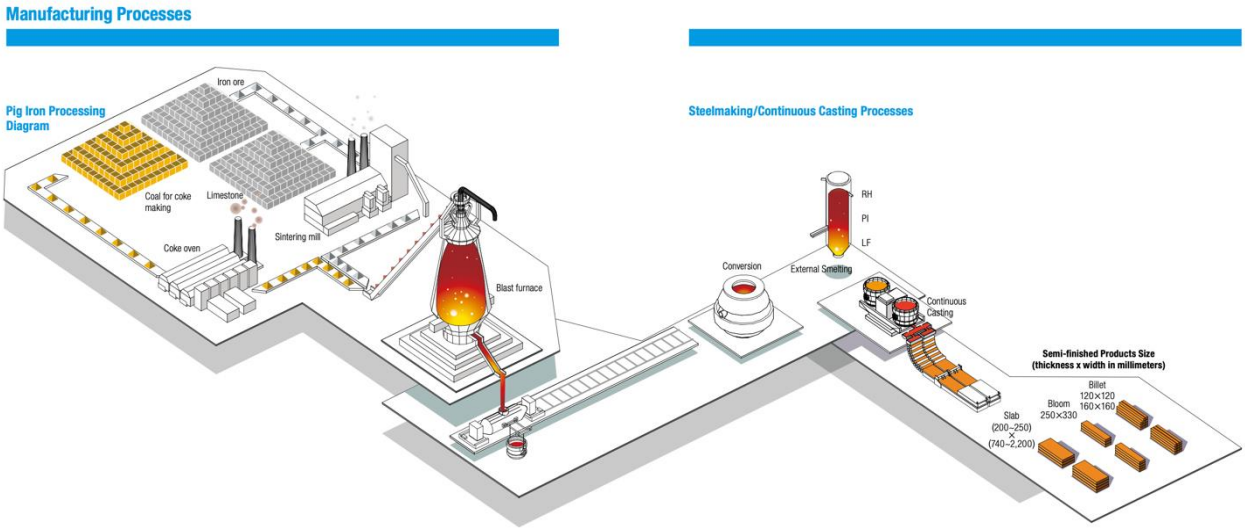
[96] V. S. Seshadri, *India- Korea CEPA – An Appraisal of Progress*, AIC – Research and Information System for Developing Countries, p. 19 (2015), https://aseanindiacentre.org.in/sites/default/files/Publication/FINAL%20India%20and%20Korea%20Report_0.pdf.
[97] *Id.*
[98] *Id.*
[99] Leading Steel Producers in South Korea in 2018, STATISTIA (Sept. 2019), https://www.statista.com/statistics/948728/south-korea-major-steel-producers-based-on-production-volume/.
[100] Manufacturing process, *Cold Rolled*, POSCO PRODUCTS, http://product.posco.com/homepage/product/eng/jsp/process/s91p2000420c.jsp.



a) International standards

ISO 9001 is a widely recognized international standard for quality management systems. Many steel manufacturers, including POSCO, may obtain ISO 9001 certification to demonstrate their commitment to quality control and continuous improvement in manufacturing processes.[101] ISO 14001 is an international standard for environmental management systems.[102] Companies like POSCO often strive to minimize their environmental impact during the production of CRGO steel, and ISO 14001 certification signifies their commitment to environmental responsibility. IEC 60404-8-7 is also referred to which specifies the standard of magnetic properties and measurement methods for grain-oriented electrical steel strip and sheet.[103]

Domestic standards

In South Korea, CRGO steel is manufactured and regulated according to domestic standards set by the KS.[104] The KS standard for CRGO steel is KS D 3527, which covers the technical requirements and testing methods for electrical steel sheets and strips.[105] KS D 3527 is the primary standard that governs the production and quality control of CRGO steel in South Korea.

The key aspects covered by KS D 3527 for CRGO steel are:

a) Chemical Composition: The standard specifies the allowable range of chemical elements in CRGO steel, including silicon (Si), carbon (C), aluminum (Al), and other alloying elements.

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101 *Supra* note 92.
102 *Id.*
103 *Supra* note 93.
104 Consulting Fields, KS Certification Product, MAJORWITH, https://www.mmc9001.com/en/sub/part/quality/01.asp?ACE_REF=adwords_g&ACE_KW=korean%20industrial%20standards&gclid=CjwKCAjwvfmoBhAwEiwAG2tqzMX0rKP_oo-.
105 KS D 3527: Rerolled steel bars for concrete reinforcement, KOREAN STEEL STANDARDS, http://steeljis.com/korea/ks_steel_standard_grades.php?cl_id=3.

b) Magnetic Properties: KS D 3527 defines the magnetic properties of CRGO steel, including magnetic flux density (B) and core loss (iron loss), under specific test conditions.
c) Mechanical Properties: The standard may specify mechanical properties such as tensile strength, elongation, and hardness to ensure that the material can be processed effectively.
d) Grain Orientation: KS D 3527 may include requirements related to the grain orientation of CRGO steel, ensuring that crystal grains are properly aligned to optimize magnetic properties.
e) Dimensional Tolerances: The standard may specify dimensional tolerances for CRGO steel sheets and strips, including thickness, width, and length.
f) Surface Quality: Surface inspection criteria may be provided to assess the quality of the CRGO steel surface, including the allowable types and sizes of defects.
g) Testing Methods: KS D 3527 outlines the testing methods and procedures to be used for evaluating the properties of CRGO steel, including methods for measuring magnetic properties and conducting mechanical tests.
h) Certification and Compliance: Manufacturers often need to ensure that their CRGO steel products comply with KS D 3527 and may obtain certification to demonstrate compliance with these domestic standards.

Apart from these standards, companies like POCSO also engage in third-party testing methodologies and their respective certifications to ensure compliance with various quality and performance criteria.

3. Germany

Apart from the IEC and ISO standards relied upon by other countries, Germany relies upon its own domestic standards. German company Thyssenkrupp is known for its electrical steel division specialising in the production of CRGO. Thyssenkrupp's grain oriented electrical steel is known as **powercore**.[106] It is most commonly used in large power transformers, distribution transformers, small transformers, current transformers, shunt reactors, wound cores and power generators.[107] Germany being one of the countries closest to the EU 2050 Climate Goals, companies producing CRGO steel greatly value their climate neutrality. Thyssenkrupp has moved away from coal-fired blast furnaces to direct reduction plants running on hydrogen to produce their CRGO steel. This reduces overall CO2 emissions as well. powercore grades have an extremely sharp crystallographic texture. This, combined with a high-performance insulation coating, improves magnetic domain structure for a reduction of core loss and noise. This enables the powercore's efficiency in power transformers. With respect to rising material costs, powercore's manufacturing cost is lesser compared to its competitors, thereby significantly reducing the overall cost.

[106] Grain Oriented Electrical Steel, https://www.thyssenkrupp-steel.com/en/products/electrical-steel/electrical-steel-grain-oriented/electrical-steel-grain-oriented.html.
[107] *Id.*

a) Domestic standards

Germany uses a range of DIN - German Institute for Standardization[108] and the VDE - Association for Electrical, Electronic, and Information Technologies[109] standards to act as quality control mechanisms and regulations in the CRGO steel industry.

i. DIN standards

DIN EN 10106 is a European standard that specifies the electrical properties of non-oriented electrical steel.[110] While it primarily applies to non-oriented electrical steel, which is different from CRGO steel in terms of its grain structure and magnetic properties, DIN EN 10106 sets important electrical property testing methods and requirements that is relevant to CRGO steel quality control in Germany.

DIN EN 10106 primarily deals with:

a) Electrical Property Testing: DIN EN 10106 outlines specific testing methods for determining the electrical properties of non-oriented electrical steel, including measurements of core loss and magnetic flux density (B).
b) Core Loss Measurements: The standard specifies procedures for measuring the core loss (iron loss) of electrical steel samples under defined conditions, including measurement at different magnetic flux densities and frequencies. Core loss is a critical parameter for assessing the energy efficiency of electrical steel in applications such as transformers.
c) Magnetic Properties: While DIN EN 10106 primarily focuses on non-oriented electrical steel, it includes methods for measuring the magnetic properties of the material, such as magnetic permeability and coercivity.
d) Sample Preparation: The standard provides guidelines for the preparation of test samples, ensuring consistency and accuracy in measurements.
e) Frequency and Flux Density Ranges: DIN EN 10106 defines specific ranges for the frequency and magnetic flux density at which core loss measurements are to be conducted.
f) Quality Assurance: Manufacturers in Germany use DIN EN 10106 as a reference standard to ensure that their electrical steel products meet the required electrical property specifications. Compliance with this standard helps manufacturers maintain consistent quality and performance.

DIN 46400-1 is a German standard that outlines the magnetic properties and measurement methods for grain-oriented electrical steel, including CRGO steel.[111] This standard is highly

[108] DIN Standards, https://www.din.de/en.
[109] *Id.*
[110] DIN EN 10106, EUROPEAN STANDARDS, https://www.en-standard.eu/din-en-10106-cold-rolled-non-oriented-electrical-steel-strip-and-sheet-delivered-in-the-fully-processed-state/.
[111] Global HIS DIN 46400-1, https://global.ihs.com/doc_detail.cfm?document_name=DIN%2046400%2D1&item_s_key=00028452.

relevant for assessing the quality of CRGO steel in Germany and ensuring that it meets the required magnetic property specifications. The main elements of DIN 46400-1 are:

a) Magnetic Properties: DIN 46400-1 defines the magnetic properties of grain-oriented electrical steel, which is characterized by its preferred grain orientation for optimized magnetic performance. The standard specifies parameters such as magnetic flux density (B), magnetic permeability (μ), core loss (iron loss), and other magnetic properties.
b) Testing Methods: The standard outlines the procedures and methods for measuring the magnetic properties of CRGO steel samples. This includes specifying the test conditions, such as the magnetic field strength, frequency, and temperature, under which the measurements should be conducted.
c) Sample Preparation: DIN 46400-1 provides guidelines for the preparation of test samples, ensuring that they are representative of the CRGO steel product being evaluated. Proper sample preparation is crucial for accurate measurement results.
d) Measurement Parameters: The standard defines the key measurement parameters and conditions, including the frequency range over which measurements are made, typically in the low-frequency range relevant to power applications.
e) Quality Assurance: Manufacturers of CRGO steel in Germany adhere to DIN 46400-1 as a reference standard to ensure that their products meet the required magnetic property specifications. Compliance with this standard is essential for maintaining the consistent quality and performance of CRGO steel used in transformers and other electrical equipment.
f) Comparative Testing: DIN 46400-1 allows for the comparative testing of different batches or suppliers of CRGO steel. This is particularly important for industries and manufacturers seeking to ensure that the electrical steel materials they use consistently meet their performance requirements.

ii. VDE standards

It is not a specific standard or document associated with electrical steel or CRGO steel quality control. Instead, VDE (Elektronik und Informationstechnik - Association for Electrical, Electronic, and Information Technologies) primarily focuses on electrical and electronic technologies, safety standards, and regulations related to electrical equipment and systems.

