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A sectoral view of conceptualising macroeconomics of a 'just transition' in India

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Abstract

In light of India's COP26 commitment of reaching net zero by 2070, it is important to understand how India could ensure a 'just transition.' Since the transition raises several questions regarding who will benefit from it and who will lose out, this paper offers an assessment of the sectors that will be impacted most by the transition. This includes coal, mining, power, formal manufacturing sectors, and MSMEs. Macroeconomic consequences of the transition in terms of employment intensity, energy intensity, the total value added, and export competitiveness of the above-mentioned sectors have been examined. Using data from the Annual Survey of Industries for 2017-18 and 2018-19 and key informant interviews, the paper presents a sectoral analysis of the transition in the Indian context. In terms of employment, the power and the coal sector will be affected the most. In terms of fuel use, manufacturing sectors that either use coal or purchase electricity (indirectly using coal) will also be impacted. The spatial dimension of the transition will be very important, since certain coal-producing districts will be affected the most.

Keywords: Just transition, climate change, energy transition, coal transition, manufacturing, employment

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1. Introduction

With the increasing exigency of the climate crisis, the shift towards a low-carbon economy has become even more crucial. Effecting this change is a herculean task since it affects the population in a multifarious manner. This transition, as with any other change, raises several questions regarding *who will benefit from it* and *who will lose out.* Thus, the concept of 'just transition' becomes significant.

The case for a just transition in India has been made and its gravity has been emphasised (Bhushan, 2020). Just transition is moving to a state of the economy with lower carbon footprint while precluding exclusion of any population group and ensuring a social and economic better outcome for all. For India, just transition has been interpreted as an economic change that is structural and is essentially 'a socio-economic transition' (Bhushan et al., n.d.). The energy sector has been recognised as a core element in India's just transition narrative (Roy et al., 2019). Energy transition and just transition should be simultaneously implemented in the case of India (Bhushan et al., n.d.). This paper analyses how the transition to a low-carbon economy will affect sectors like coal, mining, power, manufacturing sectors, and MSMEs in terms of broad macroeconomic indicators.

The paper is organised in the following manner: Section 2 states the objective of the study and the methodology; Section 3 presents the macroeconomic consequences of the transition in terms of output, employment, government revenue, regional inequality, and energy prices; Section 4 presents the sectoral analysis in terms of coal, mining, power, manufacturing industries, and MSMEs; Section 5 concludes with broad contours of a just transition policy.

2. Objective of the Study and Methodology

The objective of the study is to understand the concept of a *just transition* strategy, based on evidence from the Indian manufacturing sector, including the medium, small, and micro-scale enterprises (MSMEs), the coal mining sector, and the power sector. The study analyses some important characteristics like employment intensity, energy intensity, and the total value added and export competitiveness of some industries in the organised manufacturing sector to present a macroeconomic picture of what the just transition would entail. The study uses data from 2017-18 to 2018-19. While examining the industrial characteristics of the Indian organised manufacturing sector, the study used the Annual Survey of Industries (ASI) database and their summary reports of the Rounds 2017-18 and 2018-19. The ASI database is one of the principal sources of industrial statistics in India. The ASI is a comprehensive database that annually reports data on several industrial characteristics like the number of workers employed, wages, net value added, fixed capital, working capital, depreciation, material consumed, etc.

The survey covers all the factories registered under the Factories Act of 1948 and employing 10 or more workers using power, and those employing 20 or more workers without using power. The survey is conducted across Indian states and union territories. The basic unit of enumeration is the factory. The survey follows a stratified sampling technique where the strata are defined by State, District, Sector, and Industry (National Industrial Classification 3-digit level). The NIC is followed to define each industry under the survey.

The NIC has been revised over time based on the United Nation's International Standard Industrial Classification (UNISIC or ISIC). The industries in ASI Round 2017-18 have been defined following the NIC-2008 classification. The NIC-2008 classification has been developed based on the ISIC-Rev 4. The present study has examined the industrial characteristics at an aggregated level of industrial classification, that is, NIC 2-digit level. The study has used ASI 2017-18 and 2018-19 summary reports on the principal industrial characteristics, published by the Ministry of Statistics and Programme Implementation (MOSPI), to extract information on the number of workers and net value added (as shown in Table A.1).

The Directorate General of Commercial Intelligence and Statistics (DGCI&S) is one of the principal sources of foreign trade statistics in India. DGCI&S reports commodity-wise trade statistics following the Harmonized System or HS classification. The information on the export value across industries (at the 2-digit level) defined on the basis of International Standard of Industrial Classification (ISIC) Revision 3, has been extracted from the World Bank's World Integrated Trade Solution (WITS) database[1] for the year 2017-18 and 2018-19. The discussion on establishing concordance between ASI and WITS data is presented in Appendix.

