POLICY BRIEF

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# Material Efficiency Approach towards Reducing Emissions:

## G20 Experiences and Lessons for India

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**Abstract**

Climate change is often perceived solely as an energy related issue and solutions to mitigate the same are centred around the adoption of renewable energy and energy efficiency measures. However, mitigation of emissions from production and consumption can also be achieved by adopting demand side strategies by addressing the issue of material efficiency. This paper attempts to understand material efficiency policies in some of the leading G20 countries that have been working in this field and draws possible lessons for India. It discusses India's performance so far in reducing energy consumption and emissions and also details out policies and legislations prevalent in China and Germany. The paper also highlights some of the issues related to scaling up material efficiency, possible G20 engagement and next steps in the field of resource efficiency.

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# Material Efficiency Approach towards Reducing Emissions: G20 Experiences and Lessons for India

Amrita Goldar and Diya Dasgupta

## Key Messages

- India has covered substantial ground in reducing process-level energy consumption and emissions.
- Mitigation of emission from production and consumption can also be achieved by adopting demand side strategies by addressing the issue of material efficiency.
- The Draft NREP (2019) represents a step in the right direction towards designing a comprehensive framework for resource efficiency.
- G20 economies have been at the forefront of leading energy transitions, being driven primarily by the need to modernise and diversify the economy, reduce import dependency, improve energy security and mitigate climate change.
- China and Germany have been spearheading the agenda on resource efficiency and waste management. They provide key insights into the measures and policies that can be adopted by India in its journey towards a circular economy.
- The G20 platform is ideal for co-ordinating and developing common indicators to measure material efficiency. Member countries can deliberate and jointly arrive at a universal standard for quality assurance of second hand resources.
- G20 countries can work towards building partnerships and supporting networks for trade in recovered and recycled materials. This holds true for multinational corporations (MNCs) in particular, which are deeply involved in international supply chains.
- The gap between the B20 and G20 negotiations can be bridged by incorporating resource efficiency in the B20 deliberations agenda and facilitate cross learning and information sharing.
- For SMEs in developing countries, the motivation to revamp their production patterns may be offset by the possible risk of a collapsed financial base that is already very fragile. Thus, G20 countries can help in designing funding and investment models that will provide the necessary financial help to SMEs.
- It is necessary to create a network of resource efficiency experts that can be approached by participating businesses in B20 and G20 member countries for solutions and inputs tailored to their individual needs. In its initial phase, it can be developed as part of the G20 resource efficiency website.

## 1. Introduction

The path to a low carbon future is circular in nature. Climate change is often perceived solely as an energy related issue and solutions to mitigate climate change are centred round the adoption of renewable energy and energy efficiency measures. While both are capable of managing 55 per cent of the emissions, it is important to identify the underlying factors responsible for increased energy demand, i.e., rising consumption of materials. By broadening the scope of the issue of climate change to encompass high material use as one of the root causes, one can expand the possible solutions to deal with climate change. The remaining emissions can be addressed through a circular economy (CE), which plays a role in the transformation of how one produces and uses products, i.e., tackle emissions through efficient material management. (Ellen MacArthur Foundation and Material Economics 2019).

Under a traditional 'make-take-waste' model, materials are extracted and transformed into products that are sold to the consumer, who ultimately discards them when it no longer serves its original purpose. The need for a CE stems from the fact that a linear model relies heavily on fossil fuels, fails to manage resources such as land, minerals, etc., and is responsible for emitting greenhouse gases (GHGs). In contrast, a CE refers to a closed loop system that aims to decouple economic growth and consumption of resources. The idea is to redefine value creation in a way that designs waste and pollutants out of the system, works towards regenerating natural capital and ensures that products and materials are kept in use. (Ellen MacArthur Foundation and Material Economics 2019). Reduced demand for primary materials via material efficiency can contribute to reducing the financial and environmental costs that accompany decarbonisation measures. Moreover, reduced material use will ultimately translate into lower emissions. (Hertwich, et al. 2020).

The 3 R's of 'reduce', 'reuse' and 'recycle' are central components of resource efficiency and are incorporated in the concept of CE as well. Building on this, CE adds the additional R's of 'repair', 'refurbish' and 'remanufacture' that play the role of closing the loop. 'Repair' entails the restoration of products once they reach their 'end of life' stage and utilising them for the same purpose, while 'refurbish' involves revamping the products once their lifetime has been exhausted without compromising on their value. On the other hand, 'remanufacturing' involves reprocessing of second hand items for producing new products while ensuring no loss of value. Together, the interaction among these 6 R's generates employment, encourages innovation and investment and paves the way for forming circular and sustainable societies. (Modak 2018)

In this paper, an attempt has been made to understand material efficiency policies in some of the leading G20 countries that have been working in this field and to draw possible lessons for India. The structure of the paper is as follows. Section II discusses India's performance so far in reducing energy consumption and emissions while section III provides details of policies and legislations prevalent in China and Germany. India's learning has been presented in section IV, while issues of scaling up material efficiency have been highlighted in section V. This is followed by G20 engagement and possible next steps in the field of resource efficiency in section VI.

## 2. India's Performance

Decarbonising efforts have been primarily focused on reducing process level energy consumption and emissions. These strategies include energy efficiency, fuel switching, carbon emission reduction and carbon capture utilisation and storage (CCUS). India has covered substantial ground in this regard, particularly in the case of energy efficiency (Hertwich, et al. 2020). Some of these efforts have been discussed below.

### 2.1 Reducing Energy Consumption: Energy Efficiency

In India, the industrial sector accounts for 22 per cent of GHG emissions and a major part of those emissions are generated by the iron and steel, cement and ammonia sub-sectors[1] (National Productivity Council 2017). The Perform Achieve and Trade (PAT) Scheme was introduced by the Bureau of Energy Efficiency (BEE) in 2012 as an instrument that was designed to reduce specific energy consumption by energy intensive sectors. It is associated with a market-based mechanism that helps enhance cost effectiveness through tradable energy saving certification. Specific energy saving targets are assigned to designated consumers (DC) for three-year periods. This target is decided based on the current levels of energy efficiency, i.e., DCs who are more energy efficient are assigned lower reduction targets as compared to others who are not. Energy saving certificates (ESCerts) are provided to firms who exceed their target. Units that are unable to meet their assigned targets have to purchase these ESCerts and are liable to pay a penalty if the target still remains unmet. PAT cycle I (2012-13 to 2014-15) covered eight energy-intensive sectors[2] and had an overall target of energy savings worth 6.686 MTOE by the terminal year. The actual savings achieved were 30 per cent higher than the assigned target, equivalent to avoiding 31 million tonnes of $CO_2$ emissions. PAT II (2016-17 to 2018-19) was extended to cover railways, refineries and discoms and had a target of 8.869 MTOE. PAT III (2017-18 to 2019-20). It has been implemented on a rolling basis with new DCs being annually included.[3]

