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NITI Aayog

EUROPEAN UNION

Strategy on Resource Efficiency

November 2017

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Foreword

Resource Efficiency is a key element of sustainable development. The Sustainable Development Goals (SDGs) have assigned an important position to resource efficiency. This is directly reflected in SDG Goal 12: Ensure Responsible Consumption and Production Patterns. Eight other goals (2, 6, 7, 8, 9, 11, 14 and 15) also relate to resource efficiency and circular economy.

There is a global commitment to achieving resource efficiency in order to establish sustainable consumption and production patterns. It is also a priority for the Government of India, and is reflected in various policies/programme announcements like Make in India, Zero Effect-Zero Defect Scheme, Smart Cities, Swacch Bharat, and Ganga Rejuvenation Mission.

In accordance with this commitment of the Government, NITI Aayog along with EU Delegation to India had prepared a Draft Strategy paper on Resource Efficiency. The draft document has been revised based on the comments received in the stakeholder meeting held on July 21, 2017 and comments received from public. These inputs were of great significance to the context and relevance of preparing a strategy for resource efficiency for abiotic materials in selected sectors in the first phase. It has inter-alia recommended an action plan with recommendations in thematic areas of promotion and regulation for achieving the goals of resource efficiency and sustainable development. It also defines the role of NITI Aayog as a facilitator and MoEFCC as a leading line Ministry who will drive the resource efficiency and circular economy discourse in India.

I am happy to note that proposed plan of action for implementation of the Strategy on Resource Efficiency (core and medium term) will receive due support of the European Union (EU) funded Resource Efficiency Initiative (EU-REI) led by GIZ in the consortium with TERI, CII and Adelphi.

I look forward to the successful rollout of this strategy as laid down in the paper. Shri. B.N. Satpathy, Senior Consultant, MeitY, assigned in my office and Shri. Suneet Mohan, Young Professional, NITI Aayog along with the team from EU Delegation to India will coordinate the implementation work related to this Strategy.

Ratan P. Watal
Principal Advisor
NITI Aayog
Government of India

Table of Contents

1. Introduction and Objectives of the Strategy Paper

The focus of this paper is to recommend a broad strategy for enhancing resource-use efficiency in the Indian economy and industry, and highlight the key elements of the strategy. Over the last two decades, India has experienced dynamic transformation with rapid economic growth, expanding industrial and service related production, rise in average income, a thriving middle class, rapid urbanisation and a growing population. These changes have been underpinned by increased scale and intensity of resource use leading to manifold increase in demand for natural resources, especially materials. Thus, concerns over resource depletion and constraints manifesting in resource supply constraints, price shocks and rapid degradation of natural resource base have become more pronounced. These have larger economic, social, political and environmental consequences. Notably, resource extraction, utilisation and disposal also typically impose significant environmental burdens, many of which, particularly climate change, are becoming acute progressively and are being borne disproportionately by the poor and vulnerable. Therefore, judicious use of resources through a combination of conservation and efficiency measures for economic, social and environmental sustainability is in every society's interest.

In an increasingly resource constrained world, the challenge for a developing country like India is to find a balance between developmental needs and minimising the negative impacts associated with resource use. While developed countries need to reduce their overall resource footprint gradually, a rapidly developing country like India will need to *increase* its overall resource consumption in the short-to-medium term in order to meet its developmental goals. Therefore, efficient use of resources is essential for India in order to achieve sustainable development and is an unavoidable policy priority.

While targeted policies, such as those that promote waste recycling, have been around for some time in most countries, including India, many governments are now moving towards more comprehensive strategies on Resource Efficiency (RE). The Government of India has established the **Indian Resource Panel (InRP)** — an advisory body under the Ministry of Environment, Forest and Climate Change (MoEFCC) — through the support of Indo-German bilateral cooperation, to assess resource-related issues facing India and advice the government on a comprehensive strategy for RE. This strategy paper is developed with the recommendations from the InRP and its goal is to outline the rationale and key recommendations for a RE strategy that can be adopted by the GoI. Due to the global inter-linkages of many resources, some aspects of this strategy can also serve as points for potential collaboration with the G20 and other relevant international platforms including World Resources Forum and World Circular Economy Forum.

Although enhancing resource efficiency has been recognized as a solution for several decades, the economy wide impacts, at scale, are yet to be established beyond niches. There are however a few examples globally where such a strategy is being followed as a critical element of development policy. Amongst the pioneers are countries in the European Union, Japan as well as, recently, China. The experiences of these countries suggest that resource efficiency has to be mainstreamed in the overall development policy. The EU for instance has adopted a Circular Economy package in 2015 and China adopted a Circular Economy Promotion Law in 2009. The lesson from these examples demonstrate that an enabling policy framework is necessary for mainstreaming RE across sectors through all stages of the life-cycle.

The 2015 Sustainable Development Goals (SDGs) also recognize the potential of resource efficiency in resolving the short-term trade-offs between growth and environmental sustainability towards enhancing the overall security of human beings.

Resource Selection

Currently the extraction and consumption of natural resources is not only an ecological challenge but also an economic and social issue. **The usage of natural resources especially raw materials in the entire value chain - from extraction to end-of-life - leads to environmental threats like GHG emission, pollutants in various media viz. air, water and soil, and risks to ecology and biodiversity.** The Indian Resource Panel (InRP), through an overarching framework on resource efficiency, strives to decouple economic growth as far as possible from resource use, reduce burden on the environment and strengthen the sustainability and competitiveness of the Indian economy.

The focus of the outputs from the InRP is on abiotic resources that are not used for energy production (ores, industrial minerals, construction minerals) to be supplemented by the material use of biotic resources in future. The use of raw materials is connected to the use of other natural resources such as water, air, land, etc., but is not a part of this document since the prevention strategies associated with such natural resource use is already a part of other processes, it is currently not a focus of the InRP. It may be considered in the future work of the Indian Resource Panel.

Raw material is defined as a substance or a mixture of substances which have not been subject to any treatment besides its detachment from its source. It is gathered because of its utility value and directly consumed or used in the production process (UBA, 2012).

Consequently, the word, "material" can be understood as any substance or mixture of substances that is used in the economy as a raw material, a semi-finished material, a finished product, or a waste (IGEP, 2013).

An analysis was conducted to prioritize materials based on the following parameters:

1. Economic importance of the material based on its usage across different sectors
2. Environmental impact due to extraction and production
3. Embodied energy
4. Supply risks determined through:
    a. Limited geological availability and criticality
    b. High import dependency for critical resources
    c. Geopolitical constraints

Prioritisation of Objectives

The focus of RE strategy in the first phase will be on abiotic material resources, excluding fossil fuels, of two strategic sectors – construction and mobility. These sectors have witnessed high growth rate, are biggest consumers of materials, and contribute significantly to GDP and employment in the country. In medium to long term, the focus of the RE Strategy will be broadened to include biotic resources like water and land; other sectors like agriculture and electronics; more materials like plastics, photovoltaics; and finally encompassing the breadth of resources in the country.

2. Definition of Resource Efficiency and Indicators

In the context of this strategy paper, it is necessary to define the term resource efficiency more precisely:

Resource efficiency or resource productivity, is the ratio between a given benefit or result and the natural resource use required for it.[1]

While the term "resource efficiency" is predominantly used in business, product or material context, "resource productivity" as a term is used in an economy-wide, national context.

While indicators for measuring resource productivity exists, those for measuring resource efficiency need to be developed at the national level. As different countries follow diverse approaches based on their national goals and strategies for RE, a single universally applicable indicator does not exist. As a first step, India can follow the international accounting methods, particularly the conventions of SEEA[2] (UN et al., 2014), in order to measure Domestic Extraction, Imports and Exports as well as derived indicators such as Direct Material Input (DMI) and Domestic Material Consumption (DMC). In the initial phase, like UNEP and other countries, it can use **GDP per DMC** for measuring RE. India has the potential to improve the measurements of wastes in different material streams along with recycling rates as these form central components of resource efficiency programmes on an international level. The indicators, thus developed, must be coherent and consistent with sustainable development goals and circular economy monitoring framework.

Resource efficiency is closely linked to the concept of *"circular economy"*, which has also gained prominence as a policy goal for sustainable development in recent years. Circular economy implies reusing waste back into the production cycle to produce new products and uses instead of wasting such materials with embedded resources. Therefore, steps to achieve a circular economy are an important part of resource efficiency; however, resource efficiency encompasses a wider range of strategies through the entire life-cycle of products: Mining/Extraction → Design → Manufacturing/Production → Use/Consumption → Disposal/Recovery.

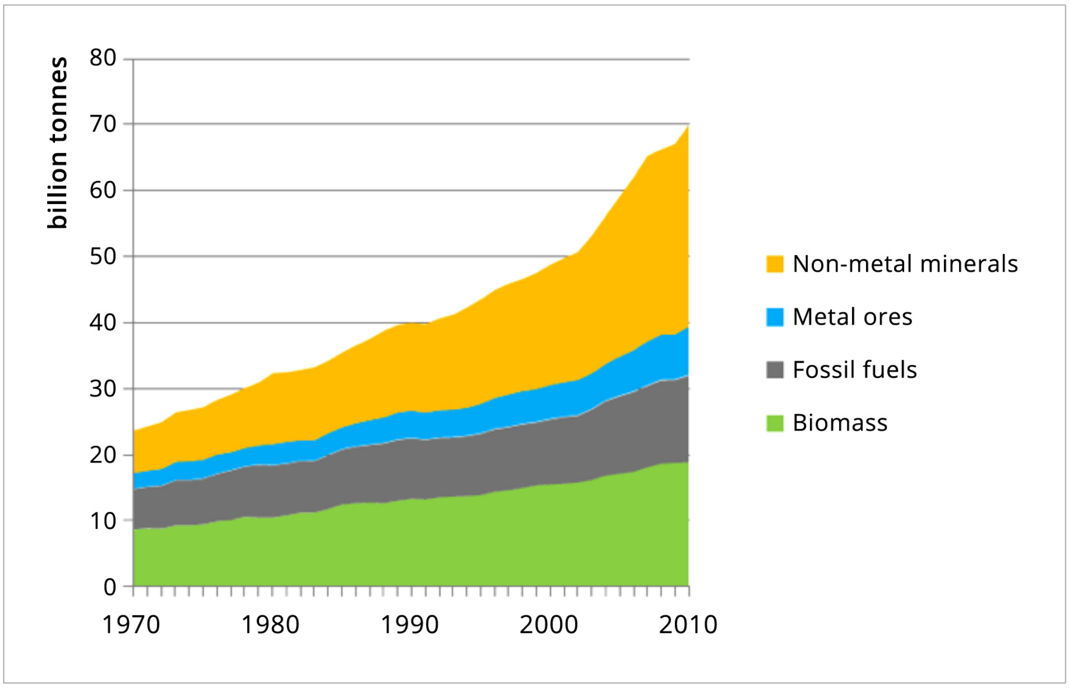
[1] Adapted from: German Federal Environment Agency (UBA, 2012): Glossar zum Ressourcenschutz.

[2] System of Environmental Economic Accounting.

3. Global Context

World-wide, the use of natural resources has been growing remarkably over the last several decades; the extraction of primary materials increased by a factor of three from 24 billion tonnes in 1970 to 70 billion tonnes in 2010 (UNEP, 2016). The extraction of both biomass and fossil fuels has doubled, while extraction of metal ores has tripled and the extraction of non-metal minerals has nearly quadrupled during the period (Figure 1). Regionally, the highest increase can be found in Asia, where the extraction of primary materials more than quintupled in just 40 years, particularly after 1990.

