From the inception of human civilization, Process Metallurgy has played its pivotal role in the extraction of non ferrous or ferrous metals from their respective ores/minerals. India was one of the leading nations of the world where quality iron was extracted from low grade iron ores using wood, charcoal as reluctant cum source of energy. Thousands of years back, India was known for its wrought iron and wootz steel throughout the world. Indian craftsmen had achieved process control to produce quality iron products much earlier than the developed countries. The technology of iron making was handed over from one person to another within a limited group. There was a sizeable export trade in iron to the Middle East, Africa, and Greece and perhaps to the far eastern countries also. The metallurgical process underwent a constant improvement through the centuries a tradition that survived upon the 18th -19th centuries. Even many British and other inventors failed to produce iron and steel of similar quality. Charles wood, the In-charge of the Beypur Iron Works mentioned that his company could not produce metal similar to Indian swords used in Indian Mutiny of 1857. Unfortunately this art phased out with the development of new technology during 19th and 20th century. The ancient process of iron making is still in existence in a few interior parts of our country namely in Jharkhand, Orissa, Chhattisgarh and some places in Southern and Eastern India. These practices have undergone very little change over the centuries and reflect the ancient art of iron making.

2.0. The history of modern Iron and steel industry in India is nearly a century old when the Tata Iron & Steel Company (TISCO) was set up in 1907 at Jamshedpur. Subsequently in 1960’s & 70’s several integrated steel plants were set up under the erstwhile Hindustan Steel limited. Then Visakhapatnam Steel Plant of Rashtriya Ispat Nigam Limited (RINL) came into existence in early 1990’s. However, primary steel production continued to be reserved for Public Sector till 1991 when steel industry was delicensed and deregulated. Import of Technology and equipment are also freely permissible. Post-liberalisation, large number of large/small steel plants and processing units has been commissioned in the private sector. Simultaneously existing / older plants have been modernised / expanded. Level of technology in Indian Steel industry has accordingly improved considerably over the years. Today, India adopts world class Iron making/ steel making facilities producing most of the value added steel products at competitive cost. In the liberalized regime, several foreign companies have set up their 100% subsidiaries in India producing value added steel products. Also a few plants under joint venture mode have been set up. With these measures value added product scenario is improving fast.

Today, total capacity of crude steel is over 125 MTPA which is contributed by integrated steel plants, standalone Electric Arc Furnace & Electric Induction Furnace. Unlike the global scenario, where approx 75%, Steel is produced by oxygen route & 25% by electric route, in India, approx 55% of steel is produced by electric route. However, the NSP projects that the proportion or oxygen steel making route is likely to increase to about 65% by 2030. Because of historical perspective and raw material constraint, energy/ environment scenario in Indian Steel Industry in some of plant is not world class but scenario is changing fast. The specific energy consumption in Indian steel industry varies in the range of 5.68-8.74 Gcal/tcs. Similarly GHG emission intensity (CO2 emission) is in the range of 2.26 -3.98 T/tcs.

Government of India has launched National Action Plan on Climate Change (NAPCC), which provides a sharper focus on required interventions. The NAPCC is Implemented through eight National Missions. The utmost priorities of this plan are for mitigation and adaptation to combat climate change. The National Mission for Enhanced Energy Efficiency (NMEEE) aims to strengthen the market for energy efficiency by creating a conducive
regulatory and policy regime. Under NMEEE, Government has embarked an innovative scheme known as Perform, Achieve and Trade (PAT), as a market based energy efficiency trading mechanism. PAT is legally binding scheme. First PAT Cycle (2012-15) is already over. Second PAT Cycle (2016-2019) is in progress. During PAT Cycle-I, (2012 – 2015), there were 67 Designated Consumers (DCs) in Steel Sector which accounted for nearly 25.32 Mtoe accounting for 45% of total energy consumption in the steel sector. Against total targeted energy consumption saving of 1.486 Mtoe under PAT Cycle-I in steel sector, actual saving was 2.10 Mtoe. During PAT Cycle-II (2016-19), there are 71 DCs in Steel Sector accounting for 40.44 Mtoe i.e. 72% of Energy Consumption in the Steel Sector. Under PAT Cycle-II, the envisaged energy consumption saving to be assessed in 2018-19 is 2.14 Mtoe. MoEF&CC submitted the country’s INDCs to UNFCC thereby committing to reduce GHG emission per unit of GDP by 33-35% by 2030 from the 2005 level. Ministry of Steel submitted its INDC on Iron & Steel sector to MoEF&CC after extensive deliberations with stakeholders indicating reduction from 3.1 T/tcs in 2005 to the emission intensity to 2.64 T/tcs by 2020 and 2.4 T/tcs by 2030 i.e. approximately 1% reduction per year considering both BF-BOF & DRI-EAF process routes. To achieve these targets, investment to the tune of Rs 52,000 Cr may be needed. Ministry is reviewing the status in consultation with industry to firm up the figure. In a recent review meeting, most of Integrated Steel Plant committed to achieve the target. Of late, Ministry of Steel has setup a Working Group to revised & finalize the targets for submission to MoEF&CC. Under the modernization and expansion plan, the integrated steel companies are implementing energy efficient clean and green technologies with an aim to reduce resource consumption and GHG emission intensity. During these programs, emphasis is given towards recovery of waste heat/energy which has so far been a week point in Indian Steel Sector. Further, a few new plants have recently been set up adopting state of the art clean and green technologies. It is thus expected that over the year, energy and environment scenario of Indian integrated steel sector is bound to improve.

