

## **Minutes of Brainstorming meeting to evolve a comprehensive medium-term R&D roadmap for the Iron & Steel Sector for sustainable development.**

### **List of participants at Annexure-1.**

1.0 A brainstorming meeting was held on 11<sup>th</sup> May 2023 in Ministry of Steel, under the Chairmanship of Secretary (Steel) with the stakeholders from the steel industry, academia, research laboratories, design & engineering companies and also from other concerned Ministries/ Departments viz. DST, DSIR, DRDO etc., to evolve a comprehensive medium-term R&D roadmap and action plan for the Iron & Steel Sector for the next ten years. The discussions were moderated by Dr. Indranil Chattoraj, ex-Director National Metallurgical Laboratory (CSIR-NML) Jamshedpur and Smt. Ruchika Chaudhry Govil, Additional Secretary, Ministry of Steel.

2.0 The meeting began with the discussions on the needs of the R&D initiatives which can be taken up on a common platform for the long term sustainable development of the Indian Steel Sector. The important points raised by the Chair in the meeting are highlighted below:

- The investments made on R&D by the Indian steel companies are substantially less in comparison to the global counterparts. India being the second largest steel producer need to invest at par with the global counterparts to maintain the leading position.
- All the stakeholders need to join hands to pursue collaborative coordinated research on a common issues such as beneficiation of iron ore & agglomeration, beneficiation of coal, Carbon Capture & Utilisation, utilisation of steel industry wastes such as steel slag, decarbonisation technologies, use of bio-char to substitute coke/ coal in some areas of iron & steel making, as well as R&D to address challenges & issues specific to the Secondary Steel Sector.
- There is a need to identify ways & means for strengthening Industry, research labs & academia interface for carrying out coordinated & collaborative research to address the R&D needs of the Iron & Steel sector.
- There is also need find way & means to ensure that the IPs generated through R&D are available for the entire steel sector in India and how the IPs generated through R&D can be translated into development of actual processes and also development & production of machineries & plants required for the processes.
- The requirement and sources of R&D funds and institutional development needed for undertaking such R&D efforts.

3.0 Inputs from the stakeholders:

- R&D being taken up as a bottom up approach usually done in research labs or academia. It should be a top down approach led by the steel industry.

- **Blast Furnace (reduction in CO2 reduction):**
  - National projects need to be taken up for H<sub>2</sub> injection and top gas recycling in Blast Furnace to reduce the CO<sub>2</sub> emission. Need modification in the Blast Furnace Shaft for H<sub>2</sub> injection. Additional systems required to be installed for top gas recycling & carbon capture. Tata Steel & JSW Steel showed their willingness to offer their smaller Blast Furnaces for pursuing such national projects.
  - Further developments need to be carried out in these areas with Collaboration with technology/ equipment suppliers for joint development of technology or adoption of the technology already developed.
  - Conversion of the captured CO<sub>2</sub> into usable products such as Syn Gas (CO+H<sub>2</sub>) for use in the steel plant is an important area of R&D where new patents can be developed.
  - Wherever patents already exist, such as in gas injection, the technology can be bought from the technology supplier by paying royalty, rather than re-inventing the wheel. Wherever patents do not exist, R&D can be done for developing Indian patent.
  - Such national projects can be funded from a common R&D fund contributed both by public & private funding.
  
- **Raw material beneficiation & agglomeration:**
  - Development of appropriate Coal beneficiation technologies will enable utilisation of domestic high ash coal and minimise the dependency of the imported coking coal which is mostly used by the Indian steel Industry.
  - Development of Iron ore beneficiation & agglomeration technologies are required to enable use of upto 35% Fe iron ore and ore with high Al & Si content to enable utilisation of low grade resources.
  - Development of agglomeration technologies for iron ore & coal, utilising waste resources from the steel plant also need to be taken on priority. Iron ore cold briquetting technology is one such area research can be taken up.
  - Dry beneficiation is an emerging area which need further developments for minimising the use of water.
  - Some national level projects can be taken in these areas. NMDC offered its facilities for taking up pilot projects.
  
