Background Note on Assumptions to Arrive at Probable INDC Values and Investment.

FOREWORD

Presently, India is the 4th largest steel producer in the world after China, Japan and USA. Production of crude steel in 2014-15 was about 88 million tonnes against a capacity of around 108 MT. The production is shared by Public Sector and private sector units roughly in the proportion of 25% and 75% respectively. The two public sector units are SAIL and RINL. Major players in the private sector are Tata Steel Ltd., JSW Steel Ltd., Essar Steel Ltd., Jindal Steel & Power Ltd., Bhushan Steel Ltd. and Bhushan Power and Steel Ltd.

Indian steel industry is quite fragmented wherein steel companies adopt a diversified process routes for production of iron/steel. While iron is produced in Blast Furnace (BF), Corex Furnace, Gas based DRI & Coal based DRI plants, steel is produced adopting Basic Oxygen Furnace (BOF)/LD Converter, Electric Arc Furnace(EAF) & Induction Furnace(IF) process routes. Presently, proportion of BOF, EAF & IF steel making routes is roughly 45%, 23% & 32% respectively. Further, besides the large integrated steel plants, there are stand-alone DRI/sponge iron units, stand-alone mini steel plants alone EAF/IF, steel re-rolling mills (SRRM), Cold Rolling Mills and Coating Units.

The High Level Committee on Manufacturing has envisaged an ambitious target of steel capacity at 300 million tonnes by 2025. However, since INDC projections are to be made for 2030, in the absence of any projections, it has been assumed that actual production of crude steel will be 300 MT by 2030. It has also been assumed that the proportion of BF-BOF route of steel making will gradually increase to around 60% by 2020 and to around 70% by around 2030 which is the current international mix of steel making technology. Further, for the purpose of estimation of the GHG emission under the present exercise, attempt has been made to capture GHG emission from the major contributors of the sector only. It has also been assumed in all the calculations that all the green field plants to be set up in the years to come will adopt all the clean and green energy efficient technologies and therefore, technologies and cost for modernization/renovation of existing capacities has only been assumed

Going by the energy efficiency and GHG emission, gas based DRI-EAF route is considered the best with minimum energy consumption and GH emission, while the coal based DRI-EAF/IF route is considered most energy intensive with highest GHG emission. However, production of gas based DRI has been diminishing over the years for non-availability of natural gas leading to very limited production of steel through the gas based DRI-EAF route. Secondly, the technology profile of the gas based DRI and EAF based plants is world class adopting most of the energy efficient clean and green technologies. Accordingly, this process route has not been considered while calculating the overall GHG emission from the steel sector.

<u>INTEGRATED STEEL PLANTS (Scheme-1)</u>

Status

- Presently, there are 12 integrated steel plants having capacity in the range of 2-10 million tonnes per annum. While three plants produce steel adopting EAF technology, others adopt BOF technology.
- In overall terms, the energy consumption and GHG emission per tonne of crude steel in these plants is much higher when compared with the benchmark plants abroad. Specific energy consumption in Indian plants varies in the range of 6.5-6.8 Gcal/tcs as compared to international benchmark of around 5 Gcal/tcs . Similarly, GHG emission in Indian plants varies in the range of 2.43-3.2 Tonnes/tcs (BF-BOF: 2.43-3.0 & Coal DRI-EAF/IF: 3.0-3.2)) which is almost 1.5 times the international benchmark of 1.8 Tonnes/tcs. The higher consumption/emission norms are mainly because of obsolescence in iron and steel making technology in most of the older plants, limited adoption of technologies for harnessing waste heat/energy and constraints in the quality of raw material particularly, high alumina content in Indian iron ore and high ash content in Indian coking coal. The steel industry needs to evolve well defined time bound action plans and strategies for renovation and phasing out of old /obsolete technologies/facilities as well as beneficiation of iron ore/coal to address all the bottlenecks

<u>Energy Efficiency (EE) Technologies & Investment</u>

- Advanced economies like Japan, Europe have developed and adopted a large number of clean and green technologies for harnessing waste heat/energy. A detailed list of such technologies as available in the Technology Customized List (prepared jointly by Indian steel industry /MoS and Japanese steel companies/METI) is attached (**Annex-I**).
- Some of these technologies have been adopted in some of the ISPs and others have to adopt them in years to come.
- Generally speaking, these are very costly technologies and average investment per unit is roughly estimated at around Rs 3000-3500 crores. Secondly, technologies are not available in the country and have to be imported, but subject to availability of fund. It is true that the steel companies are modernizing /expanding their capacities from time to time. However, these have not met the objective of minimizing energy

consumption and GHG emission fully. Another bottleneck is lack of space for retrofitting these technologies in existing/old plants. Therefore, the technologies can be implemented as and when renovation of the plants is carried out and funds are made available through grants or loan at cheap interest rates.