VDE standards cover a wide range of topics related to electrical engineering, including safety requirements for electrical installations, electrical appliances, power generation and distribution, and more. These standards are designed to ensure the safe and reliable operation of electrical systems and devices.

While VDE does not have a specific standard for CRGO steel quality, the organization may be indirectly involved in setting standards for electrical equipment that uses CRGO steel, such as transformers and electrical motors. In such cases, VDE standards related to the performance, safety, and testing of electrical equipment would apply.

4. China

China follows the ISO and IEC standards on the global front. On the domestic stage however, China follows the Chinese national standard that outlines the specifications for grain-oriented electrical steel, which includes CRGO steel. This standard is issued by the SAC and provides detailed requirements for the magnetic properties of grain-oriented electrical steel.[112]
Standard GB/T 2521 provides:[113]

a) Scope: GB/T 2521 specifies the requirements for the magnetic properties of grain-oriented electrical steel strips and sheets. These properties are essential for ensuring the efficient operation of transformers and other electrical equipment.
b) Magnetic Properties: The standard specifies various magnetic properties that are critical for CRGO steel, including:
c) Magnetic Flux Density (B): The maximum magnetic flux density (induction) achievable under specific conditions.
d) Magnetic Permeability (μ): A measure of the material's ability to conduct magnetic flux.
e) Core Loss (Iron Loss): The energy loss in the material when subjected to alternating magnetic fields. Core loss is a crucial parameter for assessing the efficiency of transformers.
f) Testing Methods: GB/T 2521 provides guidelines and procedures for measuring the magnetic properties of grain-oriented electrical steel, including the methods for testing magnetic flux density, magnetic permeability, and core loss. These measurements are typically performed under specified test conditions, including magnetic field strength, frequency, and temperature.
g) Sample Preparation: The standard may include requirements for sample preparation, ensuring that test samples are representative of the CRGO steel product being evaluated. Proper sample preparation is essential for accurate measurement results.
h) Tolerances and Allowable Deviations: GB/T 2521 often includes specifications for tolerances and allowable deviations in the magnetic properties to account for variations in production.
i) Surface Finish: The standard may address requirements related to the surface finish and coating of CRGO steel to reduce eddy current losses and ensure good insulation.
j) Dimensional Specifications: While the primary focus is on magnetic properties, GB/T 2521 may also specify dimensional requirements for grain-oriented electrical steel sheets and strips.

Besides this, GB/T 3655 also prescribes certain additional requirements for the dimensions, shape, and allowable deviations of grain-oriented electrical steel sheets and strips:[114]

a) Scope: GB/T 3655 outlines the requirements for the dimensions and tolerances of grain-oriented electrical steel sheets and strips used in electrical transformer cores and other applications.

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112 STANDARDIZATION ADMINISTRATION OF CHINA, http://ncse.sac.gov.cn/sacen/.
113 GB/T 2521-2008, Chinese Standard GB/T, https://www.chinesestandard.net/PDF.aspx/GBT2521-2008.
114 GB/T 3655-2008, Chinese Standard GB/T, https://www.chinesestandard.net/PDF/English.aspx/GBT3655-2008.

b) Dimensions: The standard specifies the standard dimensions and thicknesses of CRGO steel sheets and strips. These dimensions ensure compatibility with various transformer designs and specifications.
c) Tolerances: GB/T 3655 defines the allowable tolerances for dimensions such as width, thickness, and length. Tolerances are essential to control the manufacturing process and ensure that the finished CRGO steel products meet the required specifications.
d) Shape and Flatness: The standard may specify requirements related to the shape and flatness of CRGO steel sheets and strips. Proper flatness is critical to ensure the material can be processed and assembled correctly in transformer cores.
e) Surface Finish: GB/T 3655 may include provisions related to the surface finish of CRGO steel, such as allowable deviations in surface quality. Surface finish is important for reducing eddy current losses and ensuring good insulation.
f) Coating: The standard may address the presence of coatings or insulation materials on the surface of CRGO steel, which are designed to further improve its electrical and magnetic properties.
g) Testing Methods: GB/T 3655 may provide guidelines for measuring and verifying the dimensions and tolerances of CRGO steel sheets and strips. Proper testing methods are essential to ensure compliance with the standard.
h) Sample Preparation: The standard may include requirements for sample preparation to ensure that test samples accurately represent the CRGO steel products being evaluated.

Therefore, the analysis of these major steel producing economies and comparing their standards with the that of Indian steel production specifications, we see that the majorly the specifications are in line with the *Issn* grade which dominates the production standard in Indian Steel industry. Thus, it is safe to conclude that India is on the right track but by leveraging its strengths and addressing key challenges, India has the potential to sustain its momentum and contribute meaningfully to the global steel sector in the years to come. Further, collaboration and knowledge exchange between India and established steel-producing nations can also facilitate mutual growth and development in the industry.

Summary of Issue II

This section of the research paper provides an exhaustive overview of the regulatory framework, quality control measures, and environmental protocols governing the manufacture and use of CRGO steel in India, with an additional focus on the import and trade policies that impact the operations of Indian firms utilizing this material.

India's NSP 2017 is highlighted as a strategic initiative aiming to augment the country's crude steel capacity to 300 million tons by 2030-31, with a parallel increase in per capita steel consumption. The policy identifies CRGO, along with other specialized steels, as critical for high-end applications, hence necessitating concerted efforts to reduce import dependence through indigenous production and technological collaborations. QCOs are underscored, mandating BIS licensing for imported steel products, ensuring adherence to established standards, and necessitating compliance checks through the TCQCO Portal. Environmental

regulations are also rigorously enforced, with the steel industry operating under the mandates of the EPA, backed by measures from the Ministry of Steel (MoS) and Pollution Control Boards to oversee the implementation of pollution control mechanisms and the adherence to environmental norms.

Energy management is addressed through initiatives like CREP and NAPCC, setting targets for energy savings and enhanced efficiency, with specific focus on the steel industry's role in the PAT scheme. These collective efforts have yielded a notable increase in India's steel production capacity and consumption, aligning with the government's infrastructural and developmental objectives. Trade policies are explored, revealing India's shifting status from a net exporter to a potential net importer of steel, reflective of the dynamic global steel trade landscape. Indian enterprises' responses to import duties and trade measures are examined, suggesting an inclination towards advocating for increased protectionism and prioritizing domestic production. The paper culminates with a comparative analysis of international practices, particularly those of Japan, South Korea, and Germany. It draws parallels between their quality maintenance standards, such as ISO and IEC certifications, and domestic standards like JIS, KS, and DIN, to India's approaches and regulations. The analysis suggests that while India's standards are broadly aligned with international practices, there remains a spectrum of opportunities for further development and integration into the global steel quality paradigm.

At present, there is a single Indian manufacturer of CRGO steel, and it happens to be a subsidiary of a multinational corporation with a local production capacity of approximately 50,000 tonnes per year. In contrast, India's yearly requirement for CRGO steel is estimated to be about 300,000 tonnes, constituting roughly 9 percent of the global demand for this material.[115] Moreover, the majority of CRGO steel classified under HS codes 8504 and 7204 is imported globally from Russia, the United States, and India. Conversely, when it comes to the top three importers of CRGO steel under these HS codes, India leads the way with 39,617 shipments, followed by Malaysia with 2,359 shipments, and Pakistan ranking third with 1,993 shipments.[116] This highlights a notable paradox: India, despite being a significant producer of CRGO steel worldwide, remains the largest importer of this steel.

In light of this, it is necessary to provide solutions in order to limit the scarcity of CRGO steel and maintain the quality of the same.

A. LIMITING SCARCITY

The production of CRGO involves complex technology and limited patents, thus India plans to produce CRGO steel indigenously to meet the demand from the power sector. Currently, only five global steel makers around the globe have the requisite technology to produce such steel. India currently imports around USD 2 billion annually.[117]

1. Encouraging Domestic Production

A significant problem highlighted in the manufacturing capacity of CRGO is the shift of the steel mills from production of CRGO to the production of Cold Rolled Non-Oriented ["**CRNO**"] material, which is required for manufacturing of electrical vehicles as the demand is on the rise.[118] In order to subset the sudden drop in the production of CRGO steel, there is an urgent requirement for policy support from the government in order to resolve the raw material issue faced by the industry.

Hence, in response to the pressing need, a possible solution to rectify this could be to establish a centralized fund aimed at supporting SMEs in acquiring international companies or assets dealing with various raw materials such as CRGO/CRNGO steel, amorphous steel, high alloy

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[115] Pillai II, *supra* note 48.

[116] *CRGO steel, hs8504, hs code 7204 import data of World - 53,876 import shipments*, VOLZA GROW GLOBAL, (February 10, 2024),
https://www.volza.com/p/crgo-steel-or-hs8504-or-hs-code-7204/import/.

[117] Press Trust of India Ltd., *India's plan to make CRGO steel indigenously to take off soon,* THE ECONOMIC TIMES (December 16, 2012),
https://economictimes.indiatimes.com/industry/indl-goods/svs/steel/indias-plan-to-make-crgo-steel-indigenously-to-take-off-soon/articleshow/17635249.cms.

[118] *JSW Annual Report 2020-21*, JSW (February 10, 2024),
https://www.jsw.in/sites/default/files/assets/downloads/steel/IR/Financial%20Performance/Annual%20Reports%20Steel/20-21/JSW%20Steel%20Annual%20Report%202020-21.pdf.

materials, and more. To execute this, an assigned implementing agency will be responsible for soliciting, shortlisting, and providing funding to SMEs. This initiative aligns with the goals of Cluster Innovation Centres by addressing supply-demand gaps across different business aspects.[119] It intends to foster innovation tailored to the needs of industry clusters, emphasizing the industry's requirements and facilitating efforts from entities like the Government to enhance effectiveness in this direction.