3. Macroeconomic consequences of the transition

The transition to a low-carbon setup is likely to affect many of the macroeconomic variables of the Indian economy. In this paper, we discuss output, employment, regional inequality, government revenue, and energy prices, to show what the transition could mean in the Indian context.

3.1 Output

Tandon et al. (2021) identify the states most likely to be affected by the transition to net-zero as Madhya Pradesh, Jharkhand, Chhattisgarh, Uttar Pradesh, Bihar, Odisha, Telangana and Rajasthan. These states contributed about 30% to India's real Gross Domestic Product (GDP) in 2019-20.[2] The methodology for identification looks at risks pertaining to livelihoods, energy access, public finance, and human development.

3.2 Employment

Pai et al. (2021) observe that in order to meet the emission reduction target across the globe, fossil fuel extraction jobs would rapidly decline, but losses will be compensated by gains in solar

and wind jobs, particularly in the manufacturing sector (totalling 7.7 million in 2050). India's on-grid solar employment is estimated at 93,900 jobs, with another 69,600 in off-grid settings, for a total of 163,500 jobs

Worldwide, solar PV added 127 gigawatts (GW) of new capacity in 2020, up from 98 GW in 2019. More than 60%, almost 78 GW, was added in Asia, principally in five countries (China, Viet Nam, India, the Republic of Korea, and Japan); Europe installed 20.8 GW, the United States another 15 GW, Australia 4.4 GW and Brazil 3.3 GW. The potential for creating jobs is enormous: 3.4 million jobs (short and long term) by installing 238 GW solar and 101 GW new wind capacity (Tyagi et al., 2022).

The power sector is likely to be impacted the most in terms of employment due to the transition, since it is one of the largest contributors to carbon dioxide (CO_2) emissions (Jha, 2021). Besides being a significant emitter, the electricity sector in India exhibits a very high dependence on coal. The electricity generation reliance on coal has been pegged at a staggering 71% by Bhushan et al. (n.d.).

In terms of the number of jobs in fossil-fuel-based power generation (inclusive of coal mining) per lakh state jobs, Jharkhand is the state that has the highest number (1,119), as indicated by the data from the Periodic Labour Force Survey (PLFS) 2018-19, followed by Chhattisgarh (629) and Telangana (424) (Jha, 2021). The state with the lowest number is Rajasthan (14) (Jha, 2021).

A staggering 15 million people are reliant on the coal industry in a direct or indirect manner (Bhushan et al., n.d.). Nearly 25 districts are dependent on coal for growth and employment (Bhushan et al., n.d.). For instance, Ramgarh, a district in Jharkhand, has a high level of dependence on coal-related activities in respect of employment (a large share of informal workers) and the GDP of the district (Bhushan, 2020).

Zooming out from the state- and the district-level employment scenario, the employment situation during and after the completion of the transition will depend on two key parameters:

1) Availability of alternatives: There are sectors that currently do not have any alternatives, such as steel. Further, the current debate in India is not around steel decarbonisation but power sector decarbonisation, because of the ease of finding alternatives to fossil fuels for power generation. Further, the absorption of the currently employed workforce in the new sectors depends on suitability and geography.
    a. Geographically, coal is primarily based in the eastern part of India, whereas solar power is concentrated on the western side. This can make the absorption of the job losses due to coal difficult for solar power.[3]
    b. In terms of suitability, Pai et al. (2020) inspect the local solar and wind capacity required in each coal mining area to transition to solar/wind jobs for China, India, the US, and Australia. In India, almost all coal mining areas are suitable for solar power, but not for wind power.

i. For transitioning all coal miners to local solar jobs, 1.96 gigawatt electric (GWe) of solar power capacity needs to be installed in each local coal mining area (Pai et al., 2020).

ii. In the case of wind power, 1.96 GWe of wind power capacity in each coal mining is necessitated for transitioning all coal mining jobs to wind jobs (Ibid). That said, virtually no mining area is amenable to wind power generation (Ibid).

2) Labour intensity of the new sectors: Depending on whether the new sectors are as labour-intensive as the old ones, there may be changes in employment, as the labour absorption capacity of the new sectors may not be the same. For instance, it has been observed in the case of the electric vehicle sector (the new sector steadily replacing the traditional automotive sector) that the labour requirement and intensity are lower as compared to the traditional automotive sector.

Presence of informal workforce is another complicating factor. Large swathes of workers are informal (around three times the formal labour force) (Bhushan et al., n.d.). There is no comprehensive database capturing information on the employment of informal workers. The process of transition can prove to be excruciatingly painful for them. While there can still be opportunities for the formal sector workers, the informal workers may be left with no alternative livelihoods at all, putting even their survival at risk.