The building sector in India comprises mainly the residential and commercial sectors and consumes 33 per cent of the total energy produced. (MOSPI 2019). While the sector ranks second in terms of GHG emissions after the industrial sector, it has the potential to deliver considerable energy savings (BEE 2018). The Standards and Labelling (S&L) scheme was launched in 2006 by BEE to promote energy efficient appliances by informing consumers of the energy and cost saving potential of a given product. Through this scheme, energy performance labels are displayed on end-use appliances along with the minimum standards.[4] The efficiency standards are updated every few years to enhance the efficiency of products already listed under the programme as well as for expanding its scope. BEE also introduced the Energy Conservation Building Codes (ECBC) for commercial buildings in 2007, which

[1] Available at: https://www.ceew.in/sites/default/files/GHGPI_Industry_Sector_State_Level_Methodology.pdf. Accessed June 5, 2020

[2] Aluminium, cement, chlor alkali, fertiliser, iron & steel, paper & pulp, thermal power plant and textiles

[3] Available at: https://beeindia.gov.in/content/pat-cycle. Accessed June 5, 2020

[4] Available at: https://beeindia.gov.in/content/mandatory-appliances Accessed June 5, 2020

were later amended in 2010. The code listed out the minimum energy performance standards for designing and constructing new commercial buildings. In 2017, EBCB was updated to include additional requirements and to ramp up the stringency of pre-existing requirements. ECBC 2017 also encourages enhancing energy performance by achieving higher grades such as ECBC+ and Super ECBC that can provide savings of 35 per cent and 50 per cent respectively. It is expected that compliance with ECBC can generate savings worth 300 billion units and reduced peak demand by more than 15 giga watts per year.[5] In 2018, BEE launched ECBC for the residential sector (ECBC-R) to inculcate energy efficient techniques/practices in the construction of homes, apartments and townships. It is expected that the implementation of ECBC-R can deliver annual savings of 125 billion units by 2030. (Ministry of Power, Government of India 2020)[6]

In 2015, the Indian Government launched the world's largest domestic lighting project, *Ujala* (*Unnat Jyoti* by Affordable LEDs for All). Energy Efficiency Services Limited (EESL), a joint venture of four public sector companies, namely PowerGrid, National Thermal Power Corporation, Rural Electrification Corporation Limited and the Power Finance Corporation, has been spearheading this initiative and has successfully distributed roughly 36.13 crore LED bulbs across the nation, resulting in energy savings of 46.92 billion kWh per year, and reducing GHG emissions by 38 million tonnes $CO_2$ annually. [7]

Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED) are two building rating systems that are prevalent in India. The GRIHA system facilitates rating buildings in terms of their "greenness". The environmental performance of the building covers the entire life cycle spanning different stages, i.e., pre-construction, different construction phases, and operation and maintenance. Building performance is evaluated under different heads such as sustainable site planning, energy end-use, renewable energy, and health and well-being to name a few (Sande and Phadtare 2015).[8] The Indian Green Building Council (IGBC) customised LEED (which was originally designed for the US) to Indian conditions to encourage sustainable design and construction of buildings. The system lays down guidelines for the construction of buildings to ensure certain sustainability goals are met (Sande and Phadtare 2015). India currently has 1482 LEED registered buildings and 214 LEED certified buildings that make up a registered green building footprint of 1012.92 square metres (NRDC and ASCI 2012).

Rapid urbanisation leads to an increase in refrigeration and air-conditioning requirements, particularly under Indian climatic conditions. Barring a few states in the Himalayan region, thermal comfort in India is primarily linked to cooling in buildings (MOEF&CC 2018). India has been one of the few countries to design a Cooling Action Plan (CAP) with a long-term vision (spanning a 20-year period from 2017-18 to 2037-38) that addresses cooling requirements across sectors. It identifies possible actions to reduce cooling demand arising

5 Available at: https://pib.gov.in/newsite/PrintRelease.aspx?relid=165748.Accessed June 7, 2020
6 Available at: https://pib.gov.in/newsite/PrintRelease.aspx?relid=186406. Accessed June 7, 2020
7 Available at: https://pib.gov.in/Pressreleaseshare.aspx?PRID=1598481. Accessed June 7, 2020
8 Available at: https://mnre.gov.in/file-manager/UserFiles/national_rating_system_green_buildings_GRIHA.pdf. Accessed June 9, 2020

from residential and commercial buildings, cold chains, etc., covering aspects of building design and technological innovations that do not compromise on energy efficiency.[9]

## 2.2 Reducing Emissions: RE Penetration, National Targets and Stricter Norms

India is among the 189 signatories to the Paris Agreement and has announced that it will reduce its GDP emission intensity by 33 to 35 per cent from the 2005 level by 2030. In addition, India also aims to augment its installed electricity generation capacity from non-fossil fuel sources to 40 per cent and create an additional carbon sink of 2.5- 3 billion tonnes of $CO_2$ equivalent through additional forest and tree cover.[10] According to the Second Biennial Update Report (BUR) that India submitted to UNFCCC, the country has already achieved an emissions intensity reduction of 21 per cent between 2005 and 2014 (MoEFCC 2018) and is among the few countries that are on track with respect to their nationally determined contribution (NDC) targets. In the recent United Nations Climate Action Summit, held in September 2019, Prime Minister Narendra Modi announced the country's intention to augment its installed renewable energy capacity to 450 GW by 2022, an increase of 275 GW from the earlier target of 175 GW.[11]

The Indian Government launched the "National Electric Mobility Mission Plan (NEMMP) 2020" in 2011 to promote hybrid and electric mobility in India. This plan aims to increase the availability of electric vehicles (EVs) in the country by six to seven million by 2020 and complete electrification of buses in new urban areas by 2030. This was followed by the launch of the "Faster Adoption and Manufacturing of Electric/Hybrid (FAME) India" scheme, which provided subsidies to manufacturers of electric and hybrid cars, mopeds, rickshaws and buses. Further, in order to fast track NEMMP by supporting EVs, 85 per cent of the total outlay for two years of INR795 crore under the FAME scheme was earmarked for subsidy and 10 per cent for creating charging infrastructure. To promote the adoption of EVs, the government proposed a reduction in the GST rate from 12 to 5 per cent, besides providing exemption from custom duties on some EV parts. In December 2018, the Indian Government announced delicensing of charging stations as well as a subsidy on power costs, irrespective of the company that supplied the power. As of April 2020, India has leapfrogged to Bharat Stage (BS) VI norms from the earlier BS-IV norms,[12] which are on par with US and European standards. With the adoption of BS-VI, petrol driven vehicles have to deliver a 25 per cent reduction in nitrogen oxide emissions and diesel engines will have to reduce emissions of hydrocarbons, nitrogen oxide and particulate matter by 43 per cent, 68 per cent and 82 per cent respectively.[13]

As of December 2016, the Indian government ordered the phasing out of inefficient thermal power plants that are older than 25 years. These are to be replaced with supercritical units.