- Accordingly, it is projected that specific GHG emission will gradually reduce to a level of around 2.4-2.6 T/TCS for BF-BOF route and 2.8-2.9 in DRI-EAF route on adoption of relevant technologies in existing plants by 2020. Similarly, it is projected that GHG emission by 2030 will reduce to around 2.2-2.4T/tcs for BF-BOF route and 2.6-2.7 T/tcs for DRI-EAF route.
- Therefore, Government needs to take necessary efforts to facilitate transfer of technologies and funds thereof from abroad. Government took some initiatives through the CDM and NEDO Model Project initiatives. But actual benefit has been minimal. Another initiative for transfer and deployment of such technologies was the APPCDC Partnership programme which has however been stopped without much of progress. Now, this objective is being pursued under the GSEP programme. Further, Government is pursuing transfer of relevant technologies and funds thereof under the BOCM/JCM initiative with Government of Japan.
- However, as stated above, some of the plants or units have already adopted a few technologies and therefore, for the purpose of this calculation, 12 existing plants have been taken into consideration with an average investment of Rs 3,000 crore inclusive of hardware and software and capacity building requirements. This would work out to a total investment of Rs 36,000 crores to be spent over the 15 years period during 2015-2030. It has further been assumed that one-third of these identified technologies will be deployed with necessary 1/3rd fund requirement by 2020 and the balance two-third by 2030. Further, taking clue from the NEDO Model project concept and also the promotional aspects, it has been assumed that 50% fund will have to be procured from abroad at affordable rates. Accordingly, the fund requirements for 2015-2020 and 2020-2030 both from local sources and abroad have been estimated Rs 12,000 Cr by 2020 and Rs 24000 by 2030 with 50% break-up from local sources and foreign sources as per the requirement of the Template provided by MoEF &CC.

SPONGE IRON/DRI SECTOR (Scheme 2)

- India is the largest of sponge iron with production of over 20 million tonne per annum which is shared by 3 natural gas based plants (roughly one-fourth) and over 300 coal based plants adopting Roraty Kils of diverse modular sizes namely 60 tpd, 100 tpd, 200/250 tpd, 300/350 tpd and 500 tpd .
- The gas based plants are of world class both in terms of modular sizes and technology profile adopting most of the state-of-the-art technologies, requiring no technologies from abroad and hence no fund requirement therefor. However, the status of the coal

based plants are not up to mark which accounts for their very high specific energy consumption and GHG emission.

- The sole energy efficient improvement technology available for rotary kiln is the waste heat boilers, normally for generation of electricity. This technology is adopted in limited plants mainly because of retrofitability considerations, high investment cost (Rs 25 Cr, Rs 30 Cr and Rs 40 Cr respectively for 6 MW , 8MW and 10/12 MW plants) and for lack of fund. Normally speaking, this technology is feasible only in rotary kilns of capacity 60,000tpa i,e modular size 200tpd (1x200tpd or 2x100 tpd) and preferably 300 tpd (1x300 tpd or 3x100 tpd or a mix thereof) .
- Based on information available in the JPC Survey Report, it is found that there are roughly 210 such units (110 x200 tpd, 60x300 tpd and 40x500 tpd) in the country each with a capacity of 60000tpa or more. Out of these , it is assumed that 75% of 500tpd , 50% of 300 tpd and 25% of 200 tpd units have already adopted WHBs leaving thereby 10, 30 and 80 i.e total 120 units for adoption of WHBs. Total investment in respect of 120 units works out to Rs 2400 crore (80xRs 25 Cr+ 30xRs30 Cr+ 10xRs40 cr). Accordingly, fund requirements by 2020 and 2030 have been worked taking same assumption as in integrated plants.