Additionally, there is a need for a focused scheme, such as appointing a specialized body to scout global leaders engaged in producing materials such as CRGO steel and amorphous steel. These schemes should aim at granting tax breaks to wholly-owned subsidiaries, JVs, and foreign companies establishing manufacturing facilities within India.[120]

Furthermore, the already existing scheme in India i.e. the PLI Specialty Steel Promotion Scheme, [121] introduced by the government in 2021 could be pushed further with additional support from manufacturers itself. This program is designed to boost the production of CRGO and other specialty steels domestically by providing financial support tied to accomplished capacity and sales goals. It encompasses several elements, *firstly*, it provides financial incentives tied to investments, production volumes, and sales of specified specialty steel grades, with a specific focus on CRGO. *Secondly*, it places a strong emphasis on technological advancement, encouraging the adoption of state-of-the-art technologies and processes to improve efficiency and quality in steel production. *Lastly*, the scheme adopts a phased implementation approach, targeting various segments of the specialty steel value chain over a five-year period. Despite its intentions, the scheme faces challenges like slow implementation, stringent requirements, limited scope, and uncertain market demand, hindering its impact. Hence, a much needed support is required to allow for the effects of the scheme to trickle down to the masses.

Lastly, capitalize on access to local raw materials by engaging international giants willing to collaborate and share CRGO technology with Indian companies aiming to establish their manufacturing capabilities. This can be done by:

1. Cutting excise duties for domestically produced inputs or lowering customs duties for imported ones.
2. Providing financial incentives to companies that provide inputs or raw materials to the manufacturing units specializing in CRGO.

An example can be taken of Japan, where this was started by ARMCO and Allegheny Ludlum Corporation ["**ALC**"] during the period of 1940-50. They introduced CRGO steel to Japan, and it quickly replaced HR silicon steel as the primary core material in transformers. This was due to

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[119] *Capital Goods: Innovative Interventions Required*, Decide with Confidence, DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, (February 10, 2024), https://www.dsir.gov.in/sites/default/files/2022-10/5_12.pdf.

[120] Central Electricity Authority, *Guidelines for usages of amorphous core or CRGO core distribution transformers*, CENTRAL ELECTRICITY AUTHORITY, (February 10, 2024), https://cea.nic.in/wp-content/uploads/2020/04/c.pdf.

[121] PIB Delhi, *Status of Production-Linked Incentive Schemes*, MINISTRY OF COMMERCE & INDUSTRY (February 10, 2024), https://www.pib.gov.in/PressReleasePage.aspx?PRID=1710134.

the fact that CRGO steel had a lower core loss, which means that it lost less energy to heat. In 1961, Kawasaki Steel developed a new process for making CRGO steel that used MnS as a grain growth inhibitor. This process led to the creation of CRGO steel with even lower core losses.

In 1968, Nippon Steel introduced the world's first high permeability CRGO steel, called Hi-B. Hi-B had even lower core losses than conventional CRGO steel, and it also had a higher permeability, which means that it could conduct more magnetic flux. In 1973, Kawasaki Steel developed its own high permeability CRGO steel, called RGH. RGH was similar to Hi-B, but it had a slightly lower core loss. The development of high permeability CRGO steel was a major breakthrough in the field of transformer technology. It led to the development of more efficient and compact transformers, which are essential for the transmission and distribution of electricity.[122]

Additionally, the significance of local manufacturing becomes more apparent when considering that as specific Japanese companies were the exclusive originators of Hi-permeability CRGO they permitted other manufacturers to produce this steel under licenses. For instance, ARMCO manufactured TCH (Tran- Core H) after acquiring a license from Nippon Steel, showcasing a classic example of reverse technology transfer—where technology developed by one company is licensed to another. Nevertheless, due to the considerable expenses linked with these technology transfers, American companies like ALC pursued an alternate route. They developed thin gauge CRGO steel to further diminish Core Losses in a more cost-effective manner. This approach involved creating a thinner variation of CRGO steel, effectively reducing energy losses when exposed to magnetic fields.[123]

2. Strengthen Research & Development

Establish an influential, high-level committee aimed at fostering Research and Development ["**R&D**"] involvement, composed of essential contributors from educational institutions, in both private and public sectors. An example of the same could be through the Mission on Advanced and High-Impact Research ("**MAHIR**") scheme, where one of the areas identified for research is the development of Indigenous CRGO technology.[124] This body would oversee and implement strategies to advance technology development. Some of the potential responsibilities include:

- Creating a technology fund to support Electrical Equipment manufacturers in advancing product technologies and upgrading manufacturing infrastructure.[125]

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[122] *Capital Goods, Appendix B-Case Studies of innovative projects,* Decide with Confidence, DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, (February 10, 2024), https://www.dsir.gov.in/sites/default/files/2022-10/5_15.pdf.
[123] *Id.*
[124] PIB Delhi, *Mission on Advanced and High-Impact Research (MAHIR) launched to leverage Emerging Technologies in Power Sector*, MINISTRY OF POWER (February 10, 2024),
https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1930368.
[125] Sambuddha Sengupta, *Addressing the CRGO issue in Transformer Manufacturing*, ELECTRICAL MIRROR, (FEBRUARY 10, 2024),
https://www.netscribes.com/wp-content/uploads/2016/07/Addressing-The-CRGO-Issue-In-Transformer-Manufacturing.pdf.

- Initiating collaborative efforts to lead various process technologies like precision measuring, material engineering, and process control. These advancements would be disseminated across the industry through structured knowledge-sharing programs.[126]
- Identifying and inviting international entities to introduce innovative products in India. Additionally, offering incentives, especially to significant foreign multinational corporations (primarily from the EU), to introduce product technology within India.[127]
- Encouraging R&D within the Electrical Equipment industry by promoting pre-competitive research and providing incentives to industry participants for R&D expenditures.
- Establishing product development centres that encompass all stages of product development lifecycle within selected institutions such as the CPRI, CMTI, specific IIT's and NIT's, and designated PSUs.[128]
- Compiling a comprehensive list, in collaboration with sector industry associations, of available technologies to enhance energy efficiency and recycling. Additionally, allowing 100% depreciation to incentivize investments in energy-efficient and recycling equipment and technology.[129]
- Creating specialized groups comprising both private and public entities to drive R&D and technological innovation in the electrical equipment and process plant equipment sector. These champions would be incentivized for disseminating technology advancements among all industry stakeholders.[130]

An example can be drawn from Eastern European Countries like the Czech Republic and Slovakia, a new approach emerged in the production of regular Grain Oriented Silicon Steel. This method utilized Nitrides instead of sulphides as the grain growth inhibitor—a departure from the pioneering CRGO technology developed by ARMCO and ALC of the USA. Implementing Nitrides offered a significant advantage to steel makers, as Nitrides required a slab reheating temperature exceeding > 1400°C compared to Sulphides, which necessitated a reheating temperature surpassing > 1400°C for MnS to dissolve before slab rolling. This innovative approach emerged in 1986 through collaborative research at the Iron & Steel Institute in Dobra, Czech Republic, in partnership with the East Slovakian steel works at VSZ Kosice.[131]

Similarly, a more domestic example of the same could be the SDF established by the government during the fiscal year 1997-98. The purpose of this initiative was to allocate financial support of up to Rs. 150 crores annually towards research and development endeavours within the iron and steel industry. This financial provision facilitated the advancement of native technologies aimed at creating novel procedures and enhancing products, exemplified by the case

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126 *Id.*
127 *Id.*
128 *Grain-Oriented Electrical Steel*, POSCO, (February 10, 2024), https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwju1_WUr5KEAxXOka8BHT5GAX4QFnoECB8QAQ&url=https%3A%2F%2Fwww.poscoindonesia.id%2Ffiledown.jsp%3Ffilename%3D200000_A1_GO.pdf&usg=AOvVaw2uOTWe_HZDYiImDgbWVAlx&opi=89978449.
129 *Id.*
130 *Id.*
131 Capital Goods, *supra* note 119.

of CRGO Steel Sheets.[132] Nevertheless, the present state of R&D projects supported by SDF funding lacks the necessary drive towards the advancement and production of CRGO steel. Therefore, it is imperative to implement additional domestic initiatives that genuinely promote and foster such production.

3. Negotiating Technology Transfer Agreements

Such agreement must be enabled between steel manufacturers in India and CRGO manufacturers in China, United States and Germany in order to benefit from the technical skills necessary to efficiently develop and run ailing industries.[133] This can be further understood by discussing the a) necessary IPR approvals; b) establishments of JV; c) Government Incentives; and d) Special Emphasis on TTA with EU.

a) Necessary IPR approvals

A major issue that arose is Indian companies are still grappling with intellectual property rights issues relating to the technology required to make CRGO steel. [134] The government can encourage focused technology transfers that are critical for India by establishing a strong IP protection mechanism to encourage innovation and safeguard the transferred technologies. This required the government to establish clear and transparent guidelines for IPR protection and licensing procedures that would provide certainty and predictability for both foreign CRGO manufacturers and Indian steel companies.

Furthermore, there is a need for a dedicated IP dispute resolution mechanism that would ensure prompt and efficient resolution of any IPR disputes that may arise during the implementation of TTAs. This heightens the confidence of foreign companies engaging in TTAs by ensuring their technology is protected and preserved.

b) Establishments of Joint Venture

Another modality could be through encouraging the establishment of JVs. Governments can simplify and expedite the approval process for JVs, reducing administrative burdens and encouraging businesses to pursue these partnerships. This along with establishing clear and consistent regulations governing JVs, including those related to intellectual property protection, taxation, and labour laws, can provide greater certainty and predictability for businesses. Additionally, it allows companies to pool their resources and expertise, which can help to

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[132] *Government Initiatives in Steel Sector*, STEEL RESEARCH AND TECHNOLOGY MISSION OF INDIA, (February 10, 2024), https://www.srtmi.com/index.php/site/governmentinitiatives.

[133] Purnima Kumari and Aditya Prakash, *Development of CRGO Steel:-A chronological review*, RESEARCH GATE, (February 10, 2024), https://www.researchgate.net/publication/313393659_Development_of_CRGO_Steel-A_chronological_review.

