GUIDELINES FOR CENTRE OF EXCELLENCE UNDER NATIONAL CRITICAL MINERAL MISSION (NCMM)

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GOVERNMENT OF INDIA
MINISTRY OF MINES
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1. Introduction

1.1 Union Finance Minister announced the setting up of 'Critical Mineral Mission' in the Union Budget speech 2024-25 on 23.07.2024 stating: *"We will set up a Critical Mineral Mission for domestic production, recycling of critical minerals, and overseas acquisition of critical mineral assets. Its mandate will include technology development, skilled workforce, extended producer responsibility framework, and a suitable financing mechanism."* Subsequently, the National Critical Mineral Mission (NCMM) was approved by the Union Cabinet on 29.01.2025 to build a resilient value chain for critical mineral resources vital to Green Technologies, with outlay of Rs. 16,300 crore by Government of India and Rs. 18,000 crore investments expected from PSUs, etc. over the period up to 2030-31. The Mission includes provisions for augmenting domestic critical mineral capacity, human resource development, technological advancements, international collaboration, setting up of mineral processing parks and supporting the recycling of critical minerals. In terms of outcome, the Mission will *inter-alia* promote research in critical mineral technologies and towards this end, proposes the setting up of Centres of Excellence on Critical Minerals. The NCMM document inter-alia mentions as under "*4.5.2 Establishing Centers of Excellence (COE) on Critical Minerals: The Ministry also suggested the constitution of Centers of Excellence on critical minerals. The Centres shall work on a Hub and Spoke Model with institutions/organisations and research labs working on critical minerals. The Centers of Excellence (COE) will work on the critical minerals value and aim to synergise R&D and innovation with the national objectives. The existing infrastructure including manpower, of these organizations will be utilised for undertaking the proposed research work. If need be, the project related manpower will be hired on contract basis by these CoE."* It is envisaged to create at least three (03) such Centres of Excellence (CoEs).

1.2 Critical minerals have to be seen holistically, as critical minerals can be mined or extracted or processed in ore, scrap or metallic form. In this context, the term Critical Raw Materials (CRM) refer to those materials in mineral, metallic or scrap form, which are further processed and used in various sectors for economic development and national security. The lack of availability of these minerals or concentration of extraction or processing in a few geographical locations may lead to supply chain vulnerabilities and even disruption of supplies. The future global economy will be underpinned by technologies that depend on minerals such as lithium, graphite, cobalt, titanium, and rare earth elements. These are essential for the advancement of many sectors, including high-tech electronics, telecommunications, transport and defence. They are also vital to power the global transition to a low carbon emissions economy, and the renewable energy technologies that will be required to meet the 'Net Zero' commitments of an increasing number of countries around the world. Hence, it has become imperative to identify and develop value chains for the minerals, which are critical to our country.

1.3 As per the Mines and Minerals (Development and Regulation) Amendment Act, 2023 (MMDR Act), the Government of India has classified 24 minerals as Critical and Strategic Minerals and inserted them under Part D of the First Schedule. These 24 minerals are vital for national security, clean energy, high-tech industries, etc. In these minerals, the Central Government is empowered to conduct auction for grant of mining lease or composite licence. These 24 minerals are 1. Beryl and other beryllium bearing minerals, 2. Cadmium bearing minerals, 3. Cobalt bearing

minerals, 4. Gallium bearing minerals, 5. Graphite, 6. Indium bearing minerals, 7. Lithium bearing minerals, 8. Molybdenum bearing minerals, 9. Nickel bearing minerals, 10. Niobium bearing minerals, 11. Phosphate (without uranium), 12. Platinum group of elements bearing minerals, 13. Potash, I4. Minerals of the "rare earths" group not containing Uranium and Thorium, 15. Rhenium bearing minerals, 16. Selenium bearing minerals, 17. Tantalum bearing minerals, 18. Tellurium bearing minerals, 19. Tin bearing minerals, 20. Titanium bearing minerals and ores (ilmenite, rutile and leucoxene), 21. Tungsten bearing minerals, 22. Vanadium bearing minerals, 23. Zirconium-bearing minerals and ores including zircon, and 24. Glauconite.

1.4 Critical Raw Materials form the crucial supply chain for emerging sectors of clean energy and mobility transition in addition to advanced technology & strategic sectors like electronics, defence, space, etc. The domestic demand for various critical materials was limited for decades. However, India is now poised to become a 5 trillion dollar economy in next 2-3 years. A large quantum of critical raw materials requirement is directly linked with this desired rapid growth in economy and the major cause for concern is the global supply chain disruptions. Hence, a dedicated mission mode R&D to convert the ores, minerals and secondary sources to win critical raw materials has become crucial. Vectoring R&D efforts in a directed mission for beneficiation, extraction and processing in a systematic approach within a shorter time frame is of paramount importance.