[9] Available at: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1568328. Accessed June 7, 2020

[10] Available at: https://www.nrdc.org/sites/default/files/india-progress-climate-pledge-2019-ib.pdf. Accessed June 9, 2020

[11] Available at: https://pib.gov.in/PressReleasePage.aspx?PRID=1585979. Accessed June 7, 2020

[12] Available at: https://pib.gov.in/PressReleseDetailm.aspx?PRID=1609869. Accessed June 9, 2020

[13] Available at: https://www.thehindu.com/news/national/amid-lockdown-india-switches-to-bs-vi-emission-norms/article31231973.ece. Accessed June 5, 2020

Plants with subcritical technology, which use powder coal to produce steam and can achieve 38 per cent thermal efficiency, is the most common type of coal power plant in the country. As of March 2017, 7751.94 MW of inefficient units have been retired.[14] Supercritical technology generates steam at a pressure that is higher than the critical point of water and requires no water steam separation. Such plants can reach efficiency of 42- 43 per cent and have already been set in India. In addition, last year, NTPC commissioned the country's first 600 MW ultra-supercritical plant in Madhya Pradesh.[15] These plants have even higher efficiency levels and can reach a thermal efficiency level of 45 per cent (NITI Aayog and IEEJ 2017).

The Environment Protection Amendment Rules (EPAR), introduced in 2015, called for stricter limits on $SO_2$ and $NO_X$ emissions from new and existing coal-fired power plants.[16] Similarly, the PM 2.5 limit for new and existing plants has been set at 30 μg/m3 and 50 or 100 μg/m3 respectively. As of 2019, the year 2021 has been set as the deadline for compliance with these standards for the most polluting plants and 2022 for others (International Energy Agency 2020).

### 2.3 Reusing and Recycling Carbon: CCUS

The uptake of CCUS has been relatively slow in India; however, some independent companies have ventured into adopting CCUS measures. For instance, in July 2019, the Oil and Natural Gas Corporation (ONGC) and Indian Oil Corporation limited (IOL), signed an MoU to jointly work towards reducing carbon emissions through the implementation of CCUS at the Koyali Refinery in Gujarat.[17] Similarly, Dalmia Cement announced plans to build a 500,000 tonne carbon capture cement plant in Tamil Nadu and, as of September 2019, it had signed a Memorandum of Understanding (MoU) with UK-based Carbon Clean Solutions (CCSL) for the provision of technology and operational services for running the plant. While some small-scale CCS cement plants exist in the EU and China, a plant of this capacity is the first of its kind. Dalmia Cement happens to be the first cement company in the world to have committed to becoming carbon negative by 2040.[18] Additionally, a plant situated in the industrial port at Tuticorin captures $CO_2$ generated from its boiler and uses it to produce baking soda, which has a wide market base in industries such as glass making, detergents and paper products.[19]

Apart from the mitigation of emissions from production and consumption discussed in the sub-sections above, demand side strategies that address the issue of material efficiency can

[14] Available at: https://pib.gov.in/newsite/PrintRelease.aspx?relid=160206. Accessed June 10, 2020

[15] Available at: https://www.bloombergquint.com/business/ntpc-commissions-indias-first-ultra-supercritical-660-mw-unit-in-madhya-pradesh. Accessed June 5, 2020

[16] Existing plants: 200-600 $\mu g/m^3$ ($SO_2$) and 300-600 $\mu g/m^3$ ($NO_X$)
New plants: 100 $\mu g/m^3$ ($SO_2$) 100μg/m3 ($NO_X$)

[17] Available at: http://print.acjnewsline.org/?p=8534. Accessed June 10, 2020

[18] Available at: https://carboncleansolutions.com/media-center/news/article/2019/09/dalmia-cement-and-ccsl-sign-mou. Accessed June 10, 2020

[19] Available at: https://www.theguardian.com/environment/2017/jan/03/indian-firm-carbon-capture-breakthrough-carbonclean. Accessed June 10, 2020

also be used. Resource efficiency provides a number of benefits cutting across aspects of economic, environmental and social well-being. These include cost savings resulting from reduced use of materials, resource security, and reduction in GHG emissions, pollution and environmental degradation. The Draft National Resource Efficiency Policy (NREP) (2019) of India envisages an environmentally sustainable future that coexists with equitable economic growth. The idea is to reduce the consumption of resources to sustainable levels while catering to the Sustainable Development Goals (SDGs). The use of resource efficient and circular approaches will contribute to creating higher value by reducing material use. Moreover, minimising waste generation, loss of embedded materials, ensuring a secure supply of materials and reducing import dependency are some of the additional targets (MoEF&CC 2019)

## 3. Resource Efficiency and G20 Leading Countries

China and Germany have been spearheading the agenda on resource efficiency and waste management. This section discusses some of the measures adopted by them in this regard. A deeper understanding of their policies and legislations may help shape India's policy on resource efficiency and waste management.

### 3.1 Germany

Germany has been actively working towards decoupling raw materials and economic growth and is among the few EU member countries that have a separate national strategy catering to material efficiency. Since the 1970s, the country has been at the forefront of leading the path towards environment friendly practices, particularly in terms of waste management. The economic diversification that followed the oil crisis and recession during 1974-78 exacerbated the environmental issues that the country was facing and resulted in the need to adopt measures to tackle environmental degradation. In this regard, in addition to national level strategies and policies, a number of EU directives have also been incorporated into German law in the past. Some of these are presented in Table 1.

**Table 1: EU Directives and German Legislation**

| EU | Germany | Primary Focus |
|---|---|---|
| **End of Life Vehicles Directive (2000)** | End of Life Vehicle Ordinance (2002) | Original equipment manufacturers are obligated to provide cost-free take back of all end-of-life vehicles for the last registered keeper. It is legally required that at least 85 per cent of the average weight of the vehicle should be reused and recovered. Prohibited substances are also listed in the ordinance and increase in use of recycled materials in vehicle production is encouraged. |
| **Directive on Electrical and Electronic Waste (2003)** | Waste Electrical and Electronic Equipment Act (2005) | It governs the sale, return and environment friendly disposal of these items and upholds the principle of EPR. |
| **Eco design Directive (2005)** | Energy-using Products Act (2009) | The directive stipulates product specific regulations in terms of environmentally sound design. About 22 products fall under the purview of these regulations at the moment. |
| **Batteries and Accumulators Directive (2006)** | Battery Act (2009) | The aim is to augment the percentage of batteries and accumulators that are returned as they are made of valuable raw materials and contain hazardous substances. Manufacturers are expected to cover the entire life cycle of the product that they place in the market. Thus, companies are obliged to take back batteries and accumulators and follow environmental standards while disposing of them. |
| **Waste Framework Directive (2008)** | Waste Management Act (2012) | At the heart of the Waste Management Act lies the order of prioritisation in terms of waste prevention in decreasing order of preference, i.e. reuse, recycle, recover and dispose. While the Act states that by 2020, 65 per cent of municipal waste will be recycled, the country had exceeded this target back in 2016. |