[134] Kevin Lee, *Thyssenkrupp becomes first Indian company to produce CRGO steel*, CNBC TV, (February 10, 2024), https://www.cnbctv18.com/economy/thyssenkrupps-becomes-first-indian-company-to-produce-crgo-steel-40725.htm.

accelerate the development and commercialization of new technologies. Lastly, JVs can help to reduce the risk of technology transfer by sharing the costs and risks of development.[135]

An example can be taken of JSW Steel of India and Japan's JFE which has set up a JV for manufacturing CRGO Steel. This creates competition as it ensures that there isn't only one dominating entity in the market and it improves quality as well.

c) Government Incentives

Government incentives play a crucial role in promoting technology transfer and enabling domestic production of critical materials like CRGO steel.

This can be further evinced by reducing or eliminating tax levies and customs duties on raw materials, equipment, and technology imports which can significantly lower the cost of technology acquisition and production.

Another additional factor could be governments which provides financial assistance to companies to help them acquire CRGO steel technology from foreign patent holders, these development help contribute significantly to the CRGO development in the country.[136] Similarly, Thyssenkrupp which after 3 years of zero import duty concessions on raw materials, was finally able to get some support in the form of zero BCD.[137]

Additionally, financial support for R&D activities related to CRGO steel technology can encourage innovation and accelerate the development of indigenous technologies. This support can be in the form of direct grants, tax breaks for R&D investments, or cost-sharing arrangements between the government and industry partners.[138]

Lastly, establishing dedicated funds to support technology acquisition can provide Indian companies with the necessary financial resources to purchase licenses, hire experts, and undertake training programs related to CRGO steel production. These funds can be particularly beneficial for SMEs that may face financial constraints in acquiring advanced technologies.[139]

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[135] Saif Quereishi, *CRGO Steel- Handle with Care*, KRYFS, (February 10, 2024), https://kryfs.com/wp-content/uploads/2020/06/CRGO-Steel-Handle-with-care.pdf.

[136] *An Assessment of China's Subsidies to Strategic and Heavyweight Industries*, Submitted to the U.S.-China Economic and Security Review Commission, CAPITAL TRADE INCORPORATED (FEBRUARY 10, 2024), https://www.uscc.gov/sites/default/files/Research/AnAssessmentofChina%27sSubsidiestoStrategicandHeavyweightIndustries.pdf.

[137] Lee, *supra* note 134.

[138] Anish Bafna, *How the government's efforts towards R&D and innovation could accelerate the Indian medtech industry*, TIMES OF INDIA, (February 10, 2024), https://timesofindia.indiatimes.com/blogs/voices/how-the-governments-efforts-towards-rd-and-innovation-could-accelerate-the-indian-medtech-industry/.;
OECD indicators and analysis on the use, cost and impacts of R&D tax incentives, OECD (February 10, 2024), https://www.oecd.org/innovation/tax-incentives-RD-innovation/.

[139] *Id.*

As mentioned, in the case of Thyssenkrupp, the temporary concession of zero BCD on raw materials provided a significant boost to their CRGO steel production efforts. However, the current concessions generally provided by the government is valid only for one year. [140]

Extending such concessions to all domestic CRGO producers until the supply-demand gap is addressed would have a more substantial and long-lasting impact on the industry. Consistent and targeted government support can create a favourable environment for technology transfer and domestic CRGO steel production, enabling India to reduce its reliance on imports and meet the growing demand for this critical material.

d) Special Emphasis on TTA with EU

The ongoing trade negotiations between India and the European Union ["**EU**"] present a significant opportunity for India to enhance its access to cutting-edge technologies, including CRGO steel, a critical component in transformer manufacturing. Additionally, the EU's India's largest trading partner and investor as well as its main source of technology transfer. Hence, it is of utmost importance to use these ongoing negotiations to address the lacunae in India gaining access to such technology and the remedies to address the same. [141]

Currently the EU has sought conformity to standards that were established by 16 international organisations and for Indian industries to enter EU markets, they must adhere to these standards. This suggests substantial expenses linked to compliance that need to be covered even post the agreement's finalization for access to EU markets.[142] There is an urgent need for harmonization of these standards in order to ease compliance and provide a boost for export of steel from India to EU.

Additionally, the importance on preserving the technology being transferred to India is necessary and in light of this, India aims to establish itself as a secure data hub, but it currently lacks the EU's recognition for data security. Despite revising its Information Technology Act in 2000 and introducing new Information Technology Rules in 2011 ["**IT Rules**"], aligning with the US "safe harbour" principles, India faces obstacles in transferring sensitive data like patient information.[143] This restriction limits Indian companies from entering the EU market, leading to escalated operational expenses.

4. Improving the Quality of Raw Products

The government should develop guidelines at the national level for sustainable and good quality raw materials in specific product categories such as steel. These guidelines should enforce quality and performance standards aligned with national climate and sustainable development objectives.

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[140] Pillai II, *supra* note 48.

[141] Ravi Dutta Mishra & Dilasha Seth, *India, EU differ on tech barriers to trade*, MINT https://www.livemint.com/economy/india-eu-differ-on-tech-barriers-to-trade-11677521879306.html.

[142] *Id.*

[143] *Id.*

Additionally, they should encourage innovation and market growth, while avoiding the creation of a detailed product catalogue.[144] An example of the same could be the PLI scheme as aforementioned. The PLI scheme are divided into three tiers, with the minimum set at 4% and the maximum at 12%, specifically allocated for CRGO. The Specialty Steel Promotion Scheme guarantees that the foundational steel utilized is domestically produced through the "melted and poured" process. This implies that the raw material (finished steel) used in crafting specialty steel will originate exclusively from India, thereby fostering comprehensive manufacturing within the country through the scheme.[145]

Additionally, several strategies can help uplift the quality of raw materials

- Government entities opting for "Development Contracts" can collaborate with Indian companies, sharing risks to foster new machines/technologies/products, a common practice internationally for major advancements.[146]
- Establish a specialized entity for SEBs to replace older, lower-rated power plants with higher-rated ones (500 MW & above) using existing land and infrastructure, departing from the Renovation and Modernization R&M approach.
- Standardize power plant ratings under the guidance of CEA/ MoP for the Indian grid. The current varied specifications by different developers/utilities hinder standardization which affects timely project completion and poses qualification challenges for manufacturers due to new ratings.[147]

5. Reduce Import Tariff

To address the scarcity of CRGO in India, a potential best practice involves the reduction of import tariffs, as demonstrated by government initiatives in 2017.[148] In a bid to alleviate the cost burden on the domestic industry, the government has taken significant steps by halving the import duty on specific grades of steel, including hot rolled coils, cold-rolled Magnesium Oxide (MgO) coated and annealed steel, as well as other variants crucial for CRGO production. This reduction, down to 5 per cent, aims to make the raw material for CRGO more accessible and cost-effective for the domestic industry. Given that CRGO plays a pivotal role in the production of stampings and cores for electrical transformers and various electromagnetic applications, this strategic move could contribute substantially to meeting the demand for CRGO within the

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144 Nathaniel Ahrens, *Innovation and the Visible Hand China, Indigenous Innovation, and the Role of Government Procurement*, CARNEGIE PAPERS, (February 10, 2024), https://carnegieendowment.org/files/indigenous_innovation.pdf.

145 PIB Delhi, *Union Cabinet approves Production-linked Incentive (PLI) Scheme for Specialty Steel*, CABINET, (February 10, 2024), https://pib.gov.in/PressReleasePage.aspx?PRID=1737722.

146 *Id.*

147 *Id.*

148 Press Trust of India, *Government halves import duty on some steel grades,* ECONOMIC TIMES, (February 10, 2024), https://economictimes.indiatimes.com/industry/indl-goods/svs/steel/government-halves-import-duty-on-some-steel-grades/articleshow/59129690.cms?from=mdr.

country.[149] Although India already imposes anti-dumping duties on certain flat-steel products, the shortage in CRGO necessitates import, making the reduction of import tariffs a crucial step in ensuring a more sustainable and self-sufficient supply chain for this essential steel grade.

B. QUALITY OF CRGO STEEL

The primary issue that arises is the cost saving technique were using scrap CRGO fits well in the Indian scheme, where cost is prime and quality is secondary. Currently the price of CRGO is about 100- 200 per kg while scrap CRGO is merely 50 per kg.[150] Furthermore, the CRGO steel used in transformers itself accounts for about 35% of the total cost of a typical distribution transformer.[151] As a result, the cost associated with CRGO makes up a significant share of the overall transformer expenses, leading manufacturers to opt for more economical steel options to allocate a greater portion of their budget to the actual manufacturing process. However, it is important to note that using defective CRGO imported from unscrupulous suppliers leads to heavy losses in distribution. In order to explain this better, attention has to be drawn to the structure of CRGO. CRGO steel has much bigger grains compared to regular steel—about 2mm to 5mm versus 0.5mm in regular steel. This size difference helps to reduce energy losses in the material when it deals with magnetic forces. Also, CRGO steel has more silicon, which makes it more resistant compared to regular steel, helping to cut down on energy lost as circulating currents in the metal.[152]

When making distribution transformers, the focus is on reducing losses in the core. CRGO steel is a preferred choice because it allows for a flux density limit of up to 1.55 Tesla while keeping core losses low. However, if the transformer is designed above 1.55 Tesla, although it becomes cheaper, its efficiency decreases.[153]

In India, CRGO steel is especially crucial because it helps balance the cost of making transformers. As the pressure to keep prices low keeps growing, CRGO is the most valuable item that can help cut costs.

1. Dual Quality Check

A favourable suggestion could be implementing a dual quality check system, incorporating a transformer QCO that includes a stipulated minimum selling price for transformers.[154] The

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[149] *Import duty cut on inputs of CRGO steel*, CARE RATINGS, (February 10, 2024), https://www.careratings.com/uploads/newsfiles/Import%20duty%20cut%20on%20inputs%20of%20CRGO%20steel.pdf.

[150] *Sheets Made Of Cold-Rolled Grain-Oriented Steel*, INDIAMART, (February 10, 2024), https://dir.indiamart.com/impcat/crgo-steel-sheets.html.

[151] Christian Freitag, Magnetic Properties of Electrical Steel, Power Transformer Core Losses and Core Design Concepts, (Feb. 9, 2017) (Unpublished Ph.D. thesis, KARLSRUHER INSTITUTES FÜR TECHNOLOGIE).

[152] Sengupta, *supra* note 125.