2. Sources and uses of CRM

2.1 Sector wise gap analysis and action plan is essential to ensure the source, uses and development of CRM. Out of 24 critical minerals outlined in Part D of the First Schedule of MMDR Act, (a) graphite, rock phosphates (phosphorous), REEs, titanium (rutile/ anatase, ilmenite) and zircon (zirconium) from beach sands are produced in India but their domestic requirement is high, (b) there are deposits of lithium, nickel, cobalt, molybdenum, PGE, potash and tungsten but their mining is not being done presently (mineral blocks auctioned recently), and c) some critical minerals like vanadium, selenium, indium, tellurium, gallium, etc. also occur in association with different ores as trace elements or as minerals in very minor to trace amounts, which can be recovered as byproducts.

2.1.1 Many of the critical minerals/ elements occur as associated phases in ores and in the lattice of different minerals. Occurrence of critical minerals in natural ores, mine rejects such as sub-grade ores, overburden & waste dumps, beneficiation products of different mineral concentrates and beneficiation plant tailings and process residue of alumina refinery and gold are primary source of critical raw materials.

2.1.2 There are secondary source of critical raw materials which are present in metallurgical industry wastes such as smelter slag of copper, lead & zinc and tin, sludge of Cu-Pb-Zn & manganese di-oxide refining process, anode slimes, flue dust, dross, fly ash/ pond ash, slag of iron & steel industry and slag of ferro-alloys viz. ferrochrome, charge-chrome, ferro-manganese, ferro-silicon, silico-manganese, etc. Alumina refinery residues known as red mud contains titanium, zirconium, scandium and rare earth elements. Iron smelting slag may contain vanadium, titanium or phosphorus, depending on the ore. Copper smelting slag often contains significant amounts of copper, along with gold, silver, and other trace metals like molybdenum and cobalt.

2.1.3 There is a tertiary source of critical metals, which can be recovered from ferrous and non-ferrous metal scrap, spent catalysts, used batteries and electronic wastes.

2.2 Thus, there are three sources for getting critical raw material, namely
(a) Primary Source - ores, beneficiation products,
(b) Secondary Source - Smelter slag, sludge, anode slimes, Flu Dust, Fly Ash, tailings & process residues, mine dumps/ rejects, and
(c) Tertiary Source - Scrap, used batteries, spent catalysts, electronic waste

The usage of CRM and its current status in the country are given at **Annexure-1.**

3. Broad Areas of Research in CRM

3.1 The following are the broad areas of R&D in critical raw materials, which may lead to technology development and frontier technology role in mining, extraction, recycling and processing value chains:

i. Focused R&D to reach higher Technology Readiness Levels of TRL – 7 / 8 in CRM;
ii. Beneficiation and process technologies to extract critical raw materials from any feed stock;
iii. Combining the generic processes that are required to process any feed stock that contains critical raw materials and dovetail it to specific feed stock;
iv. Reductant metals and specialty chemicals that aid in beneficiation and separation processes;
v. Manufacturing of chemicals used in beneficiation and extraction (solvent extraction and ion exchange);
vi. Process equipment design, development and fabrication;
vii. Encourage and engage researchers in the domain of extractive metallurgy;
viii. Large data analytics of beneficiation and extraction methods for non-ferrous metals with AI/ ML tools;
ix. Any other related area

4. Centres of Excellence (CoEs) as a model for R&D on critical raw materials

4.1 Formation of CoEs / Hub-spoke clusters

4.1.1 Critical Raw Materials may be grouped into twenty-one sets of elements based on their feedstock to formulate strategy for R&D including in beneficiation and process technologies to extract critical raw materials. These sets are listed in **Annexure-2**.

4.1.2 In order to develop, demonstrate and deploy technologies in an end-to-end systems approach, it is essential to conduct R&D so as to reach higher Technology Readiness Levels (TRL), of namely TRL 7 / 8 pilot plant and pre-commercial demonstration. This calls for top-down systems approach of identifying the outputs and pilot plant sizing as a starting point at (TRL-7) and connect it to multitude of required critical function demonstrations at TRL-3 in a work breakdown methodology. Therefore, it is essential to recognize a select few amongst the large pool of R&D/ academic institutions in the country as Centres of Excellence (CoEs).

5. Elements of a Centre of Excellence (CoE)

5.1 CoE will undertake innovative & transformational research to strengthen and advance the nation's S&T capability in the area of CRM. It will make consistent efforts to foster collaborations and synergy between universities, institutes and publicly funded organizations, government ministries, industrial & business R&D in India and overseas. This will be aimed at building cutting edge research facility and promoting inter-/ multi-disciplinary approaches to problem solving in the area of CRM. CoE should have the following basic elements:

5.2 Hub and Spoke model

5.2.1 CoE will be operated as a consortium, on a Hub & Spoke model, to leverage R&D in critical raw materials and pooling the core competence of each constituent under one umbrella.