Figure 1: Resource extraction by material category world-wide, 1970-2010



(Source: UNEP, 2016)

Growth in extraction was such that per capita global material use increased from 7 tonnes per capita in 1970 to 10 tonnes per capita in 2010 (UNEP, 2016). This indicates the improvements in the material standard of living in many parts of the world. Domestic extraction of materials has increased all over the world; however this increase happened in varying proportions in different regions. It can be observed that particularly densely populated regions in Europe and Asia have large and increasing net imports of materials, especially fossil fuels and metal ores, as compared to the other regions of the world.

Increasing demand for raw materials is usually linked to *price increases*, if the production cannot increase simultaneously. In the years before the 2008 global financial crisis, prices of several raw materials, including petroleum, showed remarkable increases. Although resource prices have decreased in recent years as growth decelerated in many countries, it can be assumed that fluctuating demands in future will continue to create volatility in prices of raw materials. This is due to the trend of ongoing economic growth in the next decades pushed by the basic drivers of increasing consumption, growing middle class due to economic development and population growth (UNEP, 2016). Countries which are currently importing scarce raw materials will have to pay higher prices or accept constraints in supply of crucial raw materials.

Globally, resource use has been gaining increasing political attention during the last two decades among countries as well as supra-national institutions and organisations. At the global level, UNEP established the **International Resource Panel (IRP)** in 2007 as a central institution to provide independent scientific assessments on sustainable use of natural resources and their environmental impacts and policy approaches to promote decoupling economic growth from environmental degradation.

Several countries and supra-national institutions, particularly those who are net importers of raw materials, have reacted to this changing global situation by formulating policies in order to change their pattern of resource use. Examples are the European Union; Asian countries such as Japan, Korea, China; and Latin-American countries such as Mexico. The German Resource Efficiency Programme (ProgRess)[3], and the European Commission's Roadmap to a Resource Efficient Europe[4] can be regarded as the most prominent examples.

[3] BMUB. (2016). Overview of German Resource Efficiency Programme (ProgRess). German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. URL: http://www.bmub.bund.de/en/topics/economy-products-resources-tourism/resource-efficiency/germanresource-efficiency-programme/overview/

[4] European Commission. (2016). The Roadmap to a Resource Efficient Europe. European Commission. URL: http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm

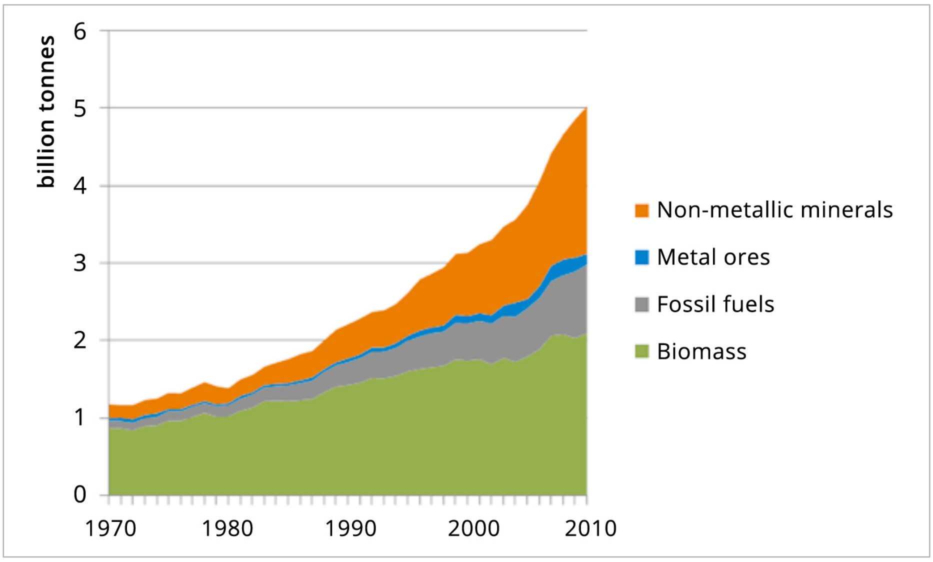
4. Indian Context of Resource Use

India is rich in primary materials. Currently, around 97% of all materials, including all abiotic and non-renewable materials consumed in India are extracted domestically. In India, extraction of primary raw materials increased by around 420% between 1970 and 2010 which is lower than the Asian average but higher than the world average. While extraction of biotic materials only increased by a factor of 2.4, extraction of abiotic materials, particularly of non-metallic minerals, show remarkable augmentation (see figure 2). Notably, extraction of non-metallic minerals, predominantly used for construction has grown, reflecting the demand of the construction sector during recent decades. The contribution of industry sector to the GDP between 1970 and 2010 also rose steadily from 23.62% to 28.27%. During the same period, contribution of manufacturing also increased from 12.74% to 16.17%; while for mining and quarrying it only increased from 2.20% to 2.30% (Planning Commission, 2014). In 2014-2015, the share for manufacturing was 17.1% with 3.3 % from metal products and 3.4% from machinery and equipment; construction sector contributed 8.8% to GDP, and mining and quarrying contributed 3% (National Accounts Statistics, 2016).

Compared to extraction, India's exports and imports are still small in terms of quantity. However, both have grown significantly. Exports continue to be dominated by metal ores, particularly iron and steel; while imports are dominated by energy-carriers, particularly petroleum and coal.

Increased extraction, imports and exports have resulted in an increase in material consumption in India. According to UNEP (2016), India consumed about 5 billion tonnes of materials in 2010, out of which about 42% are renewable biomass and 38% are non-metal minerals (figure 2). Thus, from a material perspective focusing on current situation, biomass and non-metal minerals are the most important material groups in India and domestic extraction is more important than trade.

Figure 2: Material consumption in India, 1970-2010

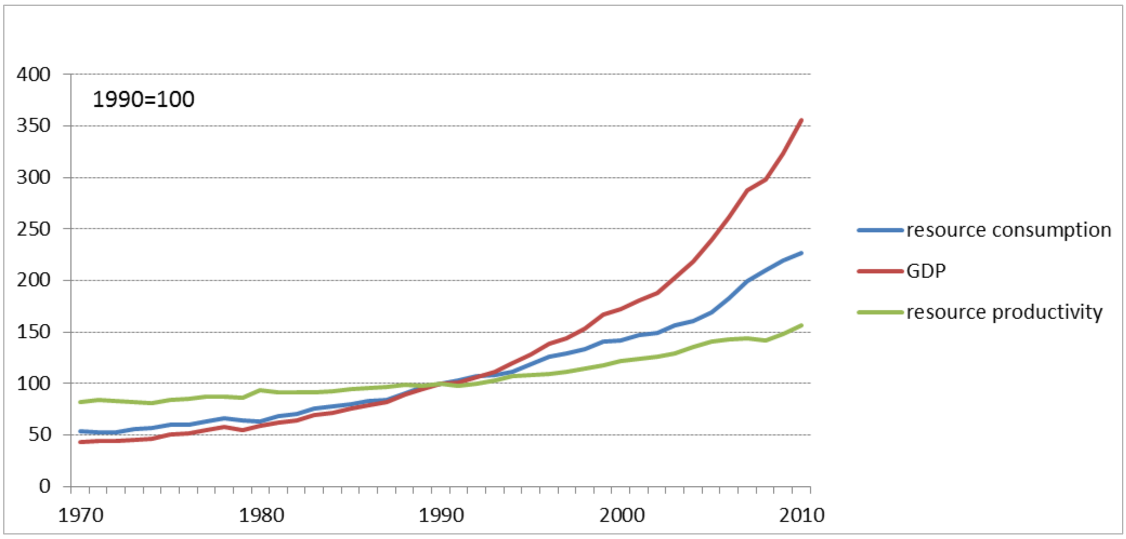


(Source: UNEP, 2016)

In 2010, India's material demand[5] was the third largest in the world, after China and the United States. India consumed about 7.2% of globally extracted raw materials in that year. In recent years, given its material consumption, the gap between India and United States has been shrinking progressively. Given the higher growth of economic activities, India could even overtake US in the not too distant future. Notably, despite high aggregate consumption levels, per capita consumption in India remains lower than the world average. The UNEP assessment (2016) demonstrates that it has increased from 2.1 tonnes per capita in 1970 to 4.2 tonnes per capita in 2010 – less than half of the world average. Until 2000, consumption was primarily biomass based; in 2010, the share of abiotic materials in consumption increased by nearly 58%. Biomass still has a high share in the material consumption with a steady increase in the abiotic materials consumption. Significantly, the assessment also notes that world-wide consumption is the strongest driver for growth in material use even when compared to population growth. Consumption patterns also remain highly differentiated in India, with an urgent need to reconcile the oversupply of resources and materials to the upper and middle classes and an undersupply along with severe lack of access of basic minimum resources for the poor.

In the following figure 3, resource consumption and resource productivity measured as GDP / DMC, is used to provide an overview of current trends in India. India has experienced a remarkable growth of GDP, resource consumption and resource productivity. Resource productivity increased slightly until around 1990 and faster during the last decade. However, resource productivity increases in India has lagged behind many other comparable countries (IGEP, 2013) which indicates much room for improvement.

Figure 3: Trends in Resource Consumption, GDP and Resource Productivity in India, 1970-2010



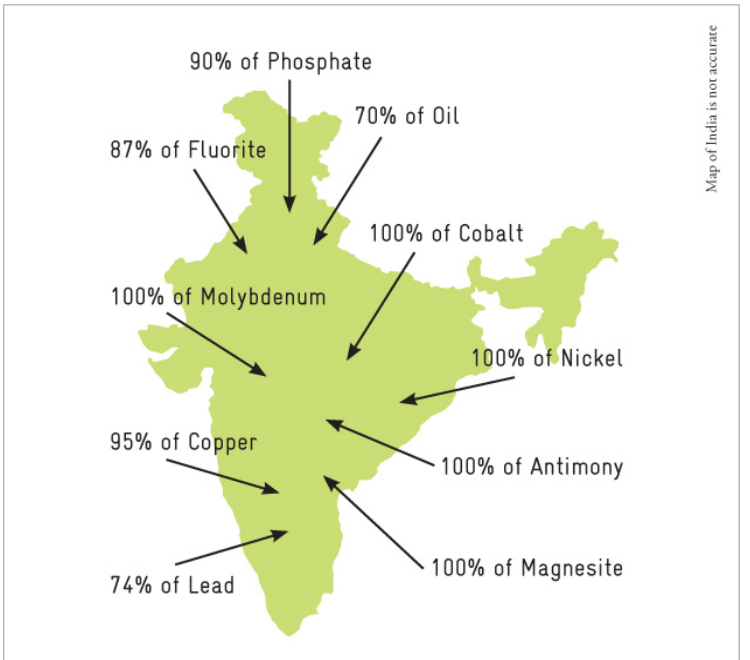
(Sources: DMC based on UNEP, 2016; GDP based on Government of India, 2016)

India is still predominantly fulfilling its resource demands domestically, and thus, is less affected by international price trends and scarcities than other import dependent countries.