[153] *Id.*

[154] Pillai II, *supra* note 48.
https://www.tndindia.com/crgo-steel-is-critical-to-indias-de-carbonization-goals-thyssenkrupp-electrical-steel/#:~:text=ThyssenKrupp%20Electrical%20Steel%20India%20Pvt,a%20key%20component%20in%20transformers.

significant rise in subpar CRGO steel in India largely stems from ineffective quality oversight. To prevent its circulation in the market, a dual-check system is crucial, involving quality assessment of the steel sheets and the end products employing CRGO steel, similar to the system followed in Germany.[155] Establishing standards for both the CRGO material and the final product would ensure proper usage in terms of quantity and duration, ultimately reducing transformer failures. While India does have a certain type of protection for transformers, however due to the number of transformers several quality checks falls through the cracks. Hence, a system that offers a dual check would improve the quality of transformers being installed in the country and also this will save several thousand crores in terms of no-load losses in the distribution system.[156] An example can be taken of the government's recent announcement of over 58 QCOs to regulate the quality of various products, including aluminum, copper items, and household electrical appliances, signifies a proactive effort to curb the influx of sub-standard goods and stimulate domestic industry growth. These directives align with the WTO Agreement on TBT, applicable to sectors under its purview. The agreement acknowledges that nations should not be impeded from implementing measures essential for safeguarding the quality of exports . Furthermore, BIS adheres to a policy where the development of standards is closely coordinated with those established by the International Organization for Standardization/IEC. Standards set for any product are initially for voluntary compliance, unless the central government mandates them through the issuance of technical regulations, primarily communicated through the notification of QCOs and the compulsory registration order ["**CRO**"] under the BIS Conformity Assessment Regulations of 2018.[157] Similar practice could be followed for CRGO steel as well.

Furthermore, with regards to a QCO, the government could explore targeted direct subsidies that incentivize compliance with stricter QCO. This approach could help achieve the following objectives:

- Encourage domestic manufacturers to meet higher quality standards, potentially reducing reliance on imports and increasing overall CRGO availability.
- Offset the potential cost increases associated with stricter quality control for both domestic and foreign producers, making high-quality CRGO more accessible to end-users.
- Promote investments in quality improvement technologies by domestic manufacturers, potentially leading to long-term self-sufficiency in high-grade CRGO.

Thus, instead of providing subsidies to producers, subsidizing consumers directly offers potential advantages.[158] This approach could drive market competition for high-quality CRGO, align incentives with desired outcomes, and be potentially cheaper to implement.

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[155] Beuth, *DIN Handbook 402: Iron and steel Quality standards 2*, *Structural steelwork, building and metalworking technology*, MOOKAMBIKA METALLURGICAL SOLUTIONS, (February 10, 2024), https://mmsallaboutmetallurgy.com/wp-content/uploads/2019/01/DIN-Handbook-402A.pdf.

[156] *Id.*

[157] Press Trust of India, *Government to come up with 58 quality control orders in next 6 months to stop imports of sub-standard goods*, THE HINDU (February 10, 2024), https://www.thehindu.com/business/government-to-come-up-with-58-quality-control-orders-in-next-6-months-to-stop-imports-of-sub-standard-goods/article66583289.ece.

[158] Shikha Jha, *Consumer Subsidies in India is Targetting Effective?*, 23(4) DEVELOPMENT AND CHANGE (1991).

2. Establishment of a public private partnership ["PPP"]

A PPP would bring together the government, electricity boards, and private companies to invest in the development and production of high-quality CRGO. This would allow India to reduce its reliance on imports and meet its growing demand for CRGO domestically.[159]

The PPP could be structured in a variety of ways, but one possible approach would be to have the government provide financial incentives and tax breaks to private companies that invest in CRGO production. The electricity boards could also agree to purchase a certain amount of CRGO from the PPP each year.[160]

This PPP would have a number of benefits. First, it would help to reduce India's carbon footprint by reducing the need to import CRGO. Second, it would create jobs and boost the Indian economy. Third, it would help India to achieve its climate neutrality goals.

Here are some additional ideas for how to make the PPP more successful:

- Focus on innovation. The PPP should invest in research and development to develop new CRGO production methods that are more efficient and environmentally friendly.
- Promote collaboration. The PPP should encourage collaboration between private companies and research institutions to develop new CRGO products and applications.
- Make CRGO more affordable. The PPP should work to make CRGO more affordable for electricity boards and consumers. This could be done by providing subsidies or developing new financing mechanisms.[161]

3. Variable Contract

A variable contract where the cost escalation may be allowed to be passed over to the buyer is another possible solution to combatting the concerns shared by producers, leading them to use sub-par quality of CRGO.[162] Due to the exceptional circumstances of fluctuating prices and cost escalations, executing contracts with fixed prices or strict price variation ["PV"], restrictions haVE become challenging. This is because the rising costs may not be sufficiently compensated by the profit margins. [163]

Consistent utilization of PV formulas over an extended period helps to balance the impact of short-term positive or negative variations. It also mitigates the influence of any advantages or

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[159] Business Standard B2B Bureau, *PPP model can boost manufacturing sector*, BUSINESS STANDARD (February 10, 2024), https://www.business-standard.com/content/b2b-manufacturing-industry/ppp-model-can-boost-manufacturing-sector-116113000655_1.html.
[160] *Id.*
[161] *Id.*
[162] T&D India, *Variable Contracts Could Mitigate Raw Material Inflation Impact: IEEMA Research Group*, T&D INDIA, (February 10, 2024), https://www.tndindia.com/variable-contracts-could-mitigate-raw-material-inflation-impact-ieema/.
[163] *Id.*

disadvantages observed in the short term. Price variation clauses and price indices gain more attention during market slowdowns or when there is an excessive surge. This became evident during the continuous decline in major raw material prices from 2014 to 2019, which ultimately benefited buyers by reducing their project costs. Conversely, the trend has now reversed, with an unprecedented increase of over 50 percent in FY 2020-21, which continued into FY 2021-22.[164]

Hence a constructive dialogue between the contracting parties where a shift (albeit temporary), may be made in favour of a variable contract where the cost escalation may be allowed to be passed over to the buyer. The variable contracts may be able to create a win-win situation in the current scenario:

- It reduces the risk of defaulting or project slowing down due to resource constraints
- In case of price reductions of raw materials in the future, the same will be passed on to the buyers
- Contractors will be able to offer a lower bid value since they may not be required to build-in future cost escalations
- Contractors/suppliers will be able to focus on project execution rather than channelizing their energies on timing the raw material purchases to gain from market movements.

The price hikes could potentially squeeze margins. However, a big theme this year, common to all the players in the industry, is: how much cost burden would we be able to convince buyers to share with contractors.

4. Testing and Inspection Technologies

Electricity Boards should institute a formal registration procedure for lamination suppliers, mandating the possession of certified manufacturing facilities and strict adherence to production standards. This registration process would be a one-time requirement.[165] Transformers must exclusively utilize laminations procured from these pre-approved suppliers. Given that the quality of transformers is heavily reliant on the excellence of these laminations, this measure ensures that substandard cores are not incorporated into purchased transformers. Regular assessments of these registrations should be carried out, and suppliers failing to meet quality benchmarks should be disallowed.[166]

This could be similar to the Japanese approach which involves collaborating with multiple suppliers throughout the supply chain to uphold high-quality standards in the final product.[167]

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[164] Prerna Lidhoo, *IEEMA raises concerns on continuous price rise of raw materials, suggests price variation clauses*, BUSINESS TODAY (November 12, 2021), https://www.businesstoday.in/latest/economy/story/ieema-raises-concerns-on-continuous-price-rise-of-raw-materials-suggests-price-variation-clauses-312085-2021-11-12.

[165] *Manual for Procurement of Goods*, DEPARTMENT OF EXPENDITURE, (February 10, 2024), https://doe.gov.in/sites/default/files/Manual%20for%20Procurement%20of%20Goods_1.pdf.

[166] *Id.*

[167] U.S International Trade Commission, *Grain-Oriented Electrical Steel from Germany, Japan, and Poland*, FEDERAL REGISTER (February 10, 2024), https://www.govinfo.gov/content/pkg/GOVPUB-ITC1-PURL-gpo54231/pdf/GOVPUB-ITC1-PURL-gpo54231.pdf.

While implementing quality enhancement measures for transformers may initially demand extra efforts from electricity companies, it is anticipated that, within a few years, the quality of installed transformers across the country will see an improvement. Moreover, this approach will result in significant cost reductions, potentially amounting to several thousand crores, by minimizing no-load losses in the distribution system.

5. Testing & Certification Infrastructure

Establish a National Execution Body tasked with strategizing, executing, and overseeing initiatives to enhance the testing and certification infrastructure within the capital goods industry.[168] The designated agency may concentrate on various endeavors, including:

- Encouraging private sector investments in testing and certification activities by establishing additional testing/certification agencies through PPP models. These agencies could function independently or cater to specific laboratories under the CPRI.[169]
- Simultaneously, establishing government-supported testing and certification laboratories in key clusters like Delhi/NCR, Rajkot, Coimbatore, Pune, Bangalore, etc. These labs could collaborate with testing facilities from countries like Holland and Korea to encourage the adoption of similar technologies in Indian labs. Their aim would be to mentor smaller private testing labs across the country.[170]
- Offering incentives to Indian manufacturers of electrical equipment and process plant equipment that opt for domestic testing from government-certified testing labs.[171]
- Allocating necessary financial support to enhance CPRI's testing facilities and upgrading testing laboratories in India, addressing capacity and availability concerns to eliminate the need for sending equipment abroad for type testing.[172]
- Establishing a dedicated unit within CPRI focused on conducting prototype and material development for specialized castings and forgings used in power generating equipment, requiring national-level infrastructure support to expedite the development process.[173]
- Lastly, as previously mentioned promoting collaborative research ventures between Indian companies and institutions like Indira Gandhi Centre for Atomic Research ["**IGCAR**"], Mishra Dhatu Nigam Limited ["**MIDHANI**"], etc., aimed at developing and commercializing prototypes.[174]

Summary of Issue III

India grapples with a CRGO steel shortage vital for transformers, despite being a major importer with only one local manufacturer meeting a fraction of the demand. To combat this scarcity and ensure quality, strategies are proposed: first, by boosting domestic production through SME

[168] Capital Goods, *supra* note 119.
[169] *Id.*
[170] *Id.*
[171] *Id.*
[172] *Id.*
[173] *Id.*
[174] *Id.*

support and incentivizing input suppliers; second, by intensifying Research & Development efforts, facilitating technology transfers, and instituting a procurement policy favoring indigenous products. Quality maintenance involves stringent checks on both CRGO materials and transformers, encouraging a Public-Private Partnership for high-quality CRGO production, flexible contracts to manage cost fluctuations, and upgrading testing infrastructure. These measures aim to bridge the scarcity gap and sustain quality standards in CRGO steel, crucial for the power sector's requirements in India.