5.2.2 In the consortium, the CoE becomes the Hub and other entities from research & academia and industry become the Spokes. The Hub institute will be recognized as the CoE. The Hub (host)) institute has the option to create a Section 8 company to run the CoE for developing commercially feasible solutions for the research and technology developed, including in the areas of mining, geology, metallurgy, material science and allied sectors. Then, such a Section 8 company can also be made the Hub in lieu of the host institute.

5.2.3 The CoE will bring in at least two industry partners and at least two R&D/ academic partners to start with. For that, CoE shall enter into two sets of MoUs - one set with R&D institute/ academia spokes and another set with industry spokes.

5.2.4 Hub will be allowed to become a Spoke in another CoE. Similarly, industry and R&D institutes/ academia will be allowed to participate in multiple CoEs (Hubs) as a Spoke.

5.2.5 Foreign R&D institute/ academia and industry partners will also be allowed to participate as a Spoke in a CoE based on their areas of expertise.

5.2.6 The development of flow sheets for Technology Readiness Level (TRL) 3 to 4 for the extraction or beneficiation of critical minerals from primary sources will be exempted from industry partner collaboration.

5.2.7 The CoE will be headed by a Chief Executive Officer (CEO), who will be a very senior Scientist from the Hub Institute. The CEO of the CoE will be its administrative head and will be responsible for the overall functioning of the CoE. The Director of the Hub Institute will act as the non-executive Chairman of the CoE and will have power of supervision.

5.2.8 To carry out the functions of the CoE, the following governance structure will have to be established by the Hub:

5.2.8.1 A Governing Body to be chaired by the Director of the R&D/ academic institute (Hub), with the Head/ CEO of the CoE as its Member-Secretary, and representatives from relevant stakeholders as members, including from Ministry of Mines, Spokes, industry experts, research and academic experts, etc.; and

5.2.8.2 A dedicated Secretariat located at the Hub institute comprising the Head/ CEO of the CoE and such other scientist/ technical/ administrative personnel as may be deemed necessary for the effective administration of all the R&D projects pertaining to the CoE and fulfilment of the objectives of the CoE in general

5.3 Eligibility condition: An Institute desirous to be recognized as a CoE for R&D in CRM will have to meet the following parameters:

(a) Existing academic institutions, universities, national institutes, and R&D institutions recognized with the Department of Scientific and Industrial Research (DSIR), Government of India, are eligible to apply. A Section 8 company of the above category of institutions set up to develop commercially feasible solutions for the research and technology developed by such institute, including in the areas of mining, geology, metallurgy, material science and allied sectors, can also apply in lieu of the mother institute to be recognized as CoE.
(b) The institution should be currently engaged in R&D activities in mining, mineral processing, metallurgy, recycling, material science and allied sectors, and have demonstrated substantial prior work (TRL 5 or higher) in the above areas, as indicated by publications, research projects and consultancy assignments.
(c) The institution should have adequate infrastructure in terms of land and building to house the Centre of Excellence including laboratory, equipment, plant and machinery.
(d) The institution should have sufficient/ competent manpower/ research staff who could be engaged in the field in which the CoE will be recognized.
(e) The Institution, as the Hub of the CoE, should have at least two industry partners and at least two R&D/ academic partners for promoting applied research, technology transfer and commercialization.

Basic eligibility conditions for an R&D / academic partner are conditions (a) to (d) above. Basic eligibility condition for an industry partner is a company registered under the Companies Act, 2013.

5.4 Minimum sets of elements for a CoE:

5.4.1 Each CoE will specify and commit to undertake R&D in at least five (05) sets out of the 21 sets of elements classified on feedstock basis (refer para 4.1.1) and placed at **Annexure II.**

5.5 Functions of CoE:

5.5.1 Each CoE would emerge as a recognized centre for research analysis, development and dissemination of knowledge in critical raw materials including beneficiation and process technologies. The specific functions of CoE will be as under:

i. Implement R&D programme for both TRL 3-5 and TRL 7 / 8 with well-defined problem statements and directed R&D, especially-
   a) to identify, develop and implement extraction process and beneficiation technologies for a host of critical raw materials from multiple sources and conduct directed R&D to reach higher Technology Readiness Levels of TRL 7 / 8, pilot plant and pre-commercial demonstration and create a competency centre; and
   b) the directed R&D endeavour in critical raw materials will entail both capability development (TRL 3-5) starting with existing core competence as well as capacity building at pilot plant levels (TRL 7 / 8) in a consortium along with industry stake holders so as to be industry and market ready for commercial production;

ii. Establish sound institutional base for executing the programmes/ projects;

iii. Undertake human resource development of younger researchers to work in the area of CRM as project staff, Post Graduate Internships and promoting MTech and PhD scholars to take up research problems pertaining to beneficiation, separation and other advanced technologies in CRM;

iv. Develop and incorporate AI-ML tools in mineral liberation and process selection; develop database and do continuous augmentation of learning experiences exclusively for critical raw materials;

v. The CoEs will be required to cover TRL 3 to TRL 8 spectrum as material + process + product + plant endeavour.