*Source: Author's Compilation*

Material efficiency policies in Germany are primarily based on three pillars, i.e., the sustainability development strategy, the raw material strategy and the resource efficiency programme. (Wilts , et al. 2016). The federal government adopted a sustainable development strategy back in 2002, which is periodically revised and outlines targets and long-term benchmarks for a range of issues. It highlights the country's aim to double its resource productivity from 1994 levels by 2020. (Allen & Overy 2017). The raw material strategy, announced in 2010, made Germany one of the first member states of the EU to develop such a strategy. It stressed on the responsibility of the industrial sector to ensure that they have long term supply of materials that they use. The aim of the strategy was to capitalise on the existing recycling track record in the country and build on it further through improved recycling rates driven by the Closed Substance Cycle and Waste Management Act (1996). At

the same time, the federal government also recognised that a secure supply of raw materials will not be guaranteed solely by recycling and offered funding to projects working on resource substitution and discovering resource efficient technologies. The strategy outlines the financial and political support that would be extended to German companies to deal with supply bottlenecks, exploration and extraction of new sources of raw materials. (DEFRA 2012). The German Resource Efficiency Programme (ProGress I) was adopted in 2012 to help achieve the resource productivity target of the government. It calls for sustainable extraction and use of resources while minimising the environmental burden associated with extraction and use. While ProGress I was centred round securing efficiency gains in the use of biotic and abiotic resources across the value chain, ProGress II (2016-2019) deals with energy and material flows and capitalising on the synergies that exist wherever possible. (BMUB 2016)

Apart from the ProGress initiative, the country has passed the Circular Economy Law that prioritises waste prevention over reuse, recycle, recovery and disposal. While the law does not explicitly state a target for waste prevention or reuse, it does state that by 2020, at least 65 per cent of metals, paper, plastics and glass and at least 70 per cent of construction and demolition waste should be recycled. At present, 65 per cent of the waste is recycled and composted while 35 per cent is incinerated. The Packaging Ordinance, adopted in 1991, that states how to deal with packaging waste, represents a cornerstone in the country's recycling policy framework. In fact, it formed the foundation for the EU Directive on Packaging that was issued in 1994. It makes use of market-based instruments such as deposit systems and mandates that producers and retailers must take back packaging waste and pay for its treatment; in other words, it upholds the concept of extended producer responsibility (EPR). Through a system called the green point, producers make advance payments for treatment (reuse, recycle or incinerate) of their packaging waste. Keeping in mind the fact that producers make payments based on the volume of waste, it provides an incentive for them to adopt resource efficient packaging measures.[20] The packaging EPR was initially managed by Duales System Deutschland (DSD) between 1991 and the early 2000s and was later on revised to allow for the participation of several producer responsibility organisations (PROs) (OECD 2016).

Apart from packaging waste, Germany has also been actively participating in managing waste from electrical and electronic equipment, which requires a special mention. In response to the EU WEEE Directive (2003), Germany enacted the Waste Electrical and Electronic Equipment Act (ElektroG) in 2005. It governs the sale, return and environment friendly disposal of these items and upholds the principle of EPR. Producers are mandated to provide information regarding the proportions of WEEE recovery and recycling as allocated by the state. They are required to register with the national electronic equipment registry (Shiftung Elektro-Altgerate Register (EAR)) before placing any electronic product on the market. Additionally, they must provide a bankruptcy guarantee to ensure that waste put on the market does not go unrecovered in the event of bankruptcy. Every month, the producer must

[20] Available at https://s3.amazonaws.com/s3.sumofus.org/images/CUTTING-THE-CRAP-RESOURCE-EFFICENCY-February-2016.pdf Accessed June 29, 2020

also submit information to the EAR containing details of EEE numbers, model numbers, product specifications, etc. Based on this, the EAR calculates the quantum of products to be recovered monthly. The producer's responsibility can be calculated in one of two ways – producer's market share in WEEE market or share of producer's WEEE in the total relevant WEEE category. In many cases, producers may not directly engage in the transportation, processing and disposal of waste and may contract out the work to processing enterprises. Moreover, producers may opt to independently commission processing enterprises or may join a PRO that carries out the waste recovery responsibility of the producer. Accordingly, the producer or the PRO provides details of recovery completion to EAR. Similarly, public waste management agencies (PWMAs) are responsible for the collection of WEEE from households and for overseeing WEEE collection sites. The waste may be collected in one of two ways. Either the consumers segregate their household wastes and place WEEE in separate containers within their residence or nearby locations from where they are periodically collected by PWMAs; or they deliver the WEEE to specified collection sites. The PWMAs then sort the collected waste and store it in containers. Once the container is full, the PWMA notifies EAR, who then informs the producer or the PRO. The PRO then needs to transport and dispose of the waste. The German system of PRO represents a competition-oriented compliance approach. This system was adopted because of the dissatisfaction related to the monopoly of DSD in managing packaging waste. ElektroG stipulates that the management of WEEE should steer clear of monopolies as far as possible and should allow producers the freedom to opt for their favoured PRO to comply with their EPR. Lastly, consumers and retailers are also required to fulfil certain responsibilities. Consumers are expected to segregate WEEE waste and place them in separate containers. If a door-to-door collection system is opted for, then consumers need to pay the municipality for providing this service. Retailers, on the other hand, are not allowed to sell EEE products of manufacturers who have not registered with EAR and are at liberty to voluntarily opt to participate in WEEE recovery. Once they opt to participate, they are responsible for sorting and transporting the waste and can choose their preferred disposal path such as selling it to intermediaries. Often retailers may provide recovery services through purchase discounts that allow customers to return old equipment of the same type while purchasing a new one. (Wang, et al. 2017)

### 3.2 China

The rapid industrial and infrastructural development that has occurred in China in the past twenty years has been accompanied by negative environmental effects such as rising pollution, land degradation, depleting water tables etc. A circular economy (CE) was identified as one of the policy interventions that could contribute to decoupling economic growth and environmental degradation.