[5] Measured in Domestic Material Consumption (DMC)

There is self-sufficiency in mineral raw materials for thermal power generation, iron & steel, ferro-alloys, aluminium, cement and different kinds of refractories. It is highly self-sufficient in mineral fuels for coal and lignite; in metallic minerals for bauxite, chromite, iron ore, rutile, etc. In 2016-2017, thirteen mineral rich states accounted for 96% of mining activity with mineral production of about 92.56% (Ministry of Mines, 2017). These states are Madhya Pradesh, Tamil Nadu, Jharkhand, Gujarat, Odisha, Chattisgarh, Karnataka, Maharasthra, Andhra Pradesh, West Bengal, Telangana, Goa, and Rajasthan. However, it does remain highly import dependent for certain critical materials such as molybdenum, copper, nickel (see figure 4). This may in future make India vulnerable to supply shocks.

Figure 4: Import dependencies of India



(Sources: Dittrich, 2012 and TERI, 2013, based on values from Indian Bureau of Mines, 2012)

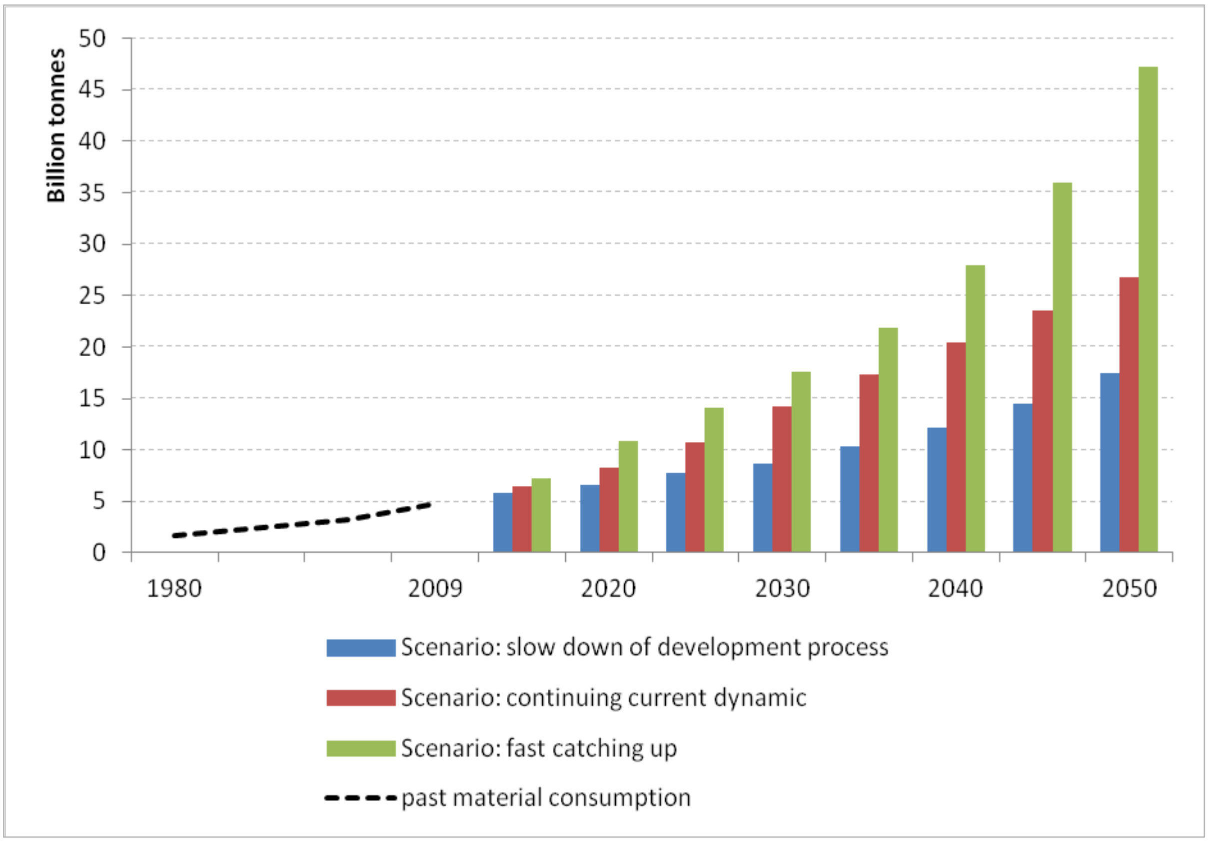
(Source: IGEP, 2013)

For India, the few projections available show that material demand will increase as its economy transitions towards greater shares of industrial and service sectors supported by a growing middle class. Thus, the question is not if material demand will grow, but the question is how fast and to what extent it will grow. IGEP (2013) study compared three different scenarios reflecting the impact of different development paces until 2050:

- **Slowdown of development process:** With, among other things, high population growth, stagnation/depletion of sources, no new technologies and low growth of production, decline in food consumption per capita (5% growth in GDP p.a.);
- **Continuing current dynamic:** With, among other things, medium population growth, new sources and technologies and a medium economic growth, stagnation in food and biomass consumption (8% growth in GDP p.a. until 2030, thereafter 5%);

- **Fast catching up:** With, among other things, low population growth, new sources and technologies and high GDP growth, medium increase in food and biomass consumption (12% growth in GDP p.a. as observed in China) until 2020.

Figure 5: India's past material demand and future projections until 2050



(Source: IGEP, 2013)

The medium scenario results in a per-capita consumption of about 9.6 tonnes in 2030 which is near the current global average. The total consumption for the medium scenario in 2030 is projected to be 14.2 billion tonnes consisting of about 2.7 billion tonnes of biomass, 6.5 billion tonnes of minerals, 4.2 billion tonnes of fossil fuels and 0.8 billion tonnes of metals (IGEP, 2013). This means that India would nearly triple its demand for primary materials compared to 2010, particularly the demand for energy carriers, metals and non-metal minerals.

India is meeting its material demand for resources predominantly domestically; thus, most of the impacts of material extraction, use and disposal occur domestically impacting a sizeable population negatively. If India triples its material demand within about 20 years, the question arises where do the required raw materials come from and what are the associated social, economic and environmental implications?

Tripling domestic resource extraction of biomass, minerals and fossil fuels will be linked to increasing pressure on natural resources such as land, forest, air and water. Mining activity, for example, has already led to large-scale destruction of forests, displacement of millions accompanied by loss of land and livelihood for many (CSE, 2008). Owing to deteriorating socio-environmental conditions, the opposition of tribals and other local communities against mining has increased during recent years. Thus, further significant increase of mining activity will lead to even more social and environmental conflicts than today.

Imports of materials also face severe constraints: import dependencies and costs for imports would increase. Moreover, 3.8 billion tonnes of fossil fuels or 4.6 billion tonnes of construction minerals annually would be further required. It would mean that India would have to import about 2/3rd of internationally traded fossil fuels or about 4.5 times more the amount of non-metal minerals in 2010 (IGEP, 2013).

5. Rationale for Resource Efficiency

Resource efficiency is a strategy to achieve the maximum possible benefit with least possible resource input. Fostering resource efficiency aims at governing and intensifying resource utilisation in a purposeful and effective way. Such judicious resource use brings about multiple benefits along the three dimensions of sustainable development - economic, social and environmental. Sustainable Development, by its very definition, must also take into consideration three critical aspects related to resource equity and access. Firstly, that all human beings, regardless of their location in the global socio-economic-environmental matrix, must have access to a minimum level of income and environmental quality for a dignified sustenance. Secondly, it also must ensure that the benefits, burdens and risks of resource use and conservation are equitably distributed in society. Thirdly, resource efficient production and consumption practices must take into account the needs of future generations by conserving access to resources.

Economic benefits: In 2009, India gained 716 dollars (in purchasing power parity and in constant 2005 terms) per tonne of used material while the global average was at 953 dollars (Dittrich, 2012; SERI, 2012; World Bank, 2012). In manufacturing sector alone Indian companies could save upto Rs. 60.8 billion in material savings by implementing resource efficiency measures (IGEP, 2013)[6] Thereby, it can be inferred that with increasing resource efficiency, GDP per tonne of material used will be increased.

RE has the potential to improve resource availability that is critical to the growth of industries, which translates into reduced price spikes due to supply constraints or disruptions. By using resources more efficiently, or by utilizing secondary resources, industries can improve competitiveness and profitability, since material cost is typically the largest cost for the manufacturing sector. RE-based innovations can also give industries an edge in the export market, as the experience of global leaders such as Germany and Japan has shown. Scientific mining can help increase recovery of primary and associated materials from mined ores. Thus, the stock of resources can be more effectively utilised. New industries can be created including those in the recycling sector, as well as in innovative design and manufacturing, and India can aspire to become a key innovation hub for RE (like it has for ITES). Finally, reduced import dependence for critical minerals helps to improve the country's trade balance and promote economic stability.

Social benefits: India's mineral rich areas are under dense forests and inhabited by indigenous communities. Extraction pressures have contributed significantly to conflicts due to displacement, loss of livelihood and have led to opposition by tribals and other local communities including fishermen in Andhra Pradesh. These social and political conflicts also pose significant threat to internal security. Mining of materials contributes to land degradation and loss due to open cast mining, excavation, stacking of waste dumps, discharge from workshops and construction of tailing ponds.

[6] This is based on the calculation of German companies that introduced incremental material efficiency measures and achieved material cost savings of around Euro 196,000. The assumption is that Indian and German manufacturing companies are on a comparative level in terms of deploying relevant technologies, the extrapolation of material savings have been taken from from German Material Efficiency Agency (DEMEA).

Reduced extraction pressures due to adoption of RE strategies have the potential to reduce conflict and displacement in mining areas, as well as improve health and welfare of local communities. RE can contribute to improved affordability of and access to resources critical for poverty reduction and human development. For example, the use of recycled aggregates and other secondary raw materials can help protect the soil by reducing impetus for land use conversion from agriculture to soil mining. RE has enormous potential for job creation, not only in the recycling sectors, but also high skilled jobs in innovative design and manufacturing. Finally, RE strategies contribute towards preserving resources for future generations.

Environmental benefits: Reduced extraction pressures due to adoption of RE strategies will help to reduce ecological degradation and pollution associated with mining. Mineral rich areas overlap with heavily forested areas in the country, for e.g. around 60% coal resources are located in forest. By 2025, area under extraction for coal mining would increase from 22,000 hectares to 73,000 hectares (Ministry of Coal, 2015). This would further increase pressures on the forest, pollution of water bodies and land degradation.

Reduced pressures from mining will provide further opportunities for undertaking landscape restoration and regeneration of degraded mined areas. Reduced waste generation will not only reduce pollution associated with disposal but also save related costs. Finally, resource extraction and use is highly energy intensive; and since our energy system is dominated by fossil fuels, it contributes to significant GHG emissions. Minerals industry contributes to around 32% GHG emissions of India. In 2007. CO_2 emissions were to the tune of 131 million tonnes from mineral industry, while the metal sector contributed about 122.7 million tonnes of $C0_2$ (Mazumdar, 2009). Furthermore, iron & steel, cement plants, sulfuric acid manufacturers, smelters of copper, zinc, lead ore, etc. are significant contributors of CO_2 and SO_x (Garg et al., 2002). Indeed, it is unlikely that global climate change mitigation goals can be met without a strong commitment to RE in extraction and manufacturing.

6. Congruence of RE Strategy with Government Obligations and Priorities

Not only does a RE strategy provide multi-dimensional benefits for sustainable development, judicious use of resources is an important part of several SDGs, most obviously Goal 12 (responsible consumption and production) and Goal 8 (decent work and economic growth), but also those related to sustainable cities and communities (Goal 11), industry, innovation and infrastructure (Goal 9), climate action (Goal 13) and affordable & clean energy (Goal 7). Further, an ambitious RE strategy has the potential to make a substantial contribution to India's Nationally Determined Contributions (NDC) commitments under the 2015 Paris Climate Change Agreement.