3.3 Regional inequality

Another possible challenge to just transition is that of regional inequality, owing to the uneven conglomeration of renewable energy in south and west India, and coal being concentrated in central and eastern parts of India (Shreeshan and Mahale, 2020).[4]

3.4 Government revenue

Governments in India draw significant shares of their revenue from resources and sectors that are likely to be phased out by the transition. 44% of Indian Railways' revenue comes from coal (Bhushan et al., n.d.). Coal royalties constitute close to half of the revenues in some states (Gambhir et al., 2018). Coal revenue accounts for 5-6% of the state budget of Jharkhand (Bhushan et al., n.d.).

3.5 Energy prices

The transition is likely to lead to increases in energy prices. Gambhir et al. (2018) underscore that transitioning to a low-carbon setup can trigger a rise in energy prices for low-income households.

4. Sectoral Analysis

In this section, the study attempts to understand each of the sectors in terms of their employment, energy intensity, value-added, and export competitiveness. This indicates which sectors may suffer or gain in the post-transition period.[5] The section also highlights different efforts and sector-policy measures taken up by the Government of India to accelerate the process of 'just transition'.

4.1 Coal

Coal accounts for approximately 55% of the total energy demand in India. It is a labour-intensive sector, directly employing a workforce of 1.2 million (Pai and Zerriffi, 2021). This study also estimated that there were 744,984 direct coal mining jobs in the financial year 2019-20; moreover, it has been observed that employment in coal mines varies across districts, with Dhanbad district in Jharkhand accounting for the highest number of coal mining jobs. Presently, coal is being produced in 51 districts across 13 states in India, with Korba district in Chhattisgarh accounting for the highest coal production, approximately 120 million tonnes.

Table 1 reflects the coal production and export-import statistics of the sector. As seen from the table, coal production in India has increased over the last three years, and currently India produces 730.87 million tonnes. Coal India Limited (CIL) and Singareni Collieries are the two major public sector enterprises accounting for the bulk of the coal produced in India.

According to the Indian Mineral Book 2019, 87.1% of the total raw coal produced in India is dispatched to the Electricity sector, followed by Steel Manufacturing, Fertilizers, Cement, and the Paper and Pulp industry. Table 1 further shows that India is a net importer of coal in the world market.

Table 1: Coal Sector Statistics[6]

	2017-18	2018-19	2019-20
Total Coal Production (Quantity in Million tonnes)	675.40	728.72	730.87
Total Export of Coal (Quantity in Million tonnes)	1.50	1.30	1.03
Total Import of Coal (Quantity in Million tonnes)	208.25	235.35	248.53

Source: Ministry of Coal

4.2 Mining

There were 1,303 mines (excluding fuel minerals, atomic fuel, and minor minerals) in India, located across all States and UTs, in 2019-20. Among them, 567 belong to metallic minerals and

736 to non-metallic minerals. There were 146 mines in the public sector, and the remaining 1,157 mines were in the private sector.

The number of existing mining leases as of March 31, 2020, for eight metallic minerals (including gold & tin) was 1,137 (33%), covering an area of 1,34,704.79 hectares (43%). On the other hand, the number of existing leases for 32 non-metallic minerals / industrial minerals was 2,300 (67%), which covered an area of 1,77,940.93 hectares (57%).

The percentage share of GVA of metallic and non-metallic minerals under the ambit of Mineral Conservation and Development Rules (MCDR) in the country's GDP (PIB, 2022) varies between 0.4 and 0.5%.

The average daily employment of labour engaged in the mining sector (excluding fuel minerals, atomic minerals, and minor minerals) was 1,11,946 in 2019-20. Out of this, 35,218 or 31% were in the public sector, and 76,728 or 69% in the private sector. Metallic minerals accounted for 80% and non-metallic minerals 20% of the total labour force during the year.

From Table 2, it can be observed that in the year 2019-20 India has been a net exporter of ores, slag, and ash.

Table 2: Mining Sector Statistics[7]

	2017-18	2018-19	2019-20
GVA (at base prices; 2011-12=100) (Rs. Crore)	329612	330521	322116
Export of Ores, Slag, and Ash (Rs. Lakh)	1,158,657.68	1,290,944.88	2,240,051.12
Import of Ores, Slag, and Ash (Rs. Lakh)	4,181,561.98	2,963,129.54	1,869,924.58

Source: RBI database; Trade data: Export-Import databank, Ministry of Commerce.

In a recent study on the environmental impact of mines of CIL conducted by the Comptroller and Auditor General of India (CAG) (Kaur, 2019), in six mines the concentration of air pollutants like $PM_{2.5}$ and PM_{10} has been higher than the prescribed limit. CAG observed that during 2013-18, out of the 28 mines studied, water pollutants exceeded the limits prescribed by Bureau of Indian Standards in eight mines. Further, certain mines continued to use groundwater for their operations without obtaining a no-objection certificate from the Central Ground Water Authority.

CAG noted that six of the seven coal-producing subsidiaries of CIL did not have an environment policy approved by the Board of Directors as mandated by the Ministry. It recommended that all coal sector companies should have an environment policy approved by their respective Boards.