"Consumers in the country are not ready to accept low quality products, and QCOs would reduce wastage and bring down prices" Mr. Piyush Goyal said.[175] "No one has the right to play with the lives of people. No one has the right to dump low-quality products in India," he added.[176]

In this backdrop, the current Government has improved its focus on the quality control measures, which are administered by the BIS. The BIS oversees the activities of "Standardization", "Conformity Assessment", and "Quality Assurance" of goods, articles, processes, systems and services.[177] Moreover, it also prescribes on the inputs used to manufacture these products; a trend especially prominent in recent times. It is noteworthy that QCOs are applicable to foreign manufacturers (exporting to India) as well as the domestic industry.[178]

A. PURPOSE OF APPLICATION OF QCOS

From a border protection perspective, such rigorous technical standards aid in restricting import of cheap and sub-standard products that could pose risks to consumer health and environment and also protect domestic manufacturing on price-competitiveness. Such an enforcement of quality standards will not only curtail low-grade imports but also aid in improving the quality of domestic products.[179] BIS is the only organization in India authorized to operate quality certification plans under an Act of Parliament.[180] The implementation of quality controls has led to a substantial increase in the issuance of QCOs, which not only specify the criteria for assessing compliance with various consumer products but also dictate the components used in their production.

The adoption of Indian Standards or the requirement to display the ISI Mark on products is generally a voluntary choice, unless specific laws, rules, or regulations make it mandatory.[181] Currently, there exist more than 21,000 standards established by the BIS, with the majority being voluntary, while some are enforced through QCOs.[182] Section 16 of the BIS Act, 2016, empowers the Union Government to compel the use of ISI marks in the public interest.[183]

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175 Quality control orders not aimed to stop imports: Goyal, The Hindu Bureau, May 3rd, 2023.
176 *Id.*
177 GUIDANCE DOCUMENT ON QCOS, BIS, ¶1.1.
178 Nishant Shah, et al., *India: Quality Standards in India: A Comprehensive Guide Part 1 – Overview of India's Quality Standard Measures and Impact for Foreign Manufacturers*, MONDAQ (Mar. 1, 2022), https://www.mondaq.com/india/compliance/1166824/quality-standards-in-india-a-comprehensive-guide-part-1--overview-of-indias-quality-standard-measures-and-impact-for-foreign-manufacturers.
179 Nishant Shah, et al., *Elp's Bis Series – Part 2: Legislative Framework in India*, ECON. LAWS PRACTICE (Mar. 23, 2022), https://elplaw.in/elp-bis-update-quality-standards-in-india-a-comprehensive-guide-part-2/.
180 Standards for Trade, India- Country Commercial Guide, Intl. Trade Administration (Sept. 8, 2022), https://www.trade.gov/country-commercial-guides/india-standards-trade.
181 ADOPTION OF INTERNATIONAL STANDARDS IN STEEL SECTOR – A PANACEA OR PANDORA'S BOX, BUREAU OF INDIAN STANDARDS (Sept, 2021) at 2.
182 Shah, *supra* note 179.
183 § 16 of the BIS Act, 2016.

To date, the government has issued QCOs mandating the use of ISI marks on 145 products,[184] including carbon steel, alloy steel, and stainless-steel items, particularly in sectors like construction, infrastructure, automobiles, and engineering applications.[185] These measures are aimed at ensuring the availability of high-quality steel. Both domestic manufacturers, and foreign manufacturers importing goods to India are obligated to adhere to Indian Standards for these specific products.[186]

The imposition of stringent quality standards also serves the broader goal of enhancing other standards, such as those related to health, safety, and environmental concerns. This, in turn, contributes to an overall improvement in the standard of living for the population. Additionally, from the perspective of safeguarding borders and trade, these rigorous technical standards help restrict the influx of inferior and inexpensive products that could jeopardize consumer health and the environment. Simultaneously, they protect domestic manufacturing by ensuring price competitiveness. Enforcing these quality standards not only curbs the entry of sub-par imports but also plays a pivotal role in enhancing the quality of domestically produced goods.[187]

B. APPLICABILITY OF QCOS ON IMPORTED AND EXPORTED GOODS

QCOs are made equally applicable to both domestically manufactured goods as well as to imported goods.[188] The requirement for imported goods to comply with QCOs may be found to exist under General Note 2(A) of Schedule-I of the ITC (HS) Import Policy, which talks about "mandatory Indian Standards" of BIS.[189] The said Note stipulates that the "quality of products that are subject to mandatory Indian Standards, as applicable to domestic goods, shall be required to comply with quality specified for the product as per same Indian Standards".[190] For compliance of this requirement, all manufactures/exporters of these products to India shall be required to obtain BIS license for using Standards mark on their product.

Appendix III of Schedule I in the Import Policy of ITC (HS), 2012, contains a list of products that require mandatory certification. Although this list is periodically revised, it may not always reflect real-time updates. Therefore, it is advisable to obtain the most recent information regarding the notification of QCOs from the Gazette of India.[191]

In this context, the data for the 2012-2020 time period, taken from the Gazetted documents, showcases how the CRGO is specifically placed under QCOs, such as the Standard Mark of the BIS [the data is provided below in a tabular format].

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184 Annual Report, Ministry of Steel, Government of India (2022-2023), https://steel.gov.in/sites/default/files/MoS%20AR%202022-23.pdf at 8.
185 Shah, *supra* note 179.
186 Standards for Trade, India- Country Commercial Guide, Intl. Trade Administration (Sept. 8, 2022), https://www.trade.gov/country-commercial-guides/india-standards-trade.
187 *Id.*
188 *Id.*
189 ITC (HS), 2017 Schedule 1 – Import Policy, General Notes Regarding Import Policy, at 2.
190 *Id.*
191 *Id.*

They restrict any person to manufacture, or store for sale, sell, and distribute any steel or steel products specified in the schedule, which do not conform to the specified standards and do not bear the standard mark of the BIS.

Year of the Ministry of Steel Order	Indian Standard Number	Title	ITC (HS) Code
12th March, 2012	3024	Grain oriented electrical steel sheet and strip CRGO	72251100 72261100
28th March, 2013	3024	Grain oriented electrical steel sheet and strip CRGO	72251100 72261100
1st October, 2013	3024	Grain oriented electrical steel sheet and strip CRGO	72251100 72261100
31st March, 2014	3024	Grain oriented electrical steel sheet and strip CRGO	72251100 72261100
16th February, 2018	IS 3024 : 2015	Grain oriented electrical steel sheet and strip	72251100 72261100
20th June, 2018	IS 3024 : 2015	Grain oriented electrical steel sheet and strip	72251100 72261100
27th May, 2020	IS 3024 : 2015	Grain oriented electrical steel sheet and strip	72251100 72261100

C. LEGAL FRAMEWORK AND DEFINITIONS

It is imperative to note certain legal provisions for a detailed understanding of the concept of QCOs.

1. Definition of the relevant terms under BIS Act, 2016

Some relevant terms under the BIS Act are explored to provide a detailed understanding regarding the application of QCOs.

- Section 2 (17): It specifies the quality and specifications of goods, articles, processes, systems, or services and includes standards adopted by the Bureau and those recognized under the BIS Act.[192] It also places obligations on various entities throughout the transaction chain, including those involved in manufacturing, importing, distributing, selling, or storing products for sale.
  In casu, as evident from the aforementioned data, the obligation of the IS mark has been placed on the steel goods such as CRGO.
- Section 2 (20): It denotes a license granted under Section 13 for using a specified Standard Mark in connection with goods, articles, processes, systems, or services conforming to a particular standard.[193]

[192] § 2(17) of the BIS Act, 2016.
[193] § 2(20) of the BIS Act, 2016.

- Section 12: The Bureau can notify conformity assessment schemes, establish Standard Marks, and provide details according to regulations.[194]
- Section 15: It imposes restrictions on import, distribution, sale, storage, and exhibition of goods or articles under Section 14(1), requiring Bureau certification.[195]

e) The BIS provisions with reference to the Standard Mark

Some relevant provisions which provide a context for the Standard Mark are explored.

- Section 14: The Central Government, in consultation with the BIS, has the authority to designate specific precious metal items or other goods as requiring either a Hallmark or a Standard Mark.[196]
  In casu, the Indian Standard mark is to be applied on CRGO, as is evident from the data aforementioned.
- Section 13: Under Section 13,[197] the BIS is authorized to issue licenses or certificates of conformance in two situations: *first*, for goods conforming to Indian standards, a license is issued for the use of a Standard Mark. This is to be obtained for the goods to be imported to India, as the Indian Standard mark on CRGO is applicable on domestic as well as foreign products as aforementioned. And *second*, when demonstrating conformity without using a Standard Mark is required, a certificate of conformance is granted. However, this situation is not relevant for the purposes of the report.
- Section 16: It empowers the Central Government to enforce the compulsory use of the standard mark on specific products through QCOs.[198]
  In casu, this will prevent the sub-standard CRGO from being imported and subsequently used for the transformers.
- Section 17: It prohibits manufacturing, importing, distributing, selling, hiring, leasing, storing, or exhibiting for sale of products under Section 16(1) without displaying a Standard Mark, even if a valid license has been granted, ensuring adherence to relevant standards and essential requirements.[199]

Summary for Issue IV (1)

The current government in India has prioritized quality control measures overseen by the BIS. BIS ensures standardization, conformity assessment, and quality assurance of various goods, services, and processes. These measures are crucial for both domestic and foreign manufacturers exporting to India. They help prevent the entry of substandard products, safeguard consumer health and the environment, and maintain the competitiveness of domestic industries.

[194] § 12 of the BIS Act, 2016.
[195] § 15 of the BIS Act, 2016.
[196] § 14 of the BIS Act, 2016.
[197] § 13 of the BIS Act, 2016.
[198] § 16 of the BIS Act, 2016.
[199] § 17 of the BIS Act, 2016.

BIS is the only organization in India authorized to operate quality certification plans under an Act of Parliament. The government has issued QCOs mandating the use of ISI marks on 145 products, including various types of steel in sectors like construction and engineering. Compliance with these standards is essential for both domestic and imported goods. These stringent quality measures contribute ultimately in enhancing the overall quality of life of the Indian population.