vi. After demonstrating the feasibility of an idea at the research labs, the activity should move to demonstrate the feasibility in the market place/ field.

vii. The CoE should strive to transform the research into a business proposal for industries both upstream and downstream. The CoE should strive to achieve self-sustainability through research and development activities including patent registration and licensing, consultancies while focusing on its core mandate.

viii. CoEs will help in the development of new products, new applications, innovation and improvement of technology, process innovation, quality, environmentally sustainable technologies, products, etc.

6. Procedure for recognition of CoE:

6.1 Submission of Proposals: An announcement will be made by Ministry of Mines for inviting proposals from eligible institutes having collaborative partnerships with industry and other academia / R&D institutions for recognizing it as a CoE for focused Research and Development in Critical Raw Materials sector. The eligible institute will come up with specific proposal for Centre of Excellence and must fill the enclosed proforma **(Annexure-3)** and submit it to the Ministry of Mines at the following address:

Under Secretary/Deputy Director
Metal-4 Section, Ministry of Mines
Room no. 115-A, F wing, Shastri Bhawan,
Dr. Rajendra Prasad Road, New Delhi - 110001
E-mail: met4-mines@gov/.in Website: https://research.mines.gov.in/

(Any change in contact details will be notified on the above and Ministry of Mines' websites)

6.2 Approval process for recognition of CoE:

The recognition of CoE will be implemented under the aegis of an Inter-Ministerial Project Approval and Advisory Committee (PAAC) under the chairmanship of Secretary, Ministry of Mines and co-chaired by Secretary (DST), which will be assisted by an expert committee namely Project Evaluation and Monitoring Committee (PEMC) under the chairmanship of Economic Adviser/ Joint Secretary, Ministry of Mines. The PEMC and PAAC will be constituted to appraise, recommend/ approve (by PAAC), monitor and review CoEs. PEMC will recommend proposals to the PAAC for recognising CoE under NCMM. The constitution of these two committees will be reviewed every three years, for changes, if any.

6.3 Evaluation of proposals by the PEMC for recognition as CoE:

The proposals received from eligible institutes for recognition as CoE will be evaluated by the Project Evaluation and Monitoring Committee (PEMC) chaired by Economic Advisor/ Joint Secretary, Ministry of Mines. If felt needed, a team of around 3 to 5 members/ Ministry of Mines' officials may be deputed for site visit and to report on the Centre's proposal. The evaluation criteria/ marking scheme for selecting the CoE are provided in **Annexure-4**. The Head/ CEO of the proposed CoE will make a presentation to the PEMC and the PEMC will make specific recommendations regarding selection of the Institute as a Centre of Excellence based on relevance of work, current research status of the applicant institute, the quality and expertise of the team, depth of collaboration with the industry and the requirements proposed. Minimum qualifying marks for a proposed CoE to be recommended by the PEMC to the PAAC will be seventy (70) out of a total of one hundred (100) marks. The composition of the Project Evaluation and Monitoring Committee (PEMC) will be as follows:

1.	Economic Adviser/ Joint Secretary, Ministry of Mines	Chair
2.	Joint Secretary, (Critical Mineral Mission) Ministry of Mines or his/her representative	Member
3.	Representative of Department of Atomic Energy (DAE)	Member
4.	Representative of Department of Defence Research & Development (DDR&D)	Member
5	Representative of Department of Science and Technology (DST)	Member
6	Representative of Council of Scientific & Industrial Research (CSIR)	Member
7	Representative of Geological Survey of India (GSI)	Member
8	Representative of Indian Bureau of Mines (IBM)	Member
9	Representative of Office of the Principal Scientific Adviser (PSA)	Member
10	Director, Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur	Member
11	Director (Technical), Ministry of Mines	Member Secretary
12	DS / Director (Metal-IV), Ministry of Mines	Member
13	Representative of Director IIT (ISM), Dhanbad	Member
14.	Representative of Director IIT, Kharagpur	Member

6.4 Final approval of proposals by the PAAC for recognition as CoE: The proposals recommended by the PEMC will be placed before the Project Approval and Advisory Committee (PAAC), co-chaired by Secretary (Mines) as well as by Secretary (DST) for final approval. If called for, the Head/ CEO of the recommended CoE will make presentation before PAAC. Recommended CoEs, as approved by the PAAC, will be recognised as a CoE for R&D in critical raw materials. The composition of the PAAC will be as follows:

1.	Secretary, Ministry of Mines	Co-Chair
2.	Secretary, Department of Science and Technology (DST)	Co-Chair
3.	Additional Secretary, Ministry of Mines	Member
4.	Economic Adviser/ Joint Secretary, Ministry of Mines	Member Secretary
5.	Joint Secretary, (Critical Mineral Mission) Ministry of Mines	Member
6.	Director General, Geological Survey of India (GSI)	Member
7.	Controller General, Indian Bureau of Mines (IBM)	Member
8.	CEO, Anusandhan National Research Foundation (ANRF)	Member
9.	Representative of Department of Defence Research & Development (DDR&D) not below the rank of Joint Secretary/ equivalent	Member
10.	Representative of Department of Atomic Energy (DAE) not below the rank of Joint Secretary/ equivalent	Member
11.	Representative of Council of Scientific & Industrial Research (CSIR) not below the rank of Joint Secretary/ equivalent	Member
12.	Director (Technical), Ministry of Mines	Member
13.	DS / Director (Metal-IV), Ministry of Mines	Member
14.	Director IIT(ISM), Dhanbad	Member
15.	Director IIT, Kharagpur	Member

6.5 Due diligence and review of CoE: The performance of a Centre of Excellence (CoE) so recognized by the Ministry of Mines will be reviewed annually, including its performance in undertaking R&D projects in selected sets and ensuring compliance with the fulfillment of conditions for recognition of CoE. Spokes will be allowed to shift in to or shift out from the attached CoE (Hub) provided the basic minimum requirement of Spokes in a Hub continues to remain fulfilled.

7. Operational parameters for a recognized CoE

7.1 Having recognized an eligible R&D institute/ academia as a Centre of Excellence for R&D on CRM, the support to the CoE will only be for specific R&D projects from among the sets mapped for the CoE. Since eligible institutions will be recognized on the basis of specified criteria including infrastructure, there will be no funding for setting up or for creation of physical infrastructure like land, building, etc. However, a sum up to Rs. 50 (fifty) lakh will be made available to the recognized CoE to carry out feasibility / assessment studies for mapping out areas of R&D in critical raw materials from among the 21 sets as at Annexure-2 towards formulation of project proposals. On being recognized as a CoE, within a period of two months, the Host institute can make a proposal to the Ministry of Mines. The sum will be approved by the PAAC, and released from the budget of Ministry of Mines.

7.2 Submission and funding of R&D proposals by CoE: A recognized CoE under this programme will be required to submit specific and eligible R&D proposals for funding. Such a CoE, following a 'Whole of Government' approach, may seek funding from any R&D schemes of Government of India such as ANRF, TDF, S&T programme of Ministry of Mines; or of various State Governments or any public entity. All the Scientific Ministries of the Government of India and Ministry of Mines will facilitate funding of focused projects on critical minerals, materials and products. Scientific Ministries, while sanctioning R&D projects for critical minerals will ensure, to the extent possible, that they are given to institutes that are recognized as CoE or a constituent spoke under the NCMM. Unlike the regular R&D projects of the Ministry of Mines, proposals for which are called through an advertisement, a CoE will be able to submit R&D proposals on an ongoing basis (without advertisement), which will however be evaluated as per existing procedure followed in regular R&D projects.

7.3 There are several research funding programmes and schemes in the Government of India including umbrella programmes, in which R&D and technology development/ commercialization in the field of critical raw materials are being pursued. The R&D programmes under the CoE initiative will be implemented in a manner that harmonizes and dovetails existing Government programmes. A management information system will be developed to reflect the 'Whole of Government' effort including funding through various R&D programmes on critical raw materials. This would help gauze the combined effort in the entire Government of India for R&D in critical minerals under the NCMM.