The development of CE in China progressed in four stages. Prior to 1992, the focus was on utilisation of resources to address the issue of resource scarcity. This was accomplished through the adoption of preferential policies. In the period between 1992 and 2002, the focus shifted to adopting cleaner production methods. Demonstration projects were carried out in

China. This was followed by the government auditing clean production plans of companies. The results of the audit encouraged many companies to shift to cleaner production methods. Additionally, a number of joint projects for clean production were successfully carried out via collaboration between foreign and Chinese companies. Gradually, there was a shift from end-of-pipe solutions of waste treatment towards prevention of waste generation. In the period between 2002 and 2008, China entered the pilot stage of CE. Guiyang City and Liaoning Province were selected as the pilot areas for the country's first CE project. The first and the second phases of the CE pilot projects were carried out in 2005 and 2007 respectively in pre-identified key industries such as steel, non-ferrous metals, coal, power, chemicals, construction materials, machine manufacturing, forestry and agro-processing. Since 2009, China has been on the path of undertaking rapid development of CE and has seen a rise in the number of pilot projects and their scope. (Li and Lin 2016).

The National People's Congress in China passed a number of laws to support CE, such as the Circular Economy Promotion Law (2009), the Cleaner Production Promotion Law (2002) and the Law on Prevention and Control of Environmental Pollution by Solid Waste (1995). The executive branch is headed by the State Council that consists of three key agencies that promote CE. These include the National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology (MIIT) and the Ministry of Environmental Protection (MEP). CE regulations, developmental plans, evaluation criteria and technological recommendations are managed by NDRC while MIIT overlooks the smooth operation of resource policies and extended producer responsibility. Regulation of Eco Industrial Parks (EIPs) and cleaner production is carried out by the MEP. In addition to these agencies, other ministries such as the Ministry of Finance, Ministry of Science and Technology, etc., also play a supportive role in policy implementation (Zhu, et al. 2019).

The implementation of CE followed a three-layered structure cutting across the micro, meso and macro levels, incorporating four key aspects, i.e., design, production, consumption and waste management (Ogunmakinde 2019). At the micro (enterprise) level, eco-design is to be incorporated at the design stage of a product to ensure reduced energy consumption throughout the life cycle of the product. Products are required to follow the principles of reuse and recycle, design that is mindful of easy maintenance and disassembling of the product. At the heart of the implementation of CE at this level lies the notion of cleaner production, wherein resource reuse is encouraged and simultaneously, efforts are made to reduce the production of toxins. At the meso (inter-firm) level, in addition to the requirement for an environment friendly design that ensures resource efficiency, easy upgradation of products to improve industrial symbiosis is also encouraged. Reuse and recycling of resources within industrial parks and industrial clusters is considered essential for effective circulation of resources. Guigang National Demonstration EIP, Suzhou Industrial Park, Nanhai National Demonstration EIP, etc., are examples of some of the EIP projects operating in China. Companies participating in EIPs engage in waste exchanges that serve as raw materials for other firms. Some of the successful waste exchanges include ash, plastics, sludge, paper and wood. For instance, there exist symbiotic relationships between manufacturing, automotive, cement and recycling firms operating in the Xi'an high tech zone

(Ogunmakinde 2019). Finally, at the macro (region/state/city) level, the idea is to combine efficient production and consumption systems to better understand the intricate material flows and develop measures to improve efficiency in the form of municipality driven collection of by products, storage, processing and distribution mechanisms (Bhattacharjiya and Kapur 2019)

Since the 1980s, China has introduced a number of laws, regulations and policies related to CE. The legal protection provided by these laws and regulations ensure a smooth transition to a circular economy. In particular, the Circular Economy Promotion Law includes development plans, extended producer responsibilities, details regarding a system for supervising high energy and water consuming entities, etc. It also details the requirements for CE cutting across production techniques, guidelines on resource exploitation and utilisation, waste recycling and reduction and so on. Some of the industrial and economic policies adopted by China to facilitate the development of CE have been discussed in Table 2 below. Upgradation of the industrial structure in China has primarily involved mandates that made it compulsory to eliminate production processes and products that were harmful to the environment and defied national regulations. This has been complemented with some fiscal measures such as the curtailment or withdrawal of loans to enterprises that are to be eliminated. The promotion of cleaner energy has involved a mix of mandates such as compulsory auditing of clean projects along with tax and fiscal measures to provide incentives in the form of tax relief or rewards for adopting cleaner production methods. Price incentives have been predominantly adopted to monitor and discourage excessive resource consumption while preferential tax rates have been used to reward firms that engage in recycling of waste and/or adopt comprehensive resource utilisation practices.

**Table 2: Major Policies Adopted by China for Promoting CE**

| Policy Type | Policy Measure | Policy | Key Points |
|---|---|---|---|
| **Upgradation of Industrial Structure** | Mandates | Gradual elimination of backward production capabilities, processes and products carried out in batches over the years 1999, 2000 and 2002 | Production processes and capabilities that violated national regulations, produced products of poor quality, major contributors to environmental pollution, material and energy guzzlers etc., are to be eliminated. |
| | Mandates | Interim regulation to promote upgrade of industrial structure and guiding lists for upgrading industries (2005) | Key technologies and products engaging in environmental protection, energy savings, etc. are encouraged and supported. |
| | Mandates | Notice of the State Council on accelerating the structural upgrading of industries with excessive production capability (2006) | Small enterprises participating in resource destruction, environmental pollution and following no safe production protocols are to be legally shut down. In addition, concerted efforts are to be made towards restricting products that are high energy consumers and pollution emitters. |
| | Mandates | Notice on accelerating the structural adjustment of the steel industry via controlling total production capability and eliminating backward production capability (2006) | Enterprises with backward and environmentally harmful production techniques are to shut down before 2007. In addition, backward products such as blast furnaces with a capacity less than 200 $m^3$ convertor furnaces with capacity below 20 tonnes are to be eliminated before 2010. |
| | Mandates | Notice on accelerating the structural adjustment of power generation industry for healthy and smooth development (2006) | Based on local conditions, high energy consuming thermal power units are to be gradually shut down along with restrictions on high energy consuming power generating units |
| | Fiscal Incentives | Guiding advice on improving and enhancing financial services for environmental protection industries (2007) | Simplified lending procedures for projects under the 'Guiding List of the Industries to be Adjusted' to boost investments. Complemented by the curtailment of credit and withdrawal of loans from projects that are to be eliminated. |
| | Fiscal Incentives | Guiding advice on financial services for supporting and promoting key industrial adjustments and suppressing excessive production capability (2009) | No provision of loans to projects not supporting industrial adjustments or relevant policies, particularly projects that are to be eliminated according to other policy regulations. |
| | Fiscal Incentives | Advice on financial services for supporting energy saving and emission reduction and | No provision of loans to projects that are under construction and violate policies on energy savings, emission reduction or are on the |