ELECTRIC ARC FURNACE (EAF) INDUSTRY (Scheme 3)

- As mentioned above , the EAF sector falls under two broad categories. The EAF based ISPs adopt large EAFs with most of the state-of –the –art technologies. Technology and balance fund requirement of such plants have been taken into account under the integrated plants.
- However, the technology profile of most of the EAF based mini steel plants (about 35 in number adopting 25-50 tonne EAFs) is not world class and some of the necessary technologies like supersonic oxygen lance system which are adopted in large pants. Roughly, total investment of all these technologies is estimated at around Rs 30 Cr per unit approx, and thus total investment for about 30 units works out to around Rs. 900 Cr of which fund requirement by 2020 and 2030 has been placed at Rs 300 Cr and Rs600 Cr respectively. Break-up of the local cost and that from abroad has been worked out taking the same strategy adopted for ISPs.

INDUCTION FURNANCE (IF) SECTOR (Scheme 4)

Status

- There are 1338 units with a total capacity of about 36 million tonnes and production of about 26 million tonnes in the country.

- Their average power consumption is of the Order of 750 units per tonnes of Crude Steel (ranging from 600-950 units) i.e. about 50 million mega joules (50 tera joules per unit).

Energy Efficiency (EE) Technologies & Investment

- Recently, under the UNDP-AusAid – MoS upscaling projects, 15 IF units are proposed to be taken up for Energy Efficiency improvement, a list of such technologies is given at **Annex-II**.
- Taking clue from the investment of about Rs 150 Crores on Energy Efficient Improvement Technologies for a 0.5 million tonnes Plant at Bangladesh Steel Re-rolling mill (BSRM), it is estimated that an investment of Rs 10800 Crores (@300 Crores per million tonnes into 36 million tone) would be required to upgrade all the IF unit in the country. Of these, 1/3 units may be covered up to 2020 requiring investment of Rs 3600 Crores and the remaining 2/3 units by 2030 requiring investment of Rs 7200 Crores. Outside fund requirement may also be assumed in the proportion of 1: 6 mentioned above i.e. Rs 500 Crores by 2020 of Rs 1000 Crores by 2030.

STEEL RE-ROLLING MILLS (SRRMs) (Scheme 5)

Status

- There are about 1800 SRRM units in India with total estimated capacity of 50 million tonnes and production of about 33 million tonnes.
- On an average, these units consume about 65 million mega joule (65tera joule) energy, and release GHG emission @8000-10000 tonnes of carbon dioxide (tCO_2) equivalent per unit / per year. Thus total GHG emission from the sector would be of the order of 15-18 million tCO_2 per year.

Energy Efficiency (EE) Technologies & Investment

- Energy Efficiency (EE) improvement Technologies where implemented in 34 model units during 2004-2012 under UNDP- GEF steel project implemented by Ministry of Steel resulting in 25-30 % reduction in Energy Consumption and GHG emission.
- Thus on an average, GHG emission reduction per unit per year was of the order of 2000-3000 tonnes.
- The average investment of Rs. 1.5 Crores per unit (Rs. 50 Lakhs – 5 Crores) and the average payback on investment was 14 months.
- Under the UNDP- AusAid – MoS upscaling project, EE Technologies are being implemented in about 285 units having potential GHG emission reduction @10% (range: 5-20%). List of Energy Efficient Clean and Green Technologies being implemented may be seen at **Annex-III**.

- Assuming that Energy Efficient Clean and Green Technologies will be implemented in remaining 1500 units by 2030, total investment @Rs. 1.5 Crores would work out to Rs. 2250 Crores (approx). It is also assumed that 500 units (i.e. 1/3) will be covered by 2020 and balance 1000 units by 2030.
- Therefore, fund requirement by 2020 and 2030 would work out to Rs. 750 Crores and Rs. 1500 Crores respectively.
- Further, based on the funding pattern in the ongoing project, it is presumed that proportion of outside fund (UNDP, GEF, Aus-Aid, etc) & Domestic fund would be in the proportion of 1:6 i.e. outside fund requirement by 2020 may be of the order of Rs. 100 Crores and by 2030 Rs. 200 Crores respectively.
- The above assessment is based on assumption that all new SRRM units to come up in future will be set-up with latest technologies adopting all the Energy Efficient Clean and Green Technologies.