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Annexure-1

Usage of CRM and its current status in the country

No	Sector	Critical Raw Materials	National Status
1	**Aerospace / aeronautica**l	Ni, Ti, Co, V, Mo, Nb, Ta, W, Rh, Ge, Ga, RE (Nd, Pr, Sm), PGE (Pt, Pd), Li	Ti, RE available Nb, Ta >> just sufficient Rest >> not available/not produced
2	**Nuclear Reactors**	Zr, Nb, Be, B	All available
3	**Automotive (EV)**	RE Magnets (Nd,Pr), Sm, Gd	RE (Nd, Pr) , Sm & Gd available
4	**Energy storage** (rechargeable) Battery, Capacitor	Li, Ni, Co, Ta, Graphite Mn	Not available/not produced High purity graphite in infancy stage. tantalum capacitors >> in infancy state as sector Mn is available
5	**Energy Production** PV, Wind generation Fuel Cells, Thermo-electric Green H2 production	As, In, Te, Cd, Se RE oxides (Sm, Gd, Ce), PGE (Pt, Pd), Ni	Except for RE rest not produced or not available. Si, and As etc are used as photovoltaic multi junction materials RE oxides and PGE are used in fuel cells. Ni electrode in H2 production
6	**Electronics**	Ge, Ga, In, As, Te,Cd, REEs	Only some of the REs available
7	**Catalysts (petrochemical and Chemical)**	Mo, V, Ni, Co, RE (La, Ce), PGE (Pt, Pd, Ir, Rh)	Only La, Ce available
8	Metallurgical **alloying element** Steel & Nonferrous	Ni, Ti, Co, V, Mo, Nb, W, Zr, Sc, Be	Except Ti and Be, other alloying metals are not available
9	**Glass& Ceramics**	Li, potash, RE oxides, oxides of Ni, Co, Se oxides, Sn Zr, Y RE oxides Carbides and nitrides of Ta,Ti,Nb, V	Not available; most oxides are used in small quantities except silica, soda and lime which forms the basic glass.
10	**High Temp applications**	Refractory metals as in Mo, Nb, W, Zr, Ta	Nb, Zr available
11	**Cutting tools for manufacturing sector**	Mo, V, W for specialty steel making, and compounds of W,Ta, Ti, Nb, V	Advanced cutting tools made of carbo-nitrides and oxy-nitrides yet to take off.
12	**Fertilizer**	Potash	Significant quantities imported
13	**Pharmaceuticals**	Li, P, Potash, Se, Ti	Se, Ti available
14	**Pigments & Paints**	Ti, Se oxides oxides of Ni, Co, Se	Se, Ti available Rest used in small quantities
15	**Biomedical**	Ti, Zr; Co	Ti, Zr Available; Cobalt not available

Annexure-2

Grouping of Critical Minerals/Metals based on Sources of Raw Materials for Focused R&D

Set	Target Critical Raw Materials	Critical Raw Materials Sources
PRIMARY SOURCES (ORES AND BENEFICIATION PRODUCTS)		
1	**Co, Mo, Ni, Ti, V, PGE, Li** from Mn-ore	Ferrous ores (Iron, Manganese, Chromite, Vandiferrous, lateritic Ni, etc.)
2	**Cd, Co**, **Ga Li, In, Mo**, **Ni, Re, REE**, **Se, Te, Ti, V, Zr**	Non-ferrous ores (Base Metal Circuits of Al, Cu, Pb, Zn Sn) and Zircon and Illemenite
3	**K, P, REE**	Fertilizer Minerals (Phosphorites, Glauconite, Potash Salt)
4	**REE, V, W**	Graphite ore, Celestite (Sr)
5	**Be,Li, Nb**, **Sn,** , **Ta, Ti, V, W**	Lithium, Tin, columbite/tantalite, WO3 concentrate, Para tungstate, Tungsten & Gold ores
6	**PGE, Co**, **Ni**	PGE ores
7	**Nb, Ta, REE, Zr**	REE ores
8	**Different critical minerals/ metals**	Other ores except atomic minerals
9	**Co, Mo, Ni, REE, Ti**	Polly-metallic nodules and other offshore minerals
SECONDARY SOURCES		
10	Above critical metals	Mine Rejects/old mine dumps
11	**Be, Cd**, **Co**, **Ga, In, K, Li, Mo, Ni, Nb**, **P, PGE, Re, REE, Se, Sn**, **Ta, Te, Ti, V, W, Zr**	Beneficiation tailings of base metal, graphite, rock phosphate etc. (generated by physical separation processes of different ores) and process residues of alumina refinery and gold**.**
12	**Cd, Co, Ga, Mo**, **Nb, Ni, Re, `REE, Se, Ta, Te, Ti, V**	Slag (Smelter slag of copper, Lead & Zinc and tin, slag of iron & steel industry and Ferro-alloys)
13	**Cd, Co, Ga, Li, Mo, Ni, Re, REE, Se, Te, Ti, V, W, Zr,**	Sludge [Sludge of Cu-Pb-Zn refining, manganese di-oxide etc.]
14	**Cd, Co, In, Mo, Ni, PGE, Se, Sn, Te,Ti**	Anode slimes formed during electro-refining of metals
15	**Ni, V, PGM, REE**	Flue dusts from pyro-metallurgical processes viz. smelters, rotary kilns, thermal plants etc.
16	**Co, Ga, Li, Ni, REE, Ti, V,**	Fly Ash/Pond Ash from Power plants
TERTIARY SOURCES		
17	**Co, Mo, Nb, Ni**, **Ta, V, W** / **Co, Ni, REE, Ti, Sn**	**Metallic Scrap:-** Ferrous metals / Non-ferrous metals and alloys
18	**Li, Cd, Co**, **Mo, Ni,**	Used Batteries (Ni-Cd, , Ni-MH, Li-Ion, Co, Cu, Pb-Acid & graphite batteries)
19	**Ni, PGE, Mo, Ti, V**	Spent Catalysts
20	**Cd, Ga, In, Li, Ni, REE, PGM**, **Sn, Ta**	electronic waste (e-waste) including EOL solar PV, panels
Process supportive technologies		
21	**All**	Reductants (Ca, Na, Mg) are won by electrolysis and Chemicals/additives. Salts of chlorides, fluorides and sulphates are the starting point