| Policy Type | Policy Measure | Policy | Key Points |
|---|---|---|---|
| | | eliminating backward production capability (2010) | elimination list. |
| | Fiscal Incentives | Management method of the central financial rewarding fund for eliminating backward production capability (2011) | Enterprises that eliminate backward production are to be rewarded so as to fund the resettlement of laid off workers, debt payments etc. |
| **Encouraging Cleaner Production** | Mandates | Interim method for auditing cleaner production projects (2004) | Compulsory audits are to be conducted on enterprises violating emission standards, using hazardous materials or discharging toxic matter. |
| | Tax Incentives | Preferential income tax lists for enterprises producing special safety production devices (2008) | Expenditure on special equipment purchased by enterprises for environmental protection, energy and water saving, etc., is to be deducted from taxable income. |
| | Fiscal Incentives | Interim management method of the central financial rewarding fund for energy-saving technologies (2011) | Energy saving projects are to be provided rewards at the rate of CNY240 per tonne of standard coal in East China and CNY300 per tonne of standard coal in Middle and West China. |
| **Comprehensive Resource Utilisation** | Tax Incentives | Notice on the policy of preferential income tax for enterprises (1994) | Enterprises making use of waste water, waste gas or solid waste as raw materials in their production process will be charged a lower tax rate or may receive tax waivers for five years. |
| | Tax Incentives | Notice on the interpretation of regulation tax rating of fixed asset investment for comprehensive resource utilisation and warehouse facilities (1994) | A tax rate of zero is set for fixed asset investments that are consistent with comprehensive resource utilisation.[21] |
| | Tax Incentives | Notice on exemption of VAT for partial products of comprehensive resource utilisation projects (1995) | Firms using more than 30 per cent of solid wastes (such as limestone coal, coal dust, boiler slags, etc.) or liquid wastes to produce construction products will be provided exemption from VAT until1995 |
| | Tax Incentives | Notice on consumption tax policy of soap and tyres (2000) | Radial tyres or re-treaded tyres will be exempted from consumption taxes. |
| | Tax Incentives | Notice on the VAT policy for the business of | Enterprises dealing with waste material will be exempted from |

[21] Comprehensive Utilisation of Resources (CUR) is a policy that has been in place in China since the 1980s for the purpose of incentivising reuse of resources. Environmental benefits in various industries and processes can be quantified with the help of the CUR policy. The CUR policy allows for comprehensive coverage and special incentive schemes for reusing industrial waste (Junming and Chertow 2016)

| Policy Type | Policy Measure | Policy | Key Points |
|---|---|---|---|
| | | waste recovery (2001) | VAT. |
| | Tax Incentives | Notice on the VAT policy for comprehensive resource utilisation and related products (2008) | Enterprises engaging in sale of treated waste water, re-treaded tyres, or in the production of rubber powder with waste tyres or construction products with more than 30 per cent solid waste will receive VAT exemption. Additionally, enterprises that treat wastewater or high purity $CO_2$ produced from industrial waste gas, heat or power generated from garbage fuel, etc., will receive VAT exemption. Furthermore, enterprises selling power or heat generated from coal gangue, silt coal, bituminous shale, etc., will receive 50 per cent VAT exemption. |
| | Tax Incentives | Notice on preferential income tax for the catalogue of materials of comprehensive resource utilisation (2008) | Revenue earned by enterprises making use of materials listed in the catalogue shall be deducted by 10 per cent prior to income calculation from January 1, 2008. |
| | Tax Incentives | Notice on VAT Policy for products produced with agricultural and forestry residues (2009) | Products made from four agricultural and forestry residues such as secondary wood, crop stalks, bagasse, etc., will be exempted from paying VAT. The exemption rate was initially 100 per cent in 2009 and was later reduced to 80 per cent in 2010. |
| | Tax Incentives | Notice on exemption of consumption tax for biodiesel produced with waste animal and vegetable oils (2010) | Biodiesel produced from animal waste and vegetable oil will be exempted from consumption tax. |
| **Exploitation and Utilization of Resources and Energy** | Price Incentives | Notice on further implementation of the policy on differential power pricing and charging issues related to own power plants (2004) | In order to restrict or eliminate enterprises concentrated in electrolytic aluminium, calcium carbide, caustic soda, cement and steel industries, the price of power for these enterprises is to be increased by CNY0.2/kWh and CNY0.05/kWh respectively, in comparison to the basic price for power to industry. |
| | Price Incentives | Opinions on improving the differential power pricing policy (2006) | On the basis of basic industrial power prices, the price of power for yellow phosphorous and zinc smelting industries are to be increased by CNY0.05/kWh and CNY0.2/kWh respectively to restrict or eliminate these enterprises. |
| | Price Incentives | Pilot scheme of pricing and cost-sharing management of power generation with renewable energy (2006) | For RE generation projects, the amount by which the electricity purchase price of coal fired plants is exceeded will be compensated via an additional power fee charged from power users. |

| Policy Type | Policy Measure | Policy | Key Points |
|---|---|---|---|
| **Composite** | | Catalogue of encouraged technologies, processes, and equipment of circular economy (the first batch) (2012) | The catalogue includes details regarding reduction, reuse, recycling, remanufacturing and industrial symbiosis and their linkages. It also covers 42 circular economy technologies, devices and processes. |
| | Fiscal Incentives | Interim management method circular economy development funds (2012) | Special funds are to be allocated for recycling of kitchen waste, safe disposal, demonstration and promotion of cleaner technologies etc. |
| | Fiscal Incentives | Notice on opinions of supporting policies and measures of circular economic development investment and financing (2010) | Projects related to circular economy will be provided with credit support. This will be accompanied by reduction or withdrawal of credit to enterprises that adopt technologies, materials, equipment, etc. that are listed in the catalogue to be eliminated. |
| | Fiscal Incentives | Interim management method of energy conservation and emission reduction funds (2015) | Allocation of energy saving and emission reduction funds are to be made on the basis of certain properties, investment costs, effects, resource consumption levels and a few other project-related parameters. The fund support covers subsidies, discounts, rewards and true settlements. |

*Source: Adapted from Li and Lin (2016)*

## 4. Lessons for India

The growth and transition of cities is accompanied by changes in consumption patterns, which change the composition of waste generated. Adopting innovative measures to manage waste through CE will help ensure sustainable waste management (by enhancing material efficiency) in a country that is already grappling with the issue of resource constraints. Achieving circularity in material use will not only contribute towards handling the resource crunch but will also play a pivotal role in integrating the informal waste management sector with a formal management system. In fact, the Waste Management Rules (2016) that were released in India, particularly in the context of e-waste and solid waste, have called for training and capacity building of the informal sector for its inclusion into a formal set up (Modak 2018). The concept of 'smart cities' has evolved over the years and 'resilient', 'low-carbon' and 'circular' cities have also joined the bandwagon. The Smart Cities Mission has been operational in India since 2015 and achieving circularity in waste management could be something that smart and sustainable cities can make concerted efforts towards. However, sustaining CE efforts will require substantial investment and the adoption of new business models (Modak 2018)