- **Fluxes & Refractories:**
  - Fluxes (limestone & dolomite) being used in steel making have high carbon footprint with high LOI. Alternate newer fluxes can be developed having low LOI.
  - Higher alumina & silica in the fluxes cause high slag rates. Processes need to be developed to lower the alumina & silica in the fluxes.

- Refractories are an important consumable used in the steel industry. The high end refractories (e.g. Mg Carbon bricks) are mostly imported from China as the raw materials are not available. R&D is required to lower the Fe content to improve the Mg level in the indigenous raw material.
- **Automation & AI:**
  - Simulation, automation and AI has immense potential in improving the efficiency and quality control in the steel plants. Availability of reliable data and high quality sensors (for CO<sub>2</sub> & O<sub>2</sub> etc.) are essential in such areas. Projects can be taken up in association of the academia to setup pilot projects to improve efficiency, quality control & productivity of the steel plants.
- **Secondary Steel Sector Issues:**
  - National projects need to be taken up in association with CIMFR & IMMT for developing coal gasification technologies using indigenous coal and its utilisation in coal based DRI units using Rotary Kilns.
  - Need for development of smaller capacity vertical Shaft Kilns for utilisation of Syn Gas from coal gasification, to enable shifting from existing coal based Rotary Kilns.
  - A consortium/ cluster based approach may be taken for pursuing R&D in this area. The capex may be funded by Ministry of Steel and the opex may be funded by the industry or its associations.
- **Use of alternative fuel such as Biochar:**
  - Biochar derived from bamboo have good potential in reducing CO<sub>2</sub> emission of the steel industry by very substantial extent. Biochar can almost fully replace the PCI, can replace upto 20% of the total coking coal requirement in the coking coal blend and can also replace upto 60% of the coke breeze in the sintering plant.
  - National project can be taken up by the industry in association with IARI.

4.0 Various steel companies and steel CPSEs came forward to share their facilities for collaborative use by the entire sector. The running theme for the entire discussion was to apply scarce national R&D resources to the best possible use for rapidly addressing national priorities as also assume technological leadership in various areas of iron and steel making.

5.0 While thanking the stakeholders for their valuable inputs which have set the tone for further interactions on the matter, Secretary (Steel) stated that going forward, detailed inputs shall be sought from them for formulating the roadmap/ R&D programmes to be carried out on priority. Based on the identified R&D programmes

and their cost thereof, Ministry of Steel will identify/ facilitate the sources of funding as well as the ecosystem required for pursuing the initiatives.

6.0 Accordingly, stakeholders from the steel industry & its associations, research laboratories and academia were requested to provide detailed inputs on the following in about 2 weeks time:

- R&D activities required for the long term sustainable development of the Indian Steel Sector, with support from various stake holders including the prominent steel makers.
- Ways & means for strengthening Industry, research labs & academia interface for carrying out collaborative research to address the R&D needs of the Iron & Steel sector in a co-ordinated & collaborative manner.
- R&D presently being carried out and the knowhow & the facilities that the stakeholders would like to share to carry out co-ordinated & collaborative national R&D for the iron & steel sector.
- Ways & means to ensure that the IPs generated through R&D are available for the entire steel sector in India and how the IPs generated through R&D can be translated into development of actual processes and also development & production of machinery & plants required for the processes.
- Ten years comprehensive plan for R&D addressing the need of process efficiencies, diversification of raw material resources, resource and energy efficiency, innovative and disruptive steel making technologies and various other components relating to green steel making.
- The requirement and sources of R&D funds and institutional development needed for undertaking such R&D efforts.