Annexure-3

PROFORMA FOR SUBMISSION OF PROPOSALS BY THE PROSPECTIVE R&D INSTITUTIONS / ACADEMIA FOR RECOGNITION AS A CENTRE OF EXCELLENCE FOR R&D IN CRITICAL RAW MATERIALS

PART-I: GENERAL INFORMATION

A. Detail of Institutional/Organizational Profile of applicant for CoE (Hub):

1. Name of the R&D institutions/ Academia (Hub):
2. Type and status (R&D Institution/Academia):
3. Address, contact details, and website:
4. Year of establishment:
5. Sources of funding for the institutions/ Academia:
6. Governing structure:
7. Financial pattern of the R&D institution/ academia:

B. Details of Collaborative Partners (Industry and R&D institute/Academia):

1. Proposed CoE will bring in at least two industry partners and at least two academic partners:
    a. Names and details of two industry (spoke) collaborating with applicant (Hub):
    b. Names and details of two R&D institute/academic (spoke) collaborating with applicant (Hub):
2. Nature of collaboration (MoU, Research Partnership, Industry-Academia Linkage):
3. Roles and responsibilities of each Collaborative Partners:

PART-II: DETAILS OF EXISTING MANPOWER: [To be provided by the applicant for CoE (Hub) and R&D Institute/Academic (Spokes)]

1. Profiles of scientists, key researchers and faculty highlighting their expertise, research contributions and professional experience in critical minerals.
2. Profile of Specialists in laboratory analysis, pilot-scale experimentation, process optimization, detailing their specialized skills and roles in advancing critical mineral research.
3. Profile of experts in process design, scale-up strategies and technological innovations for beneficiation and extraction.
4. Details of Administrative and support staff including regular and contractual personnel responsible for facilitating research operations, project management and institutional coordination to ensure the effective functioning of the CoE.

PART-III: DETAILS OF INFRASTRUCTURE: [To be provided by the applicant for CoE (Hub) and R&D Institute/Academic (Spokes)]

1. Total land area of the R&D institute/academia, including campus layout, dedicated research zones and facility expansion potential.

2. Detailed overview of laboratory spaces, specialized research units, high-end instrumentation and pilot-scale setups supporting advanced studies in critical minerals and process technologies.
3. Status of registration with national research platforms such as FIST and iSTEM, reflecting institutional recognition, funding access and integration with technological advancements in critical minerals and related fields.

PART-IV: STATUS OF RESEARCH: [To be provided by the applicant for CoE (Hub) and R&D Institute/Academic (Spokes)]

1. Details of research papers published in Scopus and ABDC-listed journals in critical minerals and allied area viz. material science, geology, mining, metallurgy, etc. in last 3 years.
2. Details of patents filed and granted in Critical Mineral and allied area
3. Numbers of pilot scale project/ scale of operationalization and vision statement for commercialization of developed technology related to Critical Mineral and allied area.
4. Numbers of already developed technology for commercialization & Industry Adoption Plans.
5. Existing strength in technology transfer for critical minerals and allied areas (Material science, geology, mining, metallurgy)
6. Vision statement on technological advancements and contributions, collaborations with institutes (including foreign institutes)/industries and actual use of research into industries related to critical minerals and allied area.

PART-V: STATUS OF TECHNOLOGY DEVELOPMENT AND TECHNICAL DETAILS: [To be provided by the applicant for CoE (Hub) and R&D Institute/Academic (Spokes)]

1. Details of developed flow sheets for Technology Readiness Level (TRL) 3 to 4 or more for the extraction or beneficiation in the mining sector:
2. Details of Section 8 company, if set up, to develop commercially feasible solutions for the research and technology developed by institute, including in the field of mining, geology, metallurgy, material science and allied sectors
3. Details of ongoing and completed Research Projects funded by various funding agencies of Govt. of India/ others:
4. Details and Revenue earned out of ongoing and completed Research Projects:
5. Details of existing core competence for critical minerals & metals:
6. Details of Collaborative work with foreign institute/industry partners and their outcome:
7. Number of research projects being handled at present:
8. Number of research projects successfully commissioned and advanced to a higher TRL level:

PART-VI: OTHER ACHIEVEMENTS DETAILS: [To be provided by the applicant for CoE (Hub) and R&D Institute/Academic (Spokes)]

1. Skill Development and Training Programs:
2. Key achievements of the applicant during last 10 years:

PART-VII: DETAILS OF THE COLLABORATIVE INDUSTRY PARTNERS: [To be provided by the applicant for at least two industry (Spokes)]

1. Details of revenue, including annual turnover and funding sources.
2. Describe the team, including technical & business expertise and mentors.
3. Outline the commercialization strategy, detailing utilization of technology to create a product/service, its positioning & value addition for the intended customers, plan for-go-to-market, challenges executed.
4. Explain the potential impact, including environmental sustainability, market size, customer demographic & the technology's effect on these.