Further, it is important to recognize the implications of and potential for overlap of a RE strategy with several key policy priorities of the Government of India. With the government's goal of promoting India as a global manufacturing hub through its *Make in India* campaign and Zero Defect–Zero Effect scheme, the issue of using resources more efficiently and strategic planning for critical resources becomes extremely pertinent. The *Smart Cities* program envisages efficient urban infrastructure and the Housing for All mission has ambitious goals for affordable housing; both need judicious planning for resources to fulfil their aims. Waste and pollution reduction through adoption of RE approach can also contribute positively to the *Swachh Bharat* (Clean India) and Ganga Rejuvenation missions. Therefore, the rationale is overwhelming for India to adopt a comprehensive RE strategy as central to its developmental goals.

7. RE & SRM – Towards Achieving Vision 2030

Not only do Resource Efficiency (RE) and Secondary Raw Materials (SRM) offer a wide range of benefits with respect to broader developmental goals, they also provide synergies with several themes identified as priorities by Niti Aayog in the Vision 2030 document. These synergies are identified by themes below:

Theme 1: Accelerated Growth with Inclusion and Equity

- RE/SRM have the potential to **improve resource availability** that is critical for the growth of key industries. For example, "manufactured sand" is already a thriving enterprise in many parts of the country where natural sand is in short supply, helping the construction industry grow without disruption. However, reliance on rock quarrying for m-sand is not ideal and moving to secondary resources such as demolition waste should be the long term goal.
- RE/SRM can help to **reduce price spikes due to supply constraints** or disruptions. These not only affect businesses negatively but high costs also hurt consumers. For example, project completion delays are increasingly common in the construction industry due to supply bottlenecks for raw materials. To use the manufactured sand example again, it costs much lower than natural sand and thus keeps the concerned businesses competitive and its products affordable.
- India is almost completely import dependent for important minerals such as cobalt, nickel and copper (see Figure 4), leaving key industries extremely vulnerable. RE/SRM can help to **reduce import dependencies** of certain critical minerals and therefore protect related industries from unexpected external supply shocks as well as improve India's trade balance.
- RE/SRM can **improve competitiveness and profitability** of industries, especially material intensive manufacturing industries for which material cost is typically the largest cost factor. Innovative industries can become more profitable through RE/SRM measures and expand, while those that cannot may face increasing material costs and be forced to shut down.
- RE/SRM based innovations can not only increase the competitiveness of industries domestically but also give an edge to those industries in the **export market**. Export potential is attractive for both RE based products as well as RE based processes and technologies, as the experience of global leaders such as Germany and Japan has shown.
- RE/SRM based approaches can lead to **establishment of new industries**, especially in recycling, that can contribute significantly to economic growth. An excellent example is construction and demolition waste in India, which until recently was mostly discarded.

With the new government rules in 2016 requiring proper management and utilisation, new industries are taking shape across the country, recycling processed C&D waste into building products such as paving blocks, kerb stones, bricks, etc.

- A strong emphasis on RE/SRM will help to reduce the need for extracting virgin resources. Since extractive industries such as mining have often contributed to social conflicts and environmental degradation in India, reduced need for mining will indirectly **improve social and environmental outcomes**, especially in the vulnerable districts.

Theme 2: Employment Generation Strategies

- RE/SRM based approaches can lead to **establishment of new industries**, especially in recycling, that can contribute significantly to new employment generation. An excellent example is construction and demolition waste in India, which until recently was mostly discarded. With the new government rules in 2016 requiring proper management and utilisation, new industries are taking shape across the country, recycling processed C&D waste into building products such as paving blocks, kerb stones, bricks, etc., and creating thousands of jobs.
- RE/SRM based **innovation in design and manufacturing** has the potential to create highly **skilled jobs** that will not only benefit domestic industries but also create a potential export market. If India can create a reputation as a key innovation hub for RE (like it has for ITES), then global companies can locate efficient design and/or manufacturing here.
- With a broader push for green production and consumption that includes resource efficient products and services, there is a potential to create new **jobs in green product certification, eco-labeling, and green marketing**. As the experience with organic food shows, certified “green” products often have high commercial value including lucrative export market.
- Since most of recycling is done by the informal sector in India, often under poor labour and safety conditions, a strong governmental push for improving recycling economy-wide should result in the **upgradation of the informal sector** and its integration with the formal sector. This will result in significant improvement in labour, safety and environmental conditions, as well as wages and income. A good example is the electronic waste recycling sector where some innovative initiatives have taken place but need scaling up.

Theme 6: Swachh Bharat and Ganga Rejuvenation

- RE/SRM will lead to **reduced waste generation** which will contribute to cleaner cities and rivers/water bodies through reduced disposal and associated pollution.
- Reduced waste generation also means reduced pressure on landfills and **savings in waste disposal costs** by municipalities.

Theme 7: Energy Conservation and Efficiency

RE and reuse of secondary resources has enormous potential to **save energy** since efficient use and recycling almost always requires less energy than extracting and processing virgin resources. Therefore, economy-wide RE measures will have significant impact on energy efficiency as well.

Such energy savings also translate to **GHG emissions reduction** since most of our energy comes from fossil fuels; these reductions will significantly help India to meet the NDCs under the Paris Climate Agreement.

8. Existing Policy Context in India

In India, there are many existing policies influencing resource use at different life-cycle stages starting from mining to designing, followed by manufacturing, consumption and ultimately end-of-life management (disposal or recycling). However, their design, emphasis, integration or implementation is often sub-optimal in terms of achieving RE goals.

At the mining stage, the National Mineral Policy already includes zero-waste mining as a national goal and emphasizes the need to upgrade mining technology. In addition, there is a need to promote extraction of associated metals (Tin, Cobalt, Lithium, Germanium, Gallium, Indium, etc.) along with major metals like Copper, Lead and Zinc to enhance resource efficiency in the sector. Just as the Steel Policy aims to increase extraction rate from present 93.5% to 98%, there is a need to increase efficiency in extraction of other minerals to reduce mining and associated environmental impacts.

At the design stage, policies like the National Housing and Habitat Policy, 2007 and the Pradhan Mantri Awas Yojana (PMAY), 2015 emphasize on developing appropriate ecological design standards for building components, materials and construction methods and there is a need to introduce such components in other sector policies. The Department of Science and Technology, Ministry of Science and Technology, is promoting R&D related to waste management and there is a need to further enhance funding for RE and Secondary Raw Materials (SRM) related R&D. Further, there is a need to promote voluntary national standards, like Green Reporting Initiative and IS/ISO 14001:2015 to develop and strengthen design initiatives for improving resource efficiency and promoting use of secondary raw materials across sectors.

At the manufacturing stage, flagship programmes like "Make in India" that provide special assistance to energy efficient, water efficient and pollution control technologies through Technology Acquisition and Development Fund (TADF) can promote RE and SRM approaches as well. Industrial and sectoral policies can include promotion of industrial symbiosis (where waste from one industry is raw material for another), process efficiency programs and use of recycled materials in manufacturing.

While an eco-labelling scheme from MoEFCC is in place, its impact has been rather limited; there is a need to include provisions for preferential procurement of eco-labelled products through Green Procurement Policies. In addition, incentives should be provided through tax benefits for eco-labelled products to encourage consumers to purchase such products.

In case of end-of-life stage policies, while there are policies existing to tackle all types of waste ranging from hazardous waste to Municipal Solid Waste (MSW), Construction and Demolition (C&D) waste, plastic waste and e-waste, enforcement has been limited due to lack of support for business models that lead to better implementation. There is a need to mobilize funding or cost of treatment for waste through Extended Producer Responsibility (EPR) and Polluter Pays Principle. Also, there is a need for a unifying framework that brings together these different sources of secondary raw materials for effective closed-loop recycling. To effectively manage the dispersed waste steams there is also a need to involve the informal sector by providing them with technical capacity building and financial support.

Segregation of waste at appropriate place and time is an important factor towards ensuring the quality of secondary material recovered. In this regard, IS 16557:2016 provides guidance for managing solid waste management including segregation of waste that can aid quality resource recovery.

It is important that all the existing and new policies consider the impacts of resource extraction and use and address resource efficiency in their framework.

9. Components of the RE Strategy

This section highlights three major components that can form a RE strategy at national level, viz: assessing impact of RE measures to track progress, assessing material use and enhancing material efficiency. In the strategy at hand, the focus of two of the three components will be on two selected sectors, namely automotive and construction.

9.1 Component 1: Impact Assessment of RE Measures

9.1.1 Key Concepts and Indicators

Resource efficiency at the country level is usually measured with so-called material flow indicators. The methodological and conceptual framework is laid out in the SEEA (UN et al., 2014). Material flow indicators measure total material use or relevant components of material use of a country. Due to the large scale of its use, water is not included. Gaseous substances are taken into account only by a few countries.

The following raw material groups are distinguished:

- Biotic raw materials: food and animal feed, fibres, timber, etc.;
- Fossil resources: oil, gas, coal;
- Metallic raw materials;
- Non-metallic mineral raw materials: construction minerals, industry minerals.

Furthermore, the following material flow indicators are distinguished:

Extraction of raw materials
+ Imports
= **Domestic Material Input (DMI)**
– Exports
= **Domestic Material Consumption (DMC)**

If imported goods are measured in so-called Raw Material Equivalents **(RME)**, i.e. raw materials required to produce a good are included, material input is denoted as **Raw Material Input (RMI)**. If exports are also measured in RME, material consumption is denoted as **Raw Material Consumption (RMC)**. All indicators are measured in metric tonnes of raw materials.

Resource efficiency at a country level is measured by relating the material flow indicators mentioned above to the gross values added. In general, it is defined as:
Resource efficiency = GDP / Material flow indicator.

9.1.2 Applications of MFA and Derived Indicators

A number of countries are currently supporting approaches to increase resource efficiency. Here, resource efficiency usually refers to material use efficiency. Resource categories such as water or land area are addressed by countries' resource policies to differing extents. In general, the utilisation of other natural resources is a consequence of raw material use (and often times addressed by other policies), such that in the first step only raw material use is addressed.

In May 2016, the European Environment Agency (EEA) published updated country profiles of 32 European countries on their material efficiencies. The country profiles show that only three countries, Austria, Finland and Germany, and two regions, Flanders and Scotland, have adopted specific strategies to increase resource efficiency. The focus of most other countries is in the waste sector, where waste prevention and recycling of selected materials/waste fractions or the circular economy are promoted. Portugal and Belgium have also highlighted circular economy as a priority in their national and regional strategies. Waste management is the current focus of most countries outside Europe as well. For example, Japan, a raw material import-dependent country, promotes the so-called '3Rs: Reduce, Re-use, Recycle' not only within the country, but also in other Asian countries.

According to EEA (2016), nine European countries have currently quantified targets for economy-wide material efficiency. Most countries use the GDP / DMC indicator, which is regularly collected and published by Eurostat. One exception is Hungary which has set the goal of reducing material intensity. Material intensity measured as DMC / GDP is the inverse of material efficiency GDP / DMC.