Roughly 80 per cent of urban waste generation in India is municipal solid waste (MSW) while other waste streams include e-waste, plastics, construction and demolition (C&D) debris and biomedical waste (Modak 2018). Recycling rates in India are much lower as compared to other countries such as China, Germany and Japan, while resource consumption in the country has been rising (Bhattacharjiya and Kapur 2019). In 2017, out of the 91 per cent of the MSW that was collected, only 23 per cent was treated and the rest was sent to landfills. Similarly, while the country is one of the largest producers of e-waste in the world, only 3.47 per cent of the total is being recycled (Priyadarshini and Abhilash 2020). The Indian industrial sector generates roughly 100 million tonnes of non-hazardous solid waste per year. As of 2016, a total of 7.467 million tonnes of hazardous waste was generated in the country (Ghosh 2017). The responsibility for managing industrial solid waste is assigned to the waste generators themselves, who are required to seek clearances from their respective State Pollution Control Boards (SPCBs). However, there is evidence of industries dumping their waste in nearby water bodies or open spaces and not adhering to proper waste disposal guidelines (PWC and ASSOCHAM 2017)

The Draft NREP (2019) represents a step towards designing a comprehensive framework for resource efficiency, one that is holistic in nature. However, the country can stand to gain by drawing from the experiences of other nations who have been working in this domain for a considerable amount of time.

Like in the case of Germany, the E-waste Management and Handling Rules (2011) in India adopted the EPR approach and placed the responsibility for building collection centres and informing consumers how to return used electronic products to producers. Following the ineffectiveness of the rules, they have been amended twice in 2016 and 2018. Take back targets have been set for producers that mandate the collection of a certain percentage of products sold in the market in the previous financial year. Over the course of the past eight

years, while a number of positive developments have taken place such as the emergence of PROs, expansion of formal waste management, development of indigenous technologies for processing and recovering components of e-waste, etc., the sector is still plagued by the dominance of informal players in waste management. Almost 90 per cent of waste is being treated by the informal sector (Turaga, et al. 2019). Unlike the systematic method of information collection in Germany regarding products being placed in the market, products being discarded, recycled, etc., reporting and information generation in India is absent in the informal sector. In fact, the current regulation fails to recognise the significant role played by the informal sector and needs to be altered such that the informal sector is among the key stakeholders involved in the consultative process. Additionally, the lack of a proper system of monitoring and more stringent rules for penalisation of defaulters of EPR is also lacking.

Apart from encouraging and ensuring recovery of materials, it is also important to establish a market for recyclables to make material recovery a viable alternative to using virgin resource materials. A related issue will be the need for quality assurance of recovered materials. Thus, we would not only require some sort of standards to be established for all kinds of recovered resources, but also a separate authority in place to monitor adherence to the standards. In cases where such a market is already prevalent, India can think of ways of augmenting recycling rates. It would perhaps be a good idea to set quantifiable targets for recycling and recovery at the regional, state and national level along with an incentive mechanism in the form of tax waivers, subsidies, etc., to guarantee concerted efforts in this direction.

India has employed a number of policies and regulations catering to environmental and social needs that have a bearing on resource efficiency such as industry standards, tradable permits and certification, eco labelling and so on. However, most of the focus has been limited to the end-of-life stage of products, in particular on recycling, and not much attention has been given to other life cycle stages. To effectively establish a CE, the long-term objective of reducing resource utilisation and increasing recovery of materials has to be kept in mind to improve resource efficiency throughout the product life cycle.

In terms of dealing with industrial waste in particular, like China, India can start with running a few pilot projects in areas having industrial clusters to test the application of industrial symbiosis (IS) in the country. While it is true that a simple ‘one size fits all’ approach will not necessarily work throughout the country, a test run in some areas will shed light on some of the granular issues that may be encountered in the process. Moreover, a successful pilot project will prove to be a source of encouragement for other industries to follow suit.

## 5. Issues of Scaling Up Material Efficiency

This section discusses some the issues related to scaling up material efficiency. First, every commodity consists of numerous sub-components that are acquired through various supply networks. There is a need to examine, in detail, geographically dispersed locations to close the loops at different levels, keeping in mind the spread of activities across the value chain. Moreover, the value of second life products depends on the distance and transportation costs. The second is the issue of leakages of material that may occur owing to the complexity of

materials and the inability to separate individual components while ensuring that quality and purity remain intact. Such complexity adds to the barriers of scaling up material efficiency. In the absence of reliable classification standards, it is difficult to sort out materials at scale and at profitable supply rates. This acts as a deterrent for investors as the return on investments in new infrastructure, processes, etc., is not attractive enough. The third issue pertains to being potentially trapped in a linear system lock-in. In order to transition into a circular economy, adjustments and changes need to be made at the systems level and along the life cycle of a product. It becomes pertinent to align the incentives of different players (customers, companies, across geographies, etc.) to capture and redistribute value. In addition, there is a paucity of markets at the industrial scale for materials required for running reverse logistics. This makes it almost impossible for firms to secure reliable and quality secondary materials that can be used to replace or complement the current virgin stock. In essence, the geographical imbalance between points of manufacture/remanufacture and use needs to be addressed in a way that the resulting costs do not offset the advantages of a circular economy model (Ellen MacArthur Foundation and McKinsey & Company 2014).

## 6. G20 Engagement and Possible Next Steps

### 6.1 Progress so far

G20 economies have been at the forefront of leading energy transitions, being driven primarily by the need to modernise and diversify the economy, reduce import dependency, improve energy security and mitigate climate change. Over the years, different aspects of the broad theme of clean energy have been the focus of discussions at G20 summits. The challenges of affordability, reliability and sustainability in transitioning to cleaner alternatives have been at the centre-stage of discussions since the 2014 Brisbane Summit. Substantial ground has already been covered with regard to energy efficiency.

Since 2014, G20 member countries have participated in voluntary frameworks working towards improving energy efficiency. First amongst these was the ‘G20 Energy Efficiency Action Plan’ (2014) that encouraged international collaboration in six key areas, i.e., networked devices, buildings, industrial energy management, electricity generation, transport and finance. The plan was later subsumed under the ‘G20 Energy Efficiency Leading Programme’ in 2016, which has been one of G20’s first long-term frameworks endorsing energy efficiency co-operation until 2030. The scope for collaboration under the action plan was extended to include best practices and technologies, super-efficient equipment and appliance deployment, knowledge sharing and much more (IPEEC 2017). The ‘G20 Energy Efficiency Investment Toolkit’ was launched in 2017 by the Energy Efficiency Finance Task Group (EEFTG) in collaboration with UNEP FI and the IEA. It provided voluntary options for scaling up investments in energy efficiency and consists of commitments from 122 banks spread across 42 countries.[22] The Energy Ministers meeting in 2018 highlighted the need to step up public and private investments and directed them to finance energy efficiency across

[22] Available at: https://ipeec.org/taskgroup/12-Energy%20Efficiency%20Finance%20Task%20Group%20(EEFTG).html. Accessed June 9, 2020

sectors to facilitate energy transitions. Under the Japan presidency in 2019, the dialogue was extended to explore energy efficiency in key sectors such as buildings, heating and cooling (IPEEC 2019). The IPEEC Secretariat has been entrusted with the co-ordination of the energy efficiency work carried out under the Energy Efficiency Action Plan (2014) and the Energy Efficiency Leading Programme (2016). At present, there are nine task groups/ work streams operating under the Leading Programme namely – Networked Devices Task Group (NDTG), Super-efficient Equipment and Appliance Deployment (SEAD) Initiative, Buildings Energy Efficiency Task Group (BEET), Energy Management Working Group (EMWG), Energy Management Action Network(EMAK), High Efficiency Low Emissions Task Group (HELE), Transport Task Group (TTG), Energy Efficiency Finance Task Group (EEFTG) and Top ten Energy Efficiency Best Practices and Best Available Technologies Task Group (TOP TENs).