D. QCOS VIS-À-VIS INDIA'S COMMITMENTS AT WORLD TRADE ORGANISATION

Paragraph 2.03 of the FTP, 2015-2020 provides for compliance of imports with domestic laws.[200] It provides that domestic laws/Rules/Orders/Regulations/ technical specifications/environmental safety and health norms applicable to domestically produced goods shall apply, *mutatis mutandis*, to imports, unless specifically exempted.[201] Further, the General Notes to the Import Policy also provide that imported goods need to comply with the mandatory Indian Standards if the same are applicable for domestically produced goods.[202] In other words, if a product manufactured in India is subjected to compliance with mandatory standards, the said product if imported from outside India would also need to comply with those standards.

It is also pertinent to note that while formulating, adopting, and applying technical regulations, standards, and conformity assessment procedures, India has to ensure compliance with the WTO Agreement on TBT which aims to ensure that these are non-discriminatory and do not create unnecessary obstacles to trade.[203]

In today's complex global landscape, where there is growing consensus on important tax matters, non-tax regulations such as the licensing requirements under QCOs are increasingly considered as an alternative means for countries to govern their international trade. It is essential to examine whether India's QCOs, which make compliance with Indian Standards mandatory for imported goods, align with the country's international commitments under various multilateral and bilateral agreements.

It's worth noting that QCOs, employed as "non-tariff measures", are subject to regulation by international bodies like the WTO and regional and bilateral agreements.[204] These agreements encompass various aspects of non-tariff measures, including the TBT Agreement, the Agreement on the Application of SPS Agreement, and the Agreement on Article VII of the GATT, 1994, focusing on customs valuation.[205]

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[200] FTP (Apr. 1, 2015- Mar. 31, 2020), ¶2.03 at 34.
[201] Saurabh Malpani, *Quality Control Orders- the recent surge and challenges*, LAKSHMIKUMARAN & SRIDHARAN ATTORNEYS (Mar. 30, 2021), https://cn.lakshmisri.com/insights/articles/quality-control-orders-the-recent-surge-and-challenges/#.
[202] ITC (HS), 2017 SCHEDULE 1 – IMPORT POLICY at 2.
[203] Technical Information on Technical barriers to trade, WTO.
[204] *Non-Tariff Barriers to Trade*, Non-Tariff Barriers Reporting, Monitoring and Eliminating Mechanism, https://www.tradebarriers.org/ntb/non_tariff_barriers.
[205] The WTO Agreements Series Technical Barriers to Trade (Dec. 16th, 2013).

The primary objective of the TBT Agreement is to ensure fairness and equity in non-tariff barriers.[206] Additionally, the agreement promotes the mutual recognition of assessment procedures for determining whether a product conforms to internationally recognized standards, which are acceptable in both exporting and importing nations. This recognition minimizes the need for duplicated testing thereby, reducing commercial costs.

The mandatory adoption of BIS standards through QCOs can be categorized as a "technical regulation", while the procedures governing testing, inspection, and license approval within BIS Regulations may qualify as "conformity assessment procedures" under the TBT Agreement.[207] This is in consideration of the definition of a "technical regulation" as per the TBT Agreement, which reads as follows:

"Document which lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory".[208]

In casu, the gazetted documents by the Ministry of Steel, Government of India satisfy the definition of a "technical regulation".

E. KEY REQUIREMENTS FOR TECHNICAL REGULATIONS

There are certain requirements for technical regulations (herein QCOs) as per the TBT Agreement. It states such requirements, that Members (including India), must respect while setting out technical regulations. As long as these requirements under TBT Agreement are followed, the QCOs cannot be objected to, by the exporting members.

1. Non-discrimination

The principle entails that the treatment accorded to imported products must not be less favourable than that accorded to like domestic products and like products from other countries.[209]

The Appellate Body observed that Article 2.1 of the TBT Agreement contains a national treatment and a most-favoured nation treatment ["**MFN**"] obligation.[210] The MFN treatment obligation prohibits discrimination through "technical regulations" among "like products" imported from different countries, while the national treatment obligation prohibits discrimination between domestic and imported like products.[211]

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206 Technical Barriers to Trade, Office of the US Trade Representative.
207 Shah, *supra* note 179.
208 Annexure 1.1, TBT Agreement.
209 Article 2.1, TBT Agreement.
210 APPELLATE BODY REPORT, US – MEASURES AFFECTING THE PRODUCTION AND SALE OF CLOVE CIGARETTES, WTO DOC. WT/DS406/AB/R (ADOPTED APR. 14, 2012) ¶ 87.
211 APPELLATE BODY REPORT, US – CERTAIN COUNTRY OF ORIGIN LABELLING (COOL) REQUIREMENTS, WTO DOC. WT/DS384/AB/R; WT/DS386/AB/R (ADOPTED JULY 23, 2012) ¶ 267.

In casu, as long as the CRGO imports, i.e., the "like products" from all countries are treated similarly, the MFN treatment violation will not be attracted. So, it is imperative to apply the same standards for all foreign countries importing to India.

The IS marks are mandated for both domestic and exporting countries. It can be inferred from the statement that the order applies to steel products, except if they are meant for exports from India (because then the products have to abide by the standards of the importing countries) from the gazetted documents by the Ministry of Steel. Thereby, Article 2.1 of the TBT Agreement will also not get violated.

The Appellate Body in US – Clove Cigarettes and US – Tuna II (Mexico) set out a three-pronged legal test for this provision. It entails, "Article 2.1 of the TBT Agreement consists of three elements that must be demonstrated in order to establish an inconsistency with this provision, namely: *first*, that the measure at issue constitutes a 'technical regulation' within the meaning of Annex 1.1; *second*, that the imported products must be like the domestic product and the products of other origins; and *third*, that the treatment accorded to imported products must be less favourable than that accorded to like domestic products and like products from other countries."

So, if any of these tests are not fulfilled, then there is no violation of the TBT Agreement and the exporting country will have to abide by the technical regulations set by the importing country (herein, India) for the "like products".

f) Trade restrictiveness

The principle states that the treatment should not be more trade-restrictive than necessary to fulfil a legitimate objective.[212] It states, "Members shall ensure that technical regulations are not prepared, adopted or applied with a view to or with the effect of creating unnecessary obstacles to international trade. For this purpose, technical regulations shall not be more trade-restrictive than necessary to fulfil a legitimate objective, taking account of the risks non-fulfilment would create. Such legitimate objectives are, *inter alia*: national security requirements; the prevention of deceptive practices; protection of human health of safety, animal or plant life or health, or the environment. In assessing such risks, relevant elements of consideration are, inter alia: available scientific and technical information, related processing technology or intended end-uses of products".

As per Appellate Body Report, in the *US – Tuna II (Mexico)* and *US – COOL*,[213] a panel must assess what a member seeks to achieve by means of a technical regulation or what is its legitimate objective. "The word 'objective' describes a 'thing aimed at or sought; a target, a goal,

[212] Article 2.2, TBT Agreement.

[213] Appellate Body Report, United States — Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products, WTO Doc. WT/DS381/AB/R (adopted June 13, 2012), ¶ 314. See also Appellate Body Report, US – Certain Country of Origin Labelling (COOL) Requirements, WTO Doc. WT/DS384/AB/R; WT/DS386/AB/R (adopted July 23, 2012), ¶¶ 371-372.

an aim'. The word 'legitimate', in turn, is defined as 'lawful; justifiable; proper'. Taken together, this suggests that a 'legitimate objective' is an aim or target that is lawful, justifiable, or proper.[214] Furthermore, In *US – Tuna II (Mexico)*, the Appellate Body explained that, in the context of Article 2.2, "the assessment of 'necessity' involves a relational analysis of the trade-restrictiveness of the technical regulation, the degree of contribution that it makes to the achievement of a legitimate objective, and the risks non-fulfilment would create".[215]

In casu, the criteria of 1) legitimate objective and 2) necessity are being fulfilled:

The objective behind the QCOs on CRGO is to improve the quality of the products/goods.
It is "legitimate" as the Ministry of Steel under Sections 14 and 16 of the BIS have come up with the orders mandating the IS mark. And there is a "necessity" because in contrast with the global level for transformer failure which is around 5 percent, India's transformer failure rate is around 20-25 percent.[216]

F. CONCERNS OF FOREIGN COUNTRIES REGARDING INDIA'S QCOS

The Committee on TBT recently discussed the issue of foreign nations with India's Steel and Steel Products (Quality Control) Order, 2020 during a meeting that took place on March 8–10, 2023.[217] The application procedures for IS 17404:2020 (electrogalvanized hot rolled and cold reduced carbon steel sheets and strips) certification under the Steel and Steel Products (Quality Control) Order, 2020 have drawn concerns from the representative of The Separate Customs Territory of Taiwan, Penghu, Kinmen, and Matsu, regarding the imported products' certification procedure. They stated that the applicants are still left in a great deal of uncertainties in terms of the certification timeline due to the limited manpower of BIS. Such uncertainties and delays have made a profound impact on bilateral trade.

In 2022, the Republic of Korea expressed worries about the delay in acquiring a licence for its steel exports, citing India's lack of factory audits due to the quarantine regulations.[218] Though these rules no longer exist, it is important to observe India's reaction. It stated that the relevant Line Ministries (Regulator) of the Government of India notify the products subject to obligatory certification by issuing QCOs. All Indian Steel Standards will eventually be covered by the QCO in a progressive way. The products listed therein shall, in accordance with the terms of the QCO, exhibit a Standard Mark under a valid licence from BIS in accordance with Scheme-I of the BIS (Conformity Assessment) Regulations, 2018. According to this Scheme, a factory inspection is necessary in order to give a licence. A factory inspection of the manufacturing premises is used to evaluate the manufacturing and testing capabilities before granting a licence to use the

[214] Appellate Body Report, United States — Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products, WTO Doc. WT/DS381/AB/R (adopted June 13, 2012), ¶ 313.
[215] Appellate Body Report, United States — Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products, WTO Doc. WT/DS381/AB/R (adopted June 13, 2012), ¶ 320.
[216] TradeLab Proposition.
[217] Committee on Technical Barriers to Trade - Minutes of the meeting 8 - 10 March 2023 - Chairperson: Mr. Anwar Hussain Shaik - Note by the Secretariat. WTO Doc. G/TBT/M/89 (adopted Feb. 2, 2023).
[218] Committee on Technical Barriers to Trade - Minutes of the meeting - 9 - 11 March 2022 - Note by the Secretariat_x000D_WTO Doc. G/TBT/M/86 (adopted May 24, 2022).