A further exception is Germany which is the only country not using the consumption-based indicator DMC, but the production-based indicator DMI. Also, unlike other countries, Germany includes abiotic raw materials only in the DMI. The production-based raw material indicators are more ambitious in an export-oriented country such as Germany, since exports are fully included. At the same time, it is important, especially in countries that are heavily involved in international trade, to take account of the intermediate consumption of traded goods to avoid unwanted shifting effects. This aspect is considered in the recently updated version ProgRess II (March, 2016)[7] where $RMI_{abiotic\ and\ biotic}$ is used in addition to $DMI_{abiotic}$ as an indicator for overall raw material productivity of Germany.

Other countries, including the UK, Switzerland and Japan, monitor economy-wide material efficiency without combining it with a political objective. The indicator GDP per DMC (DMI) is criticised, particularly by countries that produce independent statistics on resource efficiency and actively develop them, since the DMI measures imports and exports in actual weight, thereby making it incompatible with the measurement of raw material extraction. This implies that the relocation of resource intensive industries to other countries is erroneously reported as an increase in resource productivity. The weakness can be circumvented by measuring imports and exports in raw material equivalents (RMEs). In contrast to the calculation of the DMC and DMI, the calculation of the RME is not yet harmonised internationally and is still in the development stage.

[7] German Resource Efficiency Programme II. Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). Available at: http://www.bmub.bund.de/en/topics/economy-products-resources-tourism/resource-efficiency/german-resource-efficiency-programme/progress-ii/

At present, Germany and Austria are the only countries that have included raw material equivalents in their goal definitions. Switzerland, UK, as well as France, are calculating RMEs of their international trade, partly using calculation approaches made available by Eurostat and, in some cases, independent approaches.

9.2 Component 2: Assessing Material Use in Selected Sectors

The automotive and construction sectors were selected for analysis due to their overall importance to the economy, quantum of resource consumption and high rate of growth.

The Indian automotive sector – comprising cars, 2 wheelers, and commercial vehicles – has enjoyed an annual growth rate of 14.4% over the past decade. Currently, it employs 13 million people (about 1% of India's population), directly and indirectly, and contributes nearly 7% to India's GDP. India's automotive production amounts to nearly 5% of world production, placing it 6th in the world (GIZ, 2015a). This is a key priority sector for the government, which has future plans to transform India into a regional export hub supplying to the Asia Pacific region.

The Indian construction sector has been growing at an average annual growth rate of 10% over the last decade, with its contribution to GDP increasing from INR 1.5 trillion in 2001-02 to INR 4 trillion in 2011-1212, equivalent to 8% of the nation's GDP. The construction sector forms the second largest segment in India's economy in terms of employment, after agriculture, providing employment to about 35 million people (Planning Commission, 2011). The housing stock in India has been increasing at a remarkable pace, from 250 million units in 2001 to 330 million units in 2011 (Census of India, 2011). However, given the strong demand drivers – population, urbanisation and income growth – the under supply of housing is becoming acute, especially in cities. The built up area in India is expected to increase exponentially; at current rates, about 70% of the buildings that will exist in 2030 are yet to be built (NRDC-ASCI, 2012).

Within the two sectors, a set of materials were shortlisted for assessment based on their importance to the sector, availability and supply risk, cost, and environmental impact including recyclability and substitutability. The selected list of materials in each sector are as follows:

Automotive Sector	Construction Sector
Iron and Steel	Iron and Steel
Copper	Sand
Aluminium	Soil
Zinc and Nickel	Stone (aggregates)
Plastics and Composites	Limestone

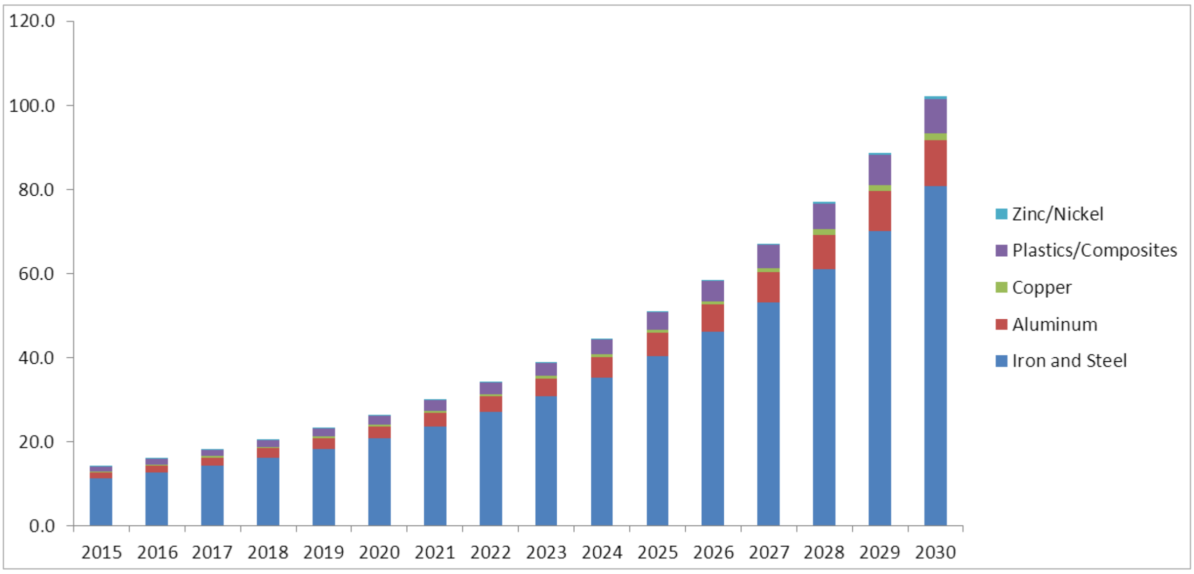
9.2.1 Automotive Sector

The automotive industry occupies a prominent place in the Indian industrial scenario with extensive forward and backward linkages, having grown at the rate of 14.4% over the past decade, making India the world's sixth largest producer of automotives in terms of volume and value (GIZ, 2015a). The industry consists of both automotive manufacturers and auto component manufacturers, and employs 13 million people contributing 7% to India's GDP. The country has been experiencing one of the highest motorisation growth rates in the world over the last decade. There were over 200 million motorised vehicles registered by 2015 (SIAM, 2015). Considering the increasing demand for mobility, the sector is expected to grow at an average of 7% for the next 20 years, and it will require significant amounts of natural resources and can face resource restraints in an economy that already has supply side constraints.

Analysing the direct and indirect raw material requirements in the Indian automotive sector and comparing them from 1997 and 2007, it was found that the material requirement of the sector doubled in a period of 10 years. If current growth trends continue, the total number of registered cars could exceed 100 million by 2030, with a concomitant rise in material requirements.

Estimates of the material requirements in the automotive sector in India, considering current use levels, reveal that if the current production trend continues over the next 15 years with no substantial resource use reduction and/or substitution, the total demand for six major raw materials, i.e. iron and steel, aluminium, copper, plastics/composites, zinc and nickel would increase from almost 14 million tonnes in 2015 to more than 102 million tonnes by 2030 (GIZ, 2016).

Figure 6: Projected raw material consumption in the auto sector, 2015–2030 (in million tonnes)



(Source: GIZ, 2016)

This translates into an urgent call to decouple the potential high growth rate of the automotive sector from increasing primary raw material use by promoting resource efficiency and use of secondary raw materials, thereby, enhancing sustainability and resource security.

Mining policies and framework need to put adequate emphasis on specific minerals to enhance efficiency in extraction including those that are important for the automotive sector. Increased use of secondary raw materials can also enhance the supply of raw materials. In order to increase the share of secondary raw materials in high-value products such as vehicles, the use of secondary raw materials should be encouraged and mainstreamed by the OEMs[8], which will also enable the various auto component manufacturers to use the same in the manufacturing of components. As per an estimate from the Society of Indian Automobile Manufacturers (SIAM, 2015), with efficient recycling, India can hope to recover by the year 2020 over 1.5 million tonnes of steel scrap, 0.18 million tonnes of aluminium scrap and 0.075 million tonnes each of recoverable plastic and rubber from scrapped vehicles.

There is also a need to encourage efficiency programmes and technologies during the manufacturing process. Some policies are already aiming at this purpose but there is still a need to establish synergy between OES[9] and OEMs, and some regulation ensuring fair amount of incentives to enhance the use of secondary raw materials and bring about process and resource use efficiency (GIZ, 2015a). During the consumption phase, predominantly fossil fuels are used by the vehicles for energy. The Indian government is already promoting concepts for reducing fuel usage to address urban air quality issues and climate change aspects. This policy path should be strengthened and expanded in future. The last stage of a vehicle's lifetime requires End-of-Life-Vehicle (ELV) management.

Currently, the retired vehicles in India usually end up in the unorganised sector where after dismantling, auto components are either refurbished or sent for recycling. Material recovery remains low as workers lack both training and appropriate equipment needed to dismantle and recycle auto components. While some professional dismantling facilities exist, these remain sporadically distributed throughout the country. This does not meet the requirements of auto component manufacturers (GIZ, 2015a). Efforts are also needed to establish a national ELV management system and a viable financial model for ELV disposal and recycling which needs to integrate consumers, collectors, recyclers and producers.

Besides the focus on raw materials required by vehicle manufacturing, the choice of modes of transportation has a very significant impact on resource use. Heavy reliance on private vehicles means much higher levels of resource requirements compared to reliance on public transportation. Thus, due to the dwindling resource availability, environmental destruction, and the challenges of climate change, developing a sustainable model of public transportation for the future is a matter of great significance and urgency.

9.2.2 Construction Sector

The Indian construction sector has been growing at an average annual growth rate of 10% over the last decade, with its contribution to GDP increasing from INR 1.5 trillion in 2001-02 to INR 4 trillion in 2011-12, equivalent to 8% of the nation's GDP. The construction sector forms the second largest segment in India's economy in terms of employment, after agriculture, providing employment to about 35 million people (Planning Commission, 2011).

[8] Original Equipment Manufacturer
[9] Original Equipment Supplier

The housing stock in India has been increasing at a remarkable pace, from 250 million units in 2001 to 330 million units in 2011 (Census of India, 2011). However, given the strong demand drivers – population, urbanisation and income growth – the under supply of housing is becoming acute, especially in cities. The built up area in India is expected to increase exponentially; at current rates, about 70% of the buildings that will exist in 2030 are yet to be built (NRDC-ASCI, 2012). Despite a temporary slowdown, it is expected that construction activity will soon increase again due to the creation of the Affordable Housing Mission, as well as increased investment in infrastructure such as roads and highways (Jain, 2016).

In India, the construction sector was the second largest sector with regard to material consumption in 2007, accounting for around 20% of all material demand. Further, the construction sector was the fastest growing sector with regard to increases in absolute material consumption: between 1997 and 2007, material consumption grew by more than 1 billion tonnes. If such growth rates continue, the construction sector will surpass the agricultural sector before 2020 and become the highest material consuming sector in India (Dittrich, 2012; IGEP, 2013). It is clear that the Indian construction industry is likely to face serious material supply problems if the predicted growth in demand continues. Supply bottlenecks are already starting to affect prices and construction schedules in some parts of the country. The construction sector is particularly vulnerable to price shocks, since material costs account for roughly 2/3rds of the total cost of a typical building.