PART-VIII: PROPOSED SET/ GROUP OF SETS FOR ESTABLISHMENT OF CENRE OF EXCELLENCE (CoE)

1. Proposed sets for recognition of CoE (as per Annexure-II of CRM):
2. Details of targeted critical metals and sources of Critical Raw Materials:
3. Relevance and significance achievements in the proposed sets for centre of excellence:
4. Objectives and expected outcomes in the targeted Critical Raw Materials sector:

PART-IX

1. Any additional information about the organisation for consideration of the PEMC for setting up of the CoE at organisation/applicant.

(A separate page may be given if information is large)

(Signature)
Director of the Hub Institute

Annexure-4

EVALUATION CRITERIA / MARKING SCHEME FOR RECOGNITION AS A CENTRE OF EXCELLENCE FOR R&D IN CRITICAL RAW MATERIALS

A. Evaluation of the proposed CoE (Hub):

(The weightage of Hub will be 80%.)

Criteria	Marks	Details
Manpower	15	• Profile including experience of scientists, researchers, faculty, specialists and experts working in the institute in the field of critical minerals and allied area viz. material science, geology, mining, metallurgy, etc.
Infrastructure	15	• Status of infrastructure, including total land area of the institute and laboratory, equipments, high-end instrumentation, pilot-scale plants, etc. being utilized in the field of critical minerals and allied area viz. material science, geology, mining, metallurgy, etc.
Status of Research	25	• Status of published research works, patents, pilot scale projects in the field of critical minerals and allied area viz. material science, geology, mining, metallurgy, etc. • Vision of the institute about the direction of research in the country in the field of critical raw materials.
Status of Technology Development	25	• Status of developed technology including technology transfer, commercialization, etc. in the field of critical minerals and allied area viz. material science, geology, mining, metallurgy, etc. • A Section 8 company set up to develop commercially feasible solutions for the research and technology developed by institute, including in the field of mining, geology, metallurgy, material science and allied sectors • Vision of the institute for technology development in India to make the country self-reliant in critical raw materials.

B. Evaluation of the two industry (spokes) collaborating with the applicant CoE:

{The weightage of industry spoke will be 5% each (5 marks x 2 = 10 marks)}

For industry-1 (spoke):

Criteria	Marks	Details
Revenue	1	**Revenue In Cr** | >100 | < 100 Marks | **1** | **Nil**
Team	1	Technical & business expertise (in mineral industry preferred), mentors
Commercialization Strategy	2	Utilization of technology to create a product/service, its positioning & value addition for the intended customers, plan for-go-to-market, challenges executed
Potential Impact	1	Environmental sustainability, Market size, customer demographic & the technology's effect on these

For industry-2 (spoke): Same criteria as Industry-1 (spoke)

Note: If the number of proposed industry Spokes is more than two, then all the proposed Spokes will be evaluated and the best two scores will only be taken.

C. <u>Evaluation of the two R&D institute/ academia (Spokes) collaborating with applicant CoE:</u>
{The weightage of R&D institute/ academia Spoke will be 5% each (5 marks x 2 = 10 marks)}

<u>For R&D institute/ academia -1 (Spoke)</u>:

Criteria	Marks	Details
Manpower	1	Profile including experience of scientists, researchers, faculty, specialists and experts working in the institute in the field of critical minerals and allied area viz. material science, geology, mining, metallurgy, etc.
Infrastructure	1	Status of infrastructure, including total land area of the institute and laboratory, equipments, high-end instrumentation, pilot-scale plants, etc. being utilized in the field of critical minerals and allied area viz. material science, geology, mining, metallurgy, etc.
Status of Research	1.5	Status of published research works, patents, pilot scale projects in the field of critical minerals and allied area viz. material science, geology, mining, metallurgy, etc.
Status of Technology Development	1.5	Status of developed technology including technology transfer, commercialization, etc. in the field of critical minerals and allied area viz. material science, geology, mining, metallurgy, etc.

<u>For R&D institute/ academia -2 (Spoke)</u>: Same criteria as R&D institute/ academia-1 (spoke)

Note: If the number of proposed R&D institute/ academia Spokes is more than two, then all the proposed Spokes will be evaluated and the best two scores will only be taken.