=====

**Annexure-1**

**List of Participants:**

<b>Sl.No.</b>	<b>Representative from</b>	<b>Nature of Stakeholder</b>	<b>Participant</b>	<b>Physical / Online</b>
1	Ministry of Steel	-	Shri Nagendra Nath Sinha, Secretary, Ministry of Steel <b>(Chair)</b>	Physical
2	Ministry of Steel	-	Smt Ruchika Chaudhry Govil, Additional Secretary, Ministry of Steel <b>(Co-Chair)</b>	Physical
3	Ex CSIR-NML	-	Dr Indranil Chattoraj, ex Director CSIR-NML <b>(Co-Chair)</b>	Physical
4	Ministry of Steel	-	Shri Parmjeet Singh, Additional Industrial Adviser, Ministry of Steel	Physical
5	SAIL	Steel Industry	Shri Nirvik Banerjee, ED (RDCIS), SAIL	Physical
6	RINL	Steel Industry	Shri A. V. Madhusudana Rao, General Manager (R&D)	Physical
7	NMDC	Steel Industry	Shri Bhagwan Singh , AGM (Mineral Processing)	Physical
8	Tata Steel	Steel Industry	1. Shri Manish Mishra, Chief Corporate Affairs 2. Debashish Bhattacharjee, VP Technology & R&D	Physical
9	JSW	Steel Industry	1. Dr. Dhiren Kumar Panda, Head (EVP) - R&D and 2. Dr Rameshwar Shah	Physical
10	AM/NS	Steel Industry	Shri Sirshendu Chattopadhyay	Physical
11	JSPL	Steel Industry	Dr. Mukesh Kumar	Physical
12	CSIR-NML	Research Agency	Dr. Jagannath Pal, Chief Scientist	Online
13	CSIR-IMMT	Research Agency	Dr. S. P. Das, Sr. Principal Scientist	Online
14	CSIR-CIMFR	Research Agency	Shri Manish Kumar, Senior Principal Scientist	Online
15	CSIR-CRRI	Research Agency	Shri Satish Pandey, Principal Scientist	Online
16	CSIR-CBRI	Research Agency	Prof. S.K. Singh, Chief Scientist,	Online
17	ICAR-IARI	Research Agency	Shri Bhupinder Singh, Prinicpal Scientist	Physical
18	IIT Bombay	Academic Institution	Prof. Sanjay Chandra, Viswanathan N N	Online

19	IIT Kharagpur	Academic Institution	Shri Shiv Brat Singh	Online
20	IIT BHU	Academic Institution	Shri Rampada Manna	Online
21	MECON	Design & Engineering Company	Shri Manoj Kumar, Sr. General Manager (R&D)	Physical
22	DASTUR	Design & Engineering Company	Shri Gaurav Verma	Physical
23	DST	Ministries/ Departments/ Other Organisation	Dr. Dileep Krishna Mathi, Scientist 'C'	Online
24	DRDO/ DMRL	Ministries/ Departments/ Other Organisation	Dr. R. Veerababu, Scientist 'F' & Group Head, Special Steels Group, DMRL	Physical
25	MIDHANI	Ministries/ Departments/ Other Organisation	Shri T Muthukumar, Director (Production & Marketing)/ Shri S Narahari Prasad,	Online
26	NISST	Ministries/ Departments/ Other Organisation	Shri Rajiv Kr. Paul	Online
27	SRTMI	Ministries/ Departments/ Other Organisation	Dr Ramen Datta, Consultant, SRTMI	Online
28	ISA	Steel Industry Association	Shri R K Bhan, Sr. Director	Online
29	ASPA	Steel Industry Association	K K Bariar: Sunflag Steel	Online
30	AIIFA	Steel Industry Association	Shri Kamal Aggarwal, Hon. Secretary General,	Online
31	SIMA	Steel Industry Association	Shri Deependra Kashiva, Director General	Online
32	SFAI	Steel Industry Association	Shri A K Jain & Dr Neeraj Pandey (Star Wire)	Physical