The most important raw materials required in the construction sector are iron/steel, cement, sand, soil, and stones (aggregates). The construction industry is the biggest consumer of finished steel in India, accounting for 35% of total consumption in the financial year 2014-15 (IBEF, 2015). India is also a net importer of finished steel. Steel has good recyclability due to it physical characteristics as a metal. Annual metal scrap consumption in India has been estimated to be about 20 million tonnes by the Metal Recycling Association of India (MRAI) (Sally, 2016). However, the recycling industry is dominated by the informal sector which limits its effectiveness. As a result, scrap imports are increasingly important to the industry, which currently imports about 1/3 of its scrap demand (Sally, 2016), with steel scrap imports alone amounting to 5 million tonnes in 2013-14 (Tewari, 2014). The government could support increased recycling of steel by providing clear guidelines on certification and support homogenous collection.

The Indian cement industry is the second largest cement producer in the world, which has been due to the exponential growth both in the infrastructure and the building construction sectors. India nearly quadrupled its cement production between 1996 and 2010. In India, per capita consumption of cement is still low relative to developed countries at less than 200 kg per person, but at current growth rates, Indian cement production may increase 4-7 times by 2050 (WBCSD & IEA, 2013). Rising demand calls for enhancing resource efficiency in the production processes. Cement is estimated to be the third largest coal consumer in the country after the power and steel industries; coal is required for both electrical and thermal energy in cement plants. Thus, given the high manufacturing costs for energy use alone, the industry has over the past decades made considerable efforts to improve efficiency in technology and continuous up-gradation of technology and innovation in design and material use. But there is still high potential for further improvement. The cement industry also contributes 7% of India's CO_2 emissions (WBCSD & IEA, 2013).

The main raw materials that are used in the production of cement are limestone, gypsum and sand. Cement companies are already facing dwindling reserves for limestone and import dependencies for gypsum. Mineable limestone reserves are expected to be depleted by 2060 (MoCI, 2011). It has become increasingly important to identify non-limestone bearing raw materials and binders as substitutes. The government has already encouraged the utilisation of fly ash, slag and red mud in concrete as substitute for other binders. There is still a lot of potential for RE during the manufacturing phase of construction.

Sand is a resource in high demand from the construction sector; an estimated 1.4 billion tonnes of sand will be required by 2020, compared to 630 million tonnes in 2010 (ABI, 2013). Due to low investments and high returns, sand mining is dominated by small actors with a high incidence of illegal mining. Some reports have indicated an amount of INR 10 billion (USD 150 million) being generated from illegal extraction of sand in India in 2011 (CSE, 2012). Due to environmental bans and restrictions, supply and consequently prices of sand have been affected in many parts of the country, affecting the construction industry negatively. In response, manufactured sand (m-sand) has become a thriving industry in some parts of the country; however, virgin granite resources are used as feedstock in the process which is undesirable in the long run. The MoEFCC has recently published the Draft Sustainable Sand Management Guidelines (MoEFCC, 2015), but its implementation nationwide remains a challenge.

Soil is primarily used by the brick kiln industry for production of clay bricks, and also for road construction as base material. Since soil mining is dominated by the unorganised sector, unchecked mining is rampant, negatively affecting agricultural productivity in areas with significant brick production. It is estimated that about 840 million tonnes of soil is extracted every year for brick production denuding 0.17 million km^2 of land (CPCB, 2015). Brick kilns are also important sources of air pollution and CO_2 emissions. The Government of India mandated the use of fly ash in building materials for construction projects falling within a 100 km radius of coal or lignite based thermal power plants in 1999. The subsequent amendments to this notification directed builders to use at least 25% of fly ash in clay bricks and 50% of fly ash by weight in fly ash bricks, blocks, etc. Currently about 12% of total fly ash generated in India is used for the production of bricks and tiles (CEA, 2015), but more substitutes for conventional clay bricks are needed.

Stone aggregates are used by the construction industry for making concrete and road laying. The construction industry prefers igneous rocks like granite and basalt to be used as aggregates due to their durability. With the growing popularity of m-sand, granite already has an emerging competing use. Basalt is mainly used by the railways. Material flow analysis suggests that the total demand of stone for concrete and road making is about 1.1 billion tonnes per annum of which about 99% goes for concrete making. In the foreseeable future, the demand for coarse aggregates is expected to soar as concrete will remain the mainstay of construction. It is estimated that the construction industry will have a demand of more than 2 billion tonnes of coarse aggregates by 2020 (ABI, 2013). Apart from concrete, the demand for coarse aggregate required as road base material will also increase in view of the recent commitment of the Indian government to build 30 km of roads per day. Stone quarrying and crushing are associated with noise and dust pollution, frequently leading to conflict with local communities. As urban areas expand, stone quarries at their peripheries are frequently closed down, leading to significant increase in transportation distances for the construction industry.

The recovery of construction and demolition (C&D) waste is a promising approach for RE in the construction sector. Compared to metals, recycled C&D waste cannot always be used for the same products due to quality losses but its accumulated amount bears a lot of potential for other construction applications. At the end of the product life-cycle, concrete can be recycled back into concrete production as a recycled aggregate or into the application of other non-load bearing construction material. The same holds for e.g. brick walls which can be recycled to aggregates and sand which is already scarce in many regions in India. In recent developments, the Construction and Demolition Waste Management Rules notified by MoEFCC in 2016 are a step in the right direction but capacity development at the local level is essential to bring about widespread recycling of C&D waste.

9.3 Component 3: Enhance Material Efficiency in Selected Sectors

9.3.1 Automotive Sector

Greater recovery of secondary materials from ELVs

Use of secondary raw materials by way of reuse and recycling is a viable option for enhancing resource efficiency. As per known reuse statistics for India, up to 70% of a vehicle is dismantled and directly reused or sold to other manufacturers; however this is not done in an economically or environmentally optimal way. It is imperative to develop a comprehensive framework for “Environmentally Sound Management” of the ELV sector to enhance resource recovery potential in the automotive sector. The Government of India has taken an initiative in this direction by framing the Draft Guidelines for End-of-Life Vehicle Management (CPCB, 2015b). Average designed life of vehicle could also be prominently displayed for information of consumers. Policies for deregistration of vehicles to aid their recovery should be formulated.

The framework should promote socially inclusive and environmentally safe methods of recycling which also allows companies to undertake for closed loop recycling and recovery. It is well documented that current recycling methods, particularly the handling of ELVs by informal dismantlers, leads to loss of resources and leakages of hazardous constituents like glass wool, waste oils, coolants, etc. Recycling also needs a well-organised collection system and energy-efficient recovery mechanisms to supply the market with competitively-priced, high-quality secondary materials.

Improved material flow management

Material flow management, which refers to the continuous and targeted optimisation of material and energy flows, is another option for enhancing resource efficiency. It helps create transparency by identifying wastage of resources that can be captured, mapped and analysed before being allocated to the relevant process steps, which can enable and support comparison of various scenarios and technologies, thereby optimising the flow of individual materials. Some Indian component manufacturing units have adopted principles of lean manufacturing leading to an improvement in flow of material in the production lines, thereby reducing rejection rate, but such approaches need to be promoted among smaller units.

Increased product life

It is also important to explore ways to increase the efficiency and life of the product. Iron and steel use has steadily decreased, while plastics and aluminium have steadily increased. The decline in steel used in automobiles is due to use of better and more compact steel components in recent years, particularly the use of the high strength steel plate (High-Tensile Steel), the use of which is rapidly increasing as a means of car body weight reduction. Aluminium and plastics are valuable car components not only for their lighter weight, but also because of their inherent corrosion resistance.

The example showcases that the strategy simultaneously supports three objectives: reduction in material and energy consumption as well as reduced environmental impact. The product and component manufacturers should focus on increasing the life of the product as well as its efficiency. The automobile industry can contribute to resource efficiency by prolonging the service life of the vehicles being produced. Manufacturers should support the longevity of vehicles and its components by ensuring that they can be serviced, repaired and maintained. The extension of the lifetime of a vehicle not only reduces costs for consumers, but also helps in conserving resources and energy.

Improved design to incorporate sustainable materials

Ways should be identified to increase the use of recycled materials and reduce the use of undesirable materials like hazardous metals in automobiles. Innovative usage for recycled materials in the non-metallic portions of the vehicle, which are typically composed of virgin materials, should be explored. For example, the Ford Motor Company had a Voluntary Recycled Content Usage Policy in North America for many years, which set goals for the use of non-metallic recycled content for each vehicle. These targets were increased year by year with each new model by Ford. Under this program, recycled materials are selected for all of Ford's vehicles, whenever technically and economically feasible.[10]

Design for Recycling (DfR) focuses on promoting efficient recycling from the production stage itself that allows easy dismantling and removal of the hazardous constituents. At the design stage of the product, optimal use of a resource should be taken into consideration that can have dual benefits such as energy conservation as well as time saving and cost reduction. The companies can invest more in improving the quality of recycled material to substitute primary material and thus conserve energy and reduce emissions. Some of the by-products or waste products could be a valuable resource for some other processes; thus re-utilising and re-using these products should be encouraged instead of disposal.

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[10] Ford Sustainability Report 2013/14. Sustainable Materials. Available at: http://corporate.ford.com/microsites/sustainability-report-2013-14/environment-products- materials.html

Importance of training and capacity development

It is also important to train the personnel involved in the manufacturing process about the efficient use of resources and motivate/encourage them to adopt skills and knowledge in resource efficient techniques and processes. As resource productivity is a step-wise process, enhanced capacities of industry personnel lead to identification of the key challenges, identification of corrective measures and its implementation mechanism in a phased manner.

Reducing air pollution and GHG emissions

The transport sector in India is a leading emitter of greenhouse gases and increased transportation demand will further push up GHG emissions in future. Growing reliance on personalised modes of transport, particularly in urban areas, leads to negative impacts like road congestion, deterioration in ambient air quality and sound pollution. However, over the last two decades, environmental problems caused by the transport sector has caught the attention of policy makers. During this period, various steps adopted by the central and state governments have included elimination of lead in petrol, switching to natural gas in public transport fleets, and adopting Euro emissions standards for new vehicles.

India's Auto Fuel Policy of 2003 identified a roadmap for vehicular emissions and fuel quality standards. India's National Action Plan on Climate Change recognised that GHG emissions from the transport sector can be reduced further by adopting measures that include increased use of public transport, increased use of biofuels, as well as improving fuel efficiency of vehicles. Since there is likely to be a substantial increase in the share of diesel run vehicles in the short to medium term, it becomes very important to implement Bharat VI emission standards earlier than the proposed timeline (Sasi, 2016). This would help in taking advantage of the fuel savings from the use of latest diesel engine technology without worsening air pollution from diesel vehicles. At the same time, a comprehensive and stringent regulatory roadmap would help the oil and automotive sectors in India have better clarity and enable faster adoption of technology (Bansal and Bandivadekar, 2013). BIS has also developed standards for fuels in the form of product specifications and testing methods to determine their quality performance like IS 15464:2004, IS1460:2005 and IS 2796:2014.

Developing a broader perspective on mobility

If the automotive sector is considered in a broader context, a comparison should be made between different mobility options. The most environmentally-friendly and resource-efficient mobility options are walking and cycling, followed by mass public transportation. Therefore, urban infrastructure should be developed to support these forms of mobility rather than undermining them. Infrastructure for pedestrians and cyclists, as well as dedicated mass transit corridors, needs comprehensive planning. In India's fast growing megacities, these forms of transport are often threatened and marginalised by motor vehicles and their attendant infrastructure.

9.3.2 Construction Sector

In order to promote resource efficiency in the construction sector through the use of secondary raw materials, policy and market decision makers should be informed about various available options and models of resource efficiency to create a complete ecosystem.