Standard Mark on a product. Mandatory BIS certification for steel products is enforced through notification of QCOs to ensure that the quality of steel being manufactured by domestic producers or imported in the country is as per the Indian standards. The implementation of QCOs ensures the availability of quality steel and steel products to the end-users. It saves the Indian consumers from "dumping" of spurious and defective steel and steel products.

Members are aware that the WTO recognizes the Member's right to implement measures to achieve "legitimate" policy objectives, such as protecting human health and safety, protecting the environment, preventing unfair trade practices, or protecting the national security. The technical regulations, i.e., QCOs on steel and steel products have been issued based on such policy objectives. Hence QCOs notified by the government are not trade-restrictive but necessary to fulfil a legitimate objective.

G. CONSEQUENCES OF NON-COMPLIANCE OF THE LEGAL PROVISIONS UNDER BIS ACT

Non-compliance with legal provisions under the BIS Act entails penalties as outlined in Section 29: *first*, on the violation of Section 11, which entails disregarding the prohibition imposed on the publishing, reproduction, or recording of any Indian Standard or part thereof, without authorisation by Bureau;[219] or *second* on the violation of Section 26(1) stating restrictions on the use of name of Bureau and Indian Standard, shall result in fines, extendable up to five lakh rupees[220].[221] *Third*, the violations of sub-Sections (6) or (8) of Section 14 stating that no testing and marking centre, other than the recognised by the Bureau, shall use the Standard Mark, on any goods or article, and make any claim in relation to the use and application of a Standard Mark; and no recognised testing and marking centre, shall use or apply a Standard Mark, unless such goods or article conforms to the relevant standard, *respectively;*[222] and *fourth*, the violation of Section 15, stating the prohibition for the importation, selling, exhibition, etc., of any goods or article, except under certification from the Bureau, may lead to imprisonment for up to one year, or an alternative fine not less than one lakh rupees but potentially up to five times the value of goods affixed with a Standard Mark, including Hallmark. Moreover, in cases where the value of goods cannot be determined, it is presumed as one year's production, with the previous year's annual turnover determining the value for such contravention.[223]

Moreover, if a person violates Section 17, by manufacturing, selling, etc., certain goods and articles without Standard Mark, he shall be penalised in forms of imprisonment extendable up to two years, or a fine not less than two lakh rupees for the first contravention and not less than five lakh rupees for subsequent contraventions, again determined based on the previous year's annual turnover.[224]

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[219] § 11 of the BIS Act, 2016.
[220] § 26(1) of the BIS Act, 2016.
[221] § 29 of the BIS Act, 2016.
[222] § 14 of the BIS Act, 2016.
[223] § 15 of the BIS Act, 2016.
[224] § 17 of the BIS Act, 2016.

Lastly, there is also a provision for consumer compensation outlined under Section 31, which states that if a licensee or certificate holder sells goods bearing a Standard Mark that does not conform to the relevant standard, they are obliged to compensate the consumer for any harm caused, with the manner of compensation prescribed by law.[225]

H. COURT PRECEDENTS UPHOLDING QCOS IN INDIA

Historically, when the validity of QCOs has been challenged through writ petitions, courts have generally leaned towards upholding these orders. This judicial stance is rooted in the recognition that QCOs are promulgated for the benefit of the public and the overall welfare of the nation.

The Pneumatic Tyres and Tubes for Automotive Vehicles (Quality Control) Order, 2009 was challenged by the petitioners in *Yash Polymers v. Union of India*,[226] and they sought the BIS's amendment. The order, according to the court, is a piece of delegated legislation created by the government using its legal authorities. The BIS Act was created to facilitate the establishment of a Bureau for the purpose of promoting the orderly growth of the goods marking, quality certification, and standardisation processes. The Indian Standards are voluntary, according to the regulations created by the BIS Act. Nonetheless, it becomes legally enforceable if it is mentioned in a law or if the government issues specific instructions making it mandatory. According to S.14 of the BIS Act, such instructions are then deemed vital to the public interest. Consequently, the criteria cannot be deemed unreasonable as demanded by the petitioners, as they were established with the intention of ensuring the safety of the people riding the vehicles.

Summary for Issue IV (2)

India, through its QCOs mandating compliance with Indian Standards for imports, aligns with its international commitments at the WTO. The FTP and General Notes to the Import Policy ensure that imports adhere to domestic laws and standards applicable to domestically produced goods. India's adherence to the WTO Agreement- TBT is vital, ensuring non-discriminatory and trade-friendly regulations.

QCOs, serving as non-tariff measures, fall under WTO scrutiny. The TBT Agreement aims for fair trade, promoting mutual recognition of standards, minimizing duplicate testing, and reducing commercial costs.

Recent WTO discussions highlight concerns about delays and uncertainties in certification procedures impacting bilateral trade. India's regulations, enforced progressively for all steel standards, demand factory inspections before granting licenses. Such measures aim to ensure quality steel availability, protect consumers from substandard products, and align with legitimate policy objectives recognized by the WTO.

In essence, India's QCOs, when adhering to WTO requirements, are not trade-restrictive but

[225] § 31 of the BIS Act, 2016.
[226] Yash Polymers vs. Union of India (2011) 3 GLH 539.

necessary for fulfilling legitimate objectives, safeguarding consumer interests, and ensuring adherence to international trade standards.

CONCLUSION

Part I provides a comprehensive examination of the CRGO Steel industry on a global scale, covering key facets such as market definition, size, growth prospects, and recent developments. It begins by elucidating the significance of CRGO steel in enhancing the magnetic properties of transformers and its evolution since its introduction in the 1940s, replacing hot-rolled steels by the 1950s.

Silicon steel, crucial for electrical applications, particularly transformers, forms the foundation of the CRGO industry. Characterized by high silicon content and specific crystallographic orientation, CRGO steel minimizes magnetic losses, making it the preferred choice for energy-efficient transformers. The market is witnessing steady growth driven by rising electricity consumption, urbanization, infrastructure development, and investments in renewable energy initiatives.

The emergence of COVID-19 disrupted the CRGO industry's supply chains, leading to production capacity reductions and closures, particularly during peak lockdown periods. Decreased power usage, resulting from commercial lockdowns, further affected demand for power generators. However, the gradual recovery from the pandemic is anticipated to mitigate these adverse effects.

Part I provides a comprehensive understanding of the CRGO industry's global landscape, highlighting its significance, growth drivers, challenges, and future prospects.

Thereon, **Part II** takes the discussion a step further. The CRGO steel sector, essential for India's transformer industry, remains challenged by reliance on imports and the persistent issue of scrap usage. Efforts to domestically produce CRGO steel have not yet been successful, leading to strategic shifts, such as the import of cost-effective scrap CRGO. Nonetheless, recent QCOs and the establishment of JVs signal a move towards improving quality standards and self-reliance in CRGO steel production. As we analyse the quality of CRGO steel in leading exporting & manufacturing countries, we notice the evident austerity of the standards employed by them. In comparison, the Indian standard for CRGO steel seems less holistic and perhaps that is the reason for such deficiency in the quality of the product. Adhering to stricter standards will inevitably ensure a more durable band of steel - furthering one of India's strongest sectors and establishing the country as a rival in the world market.

In analysing the current state of CRGO steel in India, **Part III** elaborates upon a significant challenge, with the country facing difficulties in meeting domestic demand while upholding quality standards. With only one domestic manufacturer and insufficient production capacity, India finds itself in the paradoxical situation of being both a producer and a leading importer of CRGO steel. With only one Indian manufacturer of CRGO steel and a production capacity far below the country's annual requirement, coupled with the paradox of India being both a producer and a top importer of CRGO steel, urgent actions are needed to address this issue.

To mitigate the scarcity of CRGO steel and ensure its quality, several strategies can be implemented:

1. Promoting Domestic CRGO Production: Policy support from the government is crucial to encourage domestic production. Establishing a centralized fund to support SMEs in acquiring international companies or assets dealing with raw materials like CRGO steel, along with tax breaks and incentives for manufacturing facilities, can help foster innovation and increase production capacity.
2. Strengthening Domestic Research & Development: Establishing a high-level committee to foster Research and Development involvement and promoting collaboration between private companies and research institutions can advance technology development. Encouraging R&D within the Electrical Equipment industry and establishing product development centres can drive innovation and enhance energy efficiency.
3. Negotiating Technology Transfer Agreements: Enabling technology transfer agreements between Indian and foreign manufacturers of CRGO steel, along with establishing a strong IP protection mechanism and financial incentives for technology acquisition, can accelerate domestic production.
4. Ensuring Quality Control: Implementing a dual-check system for quality assessment of both CRGO material and end products, encouraging PPPs to produce high-quality CRGO, and leveraging advanced testing and inspection technologies can ensure the quality of CRGO steel used in transformers.
5. Maintaining Affordable Prices: Instituting variable contracts to account for fluctuating prices, encouraging cost sharing between buyers and contractors, and establishing local procurement policies can help maintain affordable prices for CRGO steel.

By implementing these strategies and fostering collaboration between government, industry, and research institutions, India can address the scarcity of CRGO steel while maintaining high-quality standards, thereby supporting its energy needs and contributing to its green transformation goals.

In **Part IV**, the QCOs are elucidated upon. The implementation of QCO in India represents a significant step towards ensuring the quality, safety, and reliability of products available in the market. By mandating the use of Indian Standard Marks on products, both domestically manufactured and imported goods are subjected to rigorous quality assessments, ensuring that they meet specified criteria for safety, performance, and environmental impact.

From a legal perspective, The Bureau of Indian Standard Act, 2016 provides a robust framework for the designation of goods requiring standard marks, licensing procedures, and enforcement mechanisms. Non-compliance with QCOs can lead to penalties and consumer compensation, highlighting the seriousness with which quality standards are upheld in India.

Furthermore, India's commitments under international trade agreements, particularly the WTO Agreement on TBT, necessitate those technical regulations, including QCOs, are non-discriminatory, trade-friendly, and serve legitimate policy objectives. Therefore, the government's

rationale behind implementing QCOs, such as protecting human health, preventing deceptive practices, and promoting fair trade, aligns with these international standards.

In conclusion, addressing the multifaceted challenges confronting the CRGO industry in India necessitates concerted efforts from government, industry stakeholders, and research institutions. By embracing the recommended strategies and adhering to rigorous quality standards, India can not only bridge the gap between domestic demand and supply but also position itself as a formidable player in the global CRGO market, thereby contributing to its energy security and sustainable development objectives in the long run.