The first G20 Resource Efficiency Dialogue took place in 2017 under the German Presidency. It aimed at promoting considerate and efficient use of resources by the twenty leading economies of the world. The idea was to share experiences of policy options and best practices related to resource efficiency, across the life cycle of natural resources, products and infrastructure.[23] Since its establishment, member countries and key stakeholders have been strongly advocating sustainable consumption and production practices that will contribute towards achieving the SDGs. Taking this agenda forward, at the next Resource Efficiency Dialogue held under the Japanese Presidency in 2019, it was decided that a website would be launched for the dialogue to facilitate regular information sharing.[24] Additionally, at the Energy Ministers Meeting in the same year, the importance of improving resource efficiency via policies on the circular economy, the 3 R's (reduce, reuse, recycle) and transforming waste to value was recognised. Special emphasis was laid on the issue of marine plastic litter and the G20 Implementation Framework for Actions on Marine Plastic Litter was established.[25]

## 6.2 Next Steps

The G20 platform is ideal for co-ordinating and developing common indicators of measuring material efficiency. The member countries can deliberate and jointly arrive at a universal standard for quality assurance of second hand resources. Given the fact that a number of multi-national corporations (MNCs) are deeply involved in international supply chains, G20 countries can work towards building partnerships and supporting networks for trade in recovered and recycled materials. In particular, countries can try to bridge the gap between the B20 and G20 discussions by including resource efficiency within the B20 agenda and facilitating cross learning and information sharing. The transition to a circular economy will involve changes in consumption and production patterns, which will be accompanied by

[23] Available at: https://www.g20germany.de/Content/DE/_Anlagen/G7_G20/2017-g20-resource-efficiency-dialogue-en___blob=publicationFile&v=4.pdf. Accessed June 29, 2020

[24] Available at: https://g20re.org/about.html. Accessed June 10, 2020

[25] Available at: https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Europa___International/g20_eemm_tokyo_communique_bf.pdf. Accessed June 10, 2020

transaction costs. For small and medium enterprises (SMEs) in developing countries in particular, the motivation to revamp their production patterns may be offset by the possible risk of a collapsed of a financial base that is already very fragile. Thus, G20 countries can help in designing funding and investment models that will provide the necessary financial help to these SMEs. Like the Climate Technology Centre and Network (CTCN) under the aegis of UNFCCC, G20 can create a network of resource efficiency experts that can be approached by participating businesses in B20 and G20 member countries for solutions and inputs tailored to their individual needs. In its initial phase, it can be developed as part of the G20 resource efficiency website.

There is precedence for such successful collaborations between countries – the India-EU Resource Efficiency Initiative (REI) is an example. The EU REI (2017) aims at mainstreaming resource efficiency in India and endeavours to build an ecosystem that ensures resource security and minimises environmental harm. The initiative is led by a consortium of knowledge partners, i.e., GIZ, TERI, CII and Adelphi. In November 2017, NITI Aayog, in association with the EU delegation, launched a strategy on resource efficiency and an action plan. In 2018, the EU delegation and NITI Aayog conducted regional workshops in Bhubaneshwar (Odisha), Hyderabad (Telangana) and Panaji (Goa) to create awareness of and build capacity to increase the efficiency of resource use and establish a circular economy. Government experts as well as industry and academia representative were part of the workshop. Through the REI, EU is extending support to the Indian states of Telangana and Goa. As of February 2020, Goa became the first Indian state to develop its own state strategy on material efficiency and circular economy (TERI 2020).[26] The EU REI initiative and the engagement with India can be taken forward at the G20 level by including a material efficiency approach to reducing emissions as a priority area under the 2023 Indian Presidency.

In light of the Covid-19 pandemic, the recent B20 Special Report puts forth a number of recommendations to restore global supply chains that could be actioned upon by the G20 countries. The report reiterates the need to rely on fiscal stimulus that operates on the principles of co-operation as opposed to competition so as to avoid protectionist measures that would distort the playing field. The importance of moving towards a sustainable and resilient economy has been acknowledged and it was posited that funds need to be directed towards sustainable sectors. In line with various national and international environmental goals (e.g. Paris Agreement, Sustainable Development Goals (SDGs), etc.), fiscal stimulus packages need to cater to improving energy efficiency, water efficiency, augmenting recycled material content, reducing GHGs and so on. The G20 should be actively involved in making efforts to restore global supply chains by ensuring that transport infrastructure including ports, roads, airports, railways, etc., are opened up and operational to facilitate movement of goods. It was also suggested that procedural delays be curtailed and necessary measures be

[26] Available at: https://www.teriin.org/sites/default/files/files/strategy-fostering-RE-CE-Goa.pdf. Accessed September 25, 2020

undertaken to ensure safe but speedy release and clearance of goods at customs (B20 Saudi Arabia 2020).[27]

## 7. Conclusion

Thus, while India is well on track in terms of meeting the Paris Agreement targets, additional support in the form of material efficiency can contribute to accelerating the process further. Closing the loop via adoption of a circular economy approach has a number of benefits such as reduced use of materials, addressing the issue of resource security, reduced GHG emissions, pollution levels and effective waste management by transforming waste to value. While the Draft NREP (2019) is a step in the right direction, learning from the experience of countries spearheading the agenda of a circular economy and designing a resource efficient production system will help in smoothening the transition process further. Previous sections have discussed some of the learning along with ways to take this agenda forward in the international sphere, particularly through global platforms such as the G20.

[27] Available at: https://www.b20saudiarabia.org.sa/wp-content/uploads/2020/07/B20-Special-Report_POST-COVID-19-_Final2_reduced_compressed.pdf. Accessed October 16, 2020

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5. Climate Change and Sustainable Development
6. Physical and Social Infrastructure including Telecom, Transport, Energy and Health
7. Asian Economic Integration with focus on South Asia
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