Accurate inventorisation of C&D waste

Products made from recycled C&D waste can make a significant contribution to the supply of construction materials but that potential remains largely unfulfilled in India (GIZ, 2016). However, with the new C&D Waste Management Rules 2016, it is expected that C&D waste utilisation will gather steam in the coming years. One of the first things that needs to be addressed is to assess and estimate the quantum of C&D waste generated. While some limited studies exist, a more detailed quantification and characterisation is required to better plan an effective waste management strategy. Therefore, it is recommended that it should be mandatory for every demolition and renovation/ retrofitting activity to take a permit from the respective urban local body (ULB). The permit shall necessarily include the estimated quantum of C&D waste generated and the management plan, which will be verified against actual disposal records (at the designated site). Suitable penalty clauses shall be included in case of non-compliance. Such a permitting system will enable ULBs to create a comprehensive and accurate inventory of C&D waste generation. Large infrastructure projects undertaken by public bodies such as Public Works Departments (PWD), Metro Rail, etc. should also be covered under the system.

Promotion of Green Building Codes and Standards

Historically, building codes in India did not have much emphasis on environmental sustainability dimensions of construction. Even so, implementation of existing building codes has always been a challenge, especially outside major urban centres. BIS has developed the National Building Code 2016[11] which has significant emphasis on environmental sustainability and green building materials. There needs to be a push for nationwide adoption of such superior building codes.

Voluntary green building rating systems that go above and beyond basic building code requirements such as GRIHA have become prominent in recent years but their influence is limited to a miniscule proportion of the building market. Government mandates to adopt GRIHA standards for all public construction will go a long way towards promoting wider adoption of green building materials. Similarly, the private sector can be encouraged to adopt such green building standards as a few pioneering companies are already doing. Life-Cycle Assessment (LCA) based on international standardised guidelines, and these should be mainstreamed for green building and component ratings.

Developing favourable policies for products made from secondary materials

Fly-ash based bricks and cement have witnessed some success in the Indian market (CEA, 2015). However, a range of other building products made from secondary materials are at a very nascent stage in India. These include products made from C&D waste, industrial slag,

[11] National Building Code of India 2016. Bureau of Indian Standards. Available at: http://bis.org.in/sf/nbc.asp

mining and quarrying waste, timber scrap, low-carbon cement, etc. The range of policies used to promote fly ash utilisation can be adapted for these other categories of green building products. Codes and standards that ensure products meet quality standards will go a long way in building user confidence in the products. BIS codes should be supported by preferential procurement of products made from secondary materials. This can be done through amendments in tenders issued by public entities. Targeted tax and other financial incentives for manufacturers of such green building products will help to make these products more competitive since higher prices are often the biggest obstacle for adoption of green products by users.

Building capacities of ULBs

The responsibility of managing waste including C&D waste is with the ULB. Thus it is important that ULB officials have the technical and managerial capacity to perform effective C&D waste management, which is currently lacking. Good practice guidelines and manuals for the entire life-cycle of C&D waste management ranging from estimation, collection, segregation, processing and final disposal for C&D waste should be developed and shared with the ULBs. Through Indo-German collaboration, a manual has been developed for this purpose and may be used for capacity development of ULBs all over the country.

Similar capacity development of ULBs is also needed for implementing green building codes, and adoption/promotion of other green building materials made from alternative/secondary resources.

Technical and business case support to new entrepreneurs

SMEs form an important part of the market for production of building and construction products and are often limited by their knowledge of and access to new technologies and processes for innovative products. In many cases, technologies for making building products from waste streams such as C&D waste, quarry dust, etc. are neither complicated nor very expensive and proper outreach and demonstration can encourage potential entrepreneurs. However, more often, establishing the business case is more challenging due to a variety of factors including collection and segregation costs, negative perception of buyers towards new products, etc. Effective public-private partnerships can demonstrate viable business models such as those for C&D waste recycling in Delhi and Ahmedabad (GIZ, 2015b).

Large-scale awareness and sensitisation of users

Lack of familiarity with the products and hence inadequate confidence about their quality are obstacles for potential users. The general perception associated with products made from waste is one of inferior quality, especially when compared to those using virgin resources. This needs to be overcome through large-scale awareness efforts as well as standardisation and certification. It is recommended that demonstration projects should be implemented and properly advertised to sensitise users about products made from secondary materials, especially architects, developers and contractors through activities such as seminars, workshops, one-to-one interactions, advertisements and trade publications. Trade and professional associations for architects, engineers and builders should play an active role in this regard.

10. Guidance on RE Strategy: Recommendations

10.1 **Promotion** – Eco-labelling, Standards, Technology Development, Green Public Procurement, Industrial Clusters, Awareness

The active promotion of resource efficiency in all sectors of the national economy is an essential step in order for India to initiate policy formulation in the sphere of natural resources.

Firstly, focusing on designing cross-cutting policy instruments such as green public procurement (GPP), standards, eco-labelling and certification for promoting resource efficiency in the use of critical materials in the hotspot sectors (key industrial and strategic sectors) of the economy is key.

While an eco-labelling scheme from MoEFCC is in place, its impact has been rather limited; there is a need to develop certification and eco-labelling with emphasis on RE & SRM addressing product reuse, durability as well as secondary resource usage and to include provisions for preferential procurement of eco-labelled products through Green Procurement Policies. In addition, incentives should be provided through tax benefits for eco-labelled products to make them more price competitive and encourage consumers to purchase such products.

A comprehensive and well-designed GPP policy can be a key instrument to promote resource efficiency in the economy. GPP can serve as an important driver for creating a sustainable demand for RE & SRM products and services. It can help the market mature and foster innovation, influence consumption and production and improve competitiveness. Therefore, it is important to start with a small range of products first, for which the market is already reasonably well established, and then gradually expand as the program matures. Experience from other countries shows that an independent entity should develop criteria and standards and oversee certification and eco-labelling of products. In addition, a list of products and manufacturers of approved green products of adequate quality must be maintained by such an entity. This makes it simpler for each government agency to engage in green procurement without the need to undertake complex assessments with inadequate expertise. Perhaps the best example is the German Blue Angel Eco-Labelling scheme[12]. Finally, mandatory targets for green procurement help to achieve the desired level of performance; these targets can be graduated and made more ambitious over time depending on the maturity of the program and the market for green products.

Standards, developed by specialized standard setting organisations, have been widely used to promote quality in manufacture and performance of products. However, standards to

[12] The Blue Angel. Available at: https://www.blauer-engel.de/en/blue-angel/who-is-behind-it

promote environmental goals, especially resource efficiency, are relatively new. While standard setting organisations in countries like Germany, UK, USA have taken the lead in developing standards related to resource efficiency and recycling, international bodies such as the CEN and ISO have been working hard towards harmonisation of standards internationally. At the EU level, the EcoDesign Directive of 2009, while not a standard in itself, is a framework directive which allows for setting compulsory eco-design requirements for various product groups, and would therefore enable a gradual expansion of standards over time. In India, the Bureau of Indian Standards (BIS) has been the universally recognized and trusted professional standard setting organization with a wide range of standards for quality and performance of manufactured products. BIS standards can have an immediate impact on market acceptance of new resource efficient products. BIS has also been working to adapt internationally accepted standards related to RE to the Indian context, but a more coordinated approach with InRP is recommended for future.

Secondly, there will also need to be multi-stakeholder involvement including cross-industry collaboration as well as those among public, private, academic, and non-profit institutions, and facilitate information exchange to harmonize the interests and constraints of the different groups involved in sectors along the different life-cycle stages, which also includes technology development promoting RE and SRM across life-cycle stages and enhanced consumer awareness.

While the Department of Science and Technology, Ministry of Science and Technology, is promoting R&D related to waste management, there is a need to further enhance funding for RE and Secondary Raw Materials (SRM) related R&D.

For example, at the manufacturing stage, flagship programmes like “Make in India” that provide special assistance to energy efficient, water efficient and pollution control technologies through Technology Acquisition and Development Fund (TADF) can promote RE and SRM approaches as well. Industrial and sectoral policies can include promotion of industrial symbiosis (where waste from one industry is raw material for another), process efficiency programs and use of recycled materials in manufacturing. Resource efficiency audits can be promoted in the context of sustainable manufacturing. Through Indo-German bilateral project, RE audits for the auto-component manufacturing sector has been initiated with the involvement of the Automotive Component Manufacturers Association of India (ACMA).

Consumers are key actors who also have a shared responsibility in charting a path towards more efficient and sustainable resource use. Overall, the understanding of Indian consumers of what qualifies as environmentally-friendly, and by extension resource efficient product, especially from a life-cycle perspective, is low (GPNI, 2014). The development of consumer awareness is essential especially by communicating standards, labels and rules to aid the acceptance of green purchasing and products from waste recovery.

In order to increase demand and consumption of green products, four factors need to be addressed:

- Strengthen awareness regarding green products
- Improve availability of green products in the markets

- Clear certification for green claims made by producers though information tools
- Lowering costs of green products

A stronger regime of standards, certifications and labels is imperative as a first step towards engendering greater trust in the claims of the green products. It will aid consumers to assess the authenticity of claims by manufacturers. At the same time, a robust awareness generation campaign and marketing strategy must be developed by involving consumer bodies, government and manufacturers. Such campaigns should be carried across different media like television, radio, newspaper, internet and social networking websites.

10.2 **Regulation**, Economic Instruments – Viability Gap Funding, Policy Reforms across Life Cycle Stages

Regulation and economic instruments facilitate viable ways to decouple economic development from material consumption, through improving resource efficiency. Provisions like Viability Gap Funding (VGF) can help businesses meet the high initial cost in their attempt to overcome the barriers and become competitive over time by building scale and upgradation of technology. Establishing an enabling setting for Viability Gap Funding for RE interventions in a competitive manner with an objective to encourage players to come to the market, build up scale, upgrade technology, and enabling competition in the longer run is, therefore, an essential step. Other effective innovative financing mechanisms include private equity funding like green bonds that support resource efficiency, low interest loans to SMEs to promote investments in RE & CE models, improving SME's access to loans by pooling loan demands in order for them to get ready approval, etc. Additionally, business models that are based on sharing services as opposed to owning resources can further aid the shift towards a RE economy.

In India, there are many existing policies influencing resource use at different lifecycle stages: starting from mining to designing, followed by manufacturing, consumption and ultimately end-of-life management (disposal or recycling). However, their design, emphasis, integration or implementation is often sub-optimal in terms of achieving RE goals.

At the mining stage, the National Mineral Policy already includes zero-waste mining as a national goal and emphasizes the need to upgrade mining technology. In addition, there is a need to promote extraction of associated metals (Tin, Cobalt, Lithium, Germanium, Gallium, Indium, etc.) along with major metals like Copper, Lead and Zinc to enhance resource efficiency in the sector. Just as the Steel Policy aims to increase extraction rate from present 93.5% to 98%, there is a need to increase efficiency in extraction of other minerals to reduce mining and associated environmental impacts.

At the design stage, policies like the National Housing and Habitat Policy, 2007 and the Pradhan Mantri Awas Yojana (PMAY), 2015 emphasize on developing appropriate ecological design standards for building components, materials and construction methods and there is a need to introduce such components in other sector policies. The Department of Science and Technology, Ministry of Science and Technology, is promoting R&D related to waste management and there is a need to further enhance funding for RE and Secondary Raw Materials (SRM) related R&D. Further, there is a need to promote national voluntary standards, like BIS's Green Manufacturing Practices and IS/ISO 14001: 2015[13] to develop and strengthen design initiatives for improving resource efficiency and promoting use of secondary raw materials across sectors.