Besides the above, under bilateral program, New Energy and Development Organization (NEDO) under Ministry of Economic Trade and Industry (METI), Japan has been helping Indian steel plants by providing waste heat recovery systems under NEDO Model Project Scheme. Under this scheme, Coke Dry Quenching (CDQ) and Blast Furnace Hot Stoves waste Gas Recovery System have been set up in Tata Steel Limited, Jamshedpur. Sinter Cooler Waste Heat Recovery Systems has been set up at Rashtriya Ispat Nigam Limited (RINL), Vishakhapatnam. One more project on EMS at ISP, Burnpur is under progress.

The energy and environment scenario in the secondary steel sector, which contributes substantially in overall production of iron and steel product, has also not been up to the mark. Under this background, United Nation Development Program (UNDP)- Global Environment Facility (GEF) in association with Ministry of Steel took up a dedicated project aimed at reducing energy consumption and CO2 emission. Phase-I of the project has been completed whereby 20-45% reduction per unit was achieved. Subsequently, UNDP- AuSAid-MoS Project was taken up and thereby 5-15 % GHG emission was reduced per unit. Third Phase is in conceptual stage. It is proposed to cover about 1100 units in secondary sector. The projected GHG Reduction would be up to 30% per unit.

R&D scenario and investment in Indian steel sector is not very bright. Ministry of Steel therefore is supplementing the R&D initiatives of the research laboratories, academic institutions & steel industry by providing financial assistance for pursuing the R&D through Steel Development Fund. This scheme was launched in the year 1997-98. Apart from this, Ministry of Steel is also providing financial assistance for the R&D projects through Government of India Fund: This scheme was launched in the year 2009-10. The focus of the R&D is for development of innovative Products & Processes, Improvement in plant efficiency parameters, cost reduction, reduction in energy consumption & GHG emission. R&D projects completed so far are yielding benefits in terms of improvement in productivity, energy efficiency and environmental emission of the steel sector.

Secondary steel sector, particularly induction furnace units suffer with quality related issues primarily because refining of steel is not possible in induction furnaces. Because of this, quality inputs (Billets/ingots) are rarely available for re-rolling for production of construction steel. To address these problems being faced by the sector, Ministry of Steel has taken several R&D projects in association with NML, Jamshedpur and National Institute of Steel Technology (NISST), Mandi Gobindgarh. Lab scale and Industrial trials show encouraging results, which are proposed to be commercialized in due course. It is also satisfying to note that off late new innovative secondary refining technologies have been developed by some of Induction Furnace manufacturers. These initiatives may go a long way in making available quality steel in this sector.

Indian Steel Industry is continuously modernizing / expanding to improve its technological profile and to reduce energy & GHG emission intensity. The steel industry is also pursuing several approaches for mitigation of GHG emission under the ambit to Nationally Determined Contributions. To remove the constraint of Iron Ore, several new facilities are coming up for beneficiation, and agglomeration (Pelletization). Ministry of Steel is also encouraging through R&D programme for removing the constraints in raw material, particularly in the area iron ore and coal. Because of technical and R&D interventions, it is expected that Specific Energy Consumption and GHG emission will reduce considerably.

Accordingly, it is expected that total GHG emission intensity from the steel sector will be much lower than the business as usual scenario.