At the manufacturing stage, flagship programmes like "Make in India" that provide special assistance to energy efficient, water efficient and pollution control technologies through Technology Acquisition and Development Fund (TADF) can promote RE and SRM approaches as well. Industrial and sectoral policies can include promotion of industrial symbiosis (where waste from one industry is raw material for another), process efficiency programs and use of recycled materials in manufacturing.

In case of end-of-life stage policies, while there are policies existing to tackle all types of waste ranging from hazardous waste to Municipal Solid Waste (MSW), Construction and Demolition (C&D) waste, plastic waste and e-waste, enforcement has been limited due to lack of support for business models that lead to better implementation. There is a need to mobilize funding or cost of treatment for waste through Extended Producer Responsibility (EPR) and Polluter Pays Principle. Also, there is a need for a unifying framework that brings together these different sources of secondary raw materials for effective closed-loop recycling. To effectively manage the dispersed waste steams there is also a need to involve the informal sector by providing them with technical capacity building and financial support.

Furthermore, there is a need to develop a system to specify, monitor, and control waste streams leading to data base for volumes and types of waste, and their feasibility for the production of secondary raw materials, thus substituting virgin raw materials. Such information will aid in creation of a marketplace for SRM.

Tax reforms can play an important role in steering the economy towards resource efficient practices and circular economy. Taxes must incorporate the cost of externalities and better reflect the effects of extraction and value creation. Value-added taxes should be levied on value-added activities like mining, construction, and manufacturing, and not on value-preserving activities such as reuse, repair and remanufacture. The effect of GST on SRM products should also be analysed and harmonised with the resource efficiency goals as well as those mandated through the Waste Management Rules 2016 in order to make sure that their use is not discouraged and leads to their greater market adoption.

10.3 **Institutional Development** – Capacity Development, Institutional Set-up and Strengthening, Database and Indicators, Resource Index as a part of Economic Survey

It is not uncommon that many visionary policies and targets set for the country are envisioned at the national level but fail to trickle down to local levels for implementation or lead to inadequate adoption by industry. This discrepancy clearly is indicative of the lack of awareness and inadequate implementation capacities of actors at local levels. This problem

[13] IS/ISO14001:2015 on Environmental Management Systems – Requirements for Use provides guidance to incorporate eco-design elements for product design and development.

is especially true with respect to recycling of resources which happens mostly at the local municipal level and is undertaken by MSMEs. Capacity development should be targeted at these "weak links" and include technological, financial as well as managerial components. State government agencies such as Pollution Control Boards or Departments of Urban Development can take up the responsibility for capacity development of local governments, while that for MSMEs should be vested with industry associations. Technical or Administrative Training Institutes can act as hubs for such capacity development, and Centres of Excellence/Innovation may be created for this purpose in existing institutions.

Successful examples of such capacity development efforts include training of municipal officials as well as MSMEs on electronic-waste (e-waste) recycling, construction and demolition (C&D) waste recycling, etc. through Indo-German collaboration under MoEFCC. There is a need for replication of such training models and implementation in other sectors and in all parts of the country.

A comprehensive effort towards capacity development of key actors responsible for undertaking or overseeing RE/SRM strategies, including ULBs, MSMEs, as well as the informal sector is essential.

The creation of an institution with a strong mandate similar to the Bureau of Energy Efficiency (BEE) is recommended that works in coordination with BIS and other related government bodies. The functions of this institution could include the following:

a) Development of RE measures across the lifecycle to avoid burden shifting across stages, sectors and resources (including on biotic resources) keeping in mind ease of implementation.

b) Assessment of RE measures for their effectiveness and potential negative impacts along with providing regular bulletins of findings for stakeholders.

c) Serving as storehouse of best practices and business models.

d) Development of indicators to measure the RE progress in India. Proposed initial suitable indicator: GDP/DMC[14] (later changed to GDP/RMC[15]).

e) Development of statistical models for data generation, analysis and interpretation reflecting on indicator values for environmental, social and economic development. Regularly bringing out reports discussing the state of affairs, and ensuring their wider dissemination.

This institution could be supported by a commercial entity (on lines similar to Energy Efficiency Services Limited (EESL)) that could enable financing technology adoption, capacity building and awareness. Further, it would also be responsible for coordinating research and providing policy advice in coordination with the Indian Resource Panel (InRP). The institution could publish *State of Resources Report* on the lines of *State of Environment Report* for managing major and minor minerals, water resources and forest resources.

The support for policy formulation/policy advice can be extended by a dedicated institution that engages in coordination with the InRP and aims to promote resource efficiency in India

[14] DMC: Domestic Material Consumption
[15] RMC: Raw Material Consumption

beyond individual sectors or regional interests. The work of the said body would also look into the development of RE measures across the life-cycle to avoid burden shifting across stages, sectors and resources, keeping in mind the ease of implementation. To estimate the effectiveness and potential negative impact of the measures, there is a need to have in place effective mechanisms for collecting and synthesizing resource efficiency information – including life-cycle analysis and material flow data and case studies. These mechanisms could be supported by the institution along with acting as a storehouse of best practices and successful business models from across the world.

11. Action Plan (2017–2020)

The action plan has been formulated in two parts – short term and medium term. Part 1 deals with the short-term action plan. It details the core action agenda which is to be implemented in the fiscal year 2017–2018. Part 2 of the action plan details the medium term agenda and will be implemented in the medium term. The comments received during the meeting held on July 21, 2017 at NITI Aayog and on the RE strategy from the stakeholders, including the MoEFCC have been considered for finalizing the Action Plan.

Part 1 – Core Action Agenda 2017–2018

Category	Recommendations	Action Agenda 2017–2018	Implementing Agency	Timelines
1.1 Institutional	a) Constitute an Inter-departmental coordinating body/group of Stakeholders	- To drive overall goals of Resource Efficiency an inter-departmental body/group of Stakeholders under the Chairmanship of Principal Adviser, NITI Aayog may be setup	NITI Aayog / European Union (EU) (EU will provide secretarial and technical support to the proposed body/group of Stakeholders through the RE project in India)	December 2017 – January 2018
	b) Setup a task force of experts	- Constitute a task force of experts from relevant Ministries & Think tanks. NITI Aayog will coordinate the functioning of this taskforce with support from EU	NITI Aayog and EU-REI [16]	February – March 2018
	c) Build awareness about resource efficiency programmes, policies and best practices	- A portal to be created to share relevant information in an organised manner. - Create a RE Toolkit for policymakers - Plan three national/regional workshops within the time frame to create awareness on RE Strategy	The portal will be hosted by NITI Aayog Content provided by EU-REI Toolkit developed by EU-REI Workshops conducted by EU-REI project with relevant stakeholders	April – May 2018

[16] EU has initiated a three year project in India on Resource Efficiency. The implementing consortium comprises of GIZ, TERI, CII and adelphi. This consortium supported by the EU Delegation in India will be supporting the Niti Aayog and other key ministries for implementation of the RE Strategy.

Category	Recommendations	Action Agenda 2017–2018	Implementing Agency	Timelines
1.2 Data and Indicators	a) Official Document on RE b) Baseline data collection and development of indicators	- A document on Best Practices on Circular Economy and Resource Efficiency to be developed - A study to be initiated under auspices of NITI Aayog to prepare baseline data and indicators for monitoring progress. - Devise methodology for baseline data collection and monitoring framework for state-level RE interventions and improvements - Stakeholder consultations - Capacity building of the State governments and other stakeholders through exposure visits and events - Create a toolkit on RE indicator monitoring framework - Capacity building of the State governments and other stakeholders on indicator monitoring framework	NITI Aayog in collaboration with EU-REI	January – March 2018 December 2018 March 2018 March 2018 – June 2018 June 2018 – September 2018 September 2018 September 2018 – April 2020
1.3	Engagement with External Stakeholders	- A document on Global Best Practices to be development in consultation with EU-REI with engagement of other external stakeholders like World Bank, ADB and Indian Embassies abroad	NITI Aayog in collaboration with EU-REI	July – December 2018
1.4	A Short Term Course on RE to be initiated	- A Short Term Course on RE to be initiated under GIAN Programme of MHRD	NITI Aayog supported by the EU-REI	April 2018

Part 2 - Medium-term Action Plan

Category	Recommendations	Action Agenda 2017–2018	Implementing Agency	Timelines
2.1 Promotion	a) Eco-labelling Voluntary/ mandatory labelling scheme focussing on RE and SRM to be developed	- Identification of relevant measures needed for revision of I-mark and Eco-mark Scheme; identification of products/ sectors to be initially identified and developed	MoEFCC in consultation with BIS supported by EU-REI	April 2018 – December 2018
	b) Standards - Awareness creation on BIS standards promoting RE and SRM - Environmental standards focussing on life cycle environmental impact assessments of production and products to be developed than concentration based standards focussing on end of pipe emissions etc. - Industry/ sectoral standards for implementation of Best Available Technologies Not Entailing Excessive Costs (BATNEEC) in line with EU-BREFs to be developed or capacity development for their application.	- Sustainability standards - Recycling standards - EU BREFs/ BATNEEC documents to be developed/ promoted in selected sectors	MoEFCC in consultation with BIS supported by EU-REI and expert consultants	June 2018 – April 2020
	c) R & D and Technology Development - Best Practices on Green Mining Technology to be developed - Technologies/ recycling facilities/ business models with regional spread to be developed for catering to integrated solutions for complex metal rich wastes like electronics, automobiles etc.	- Best Practices policy brief on Green Mining and Mine closure	NITI Aayog with MoEFCC in consultation with Ministry of Mines (MoM), Indian Bureau of Mines (IBM), Ministry of Heavy Industries & Public Enterprises (MoHI), Ministry of Science & Technology (MST) supported by EU-REI and expert consultants	July 2018 – March 2020

Category	Recommendations	Action Agenda 2017–2018	Implementing Agency	Timelines
	d) Sustainable Public Procurement (SPP) - Sustainable or Green Public Procurement policy to be developed on a priority basis - Bulk Consumers like Railways, PSUs to undertake SPP/ GPP criteria in their tendering guidelines	- Development of SPP policy/guidelines - Backgrounder paper and implementation plan for SPP in selected sectors with relevant ministries - Stakeholder consultations	NITI Aayog & MoEFCC in consultation with Directorate General of Supplies & Disposal (DGS&D) supported by EU-REI	July 2018 – March 2019
	e) Industrial Clusters By-products and industrial wastes/ resources to be systematically considered for development of sustainable industrial areas	- Waste exchange platform	NITI Aayog & MoEFCC supported by EU-REI	July 2018
	f) Information Sharing and Awareness Generation - Targeted awareness creation on the waste policies notified by MoEFCC in 2016	- Development of policy paper on waste streams and SRM and its utilisation - Exposure visits/ G 20 discussions - Planning for WRF India	NITI Aayog in collaboration with EU-REI	April 2020
2.2 Regulation	a) Economic Instruments - Selected sectoral action plan and analysis of economic instruments to promote RE and SRM	- Sectoral studies in the EU project to develop action plan on RE and SRM utilization - Action plans to be shared with the Niti Aayog Task Force - Consultations/ workshops	NITI Aayog in collaboration with EU-REI and expert consultants	January 2018 - August 2018 April 2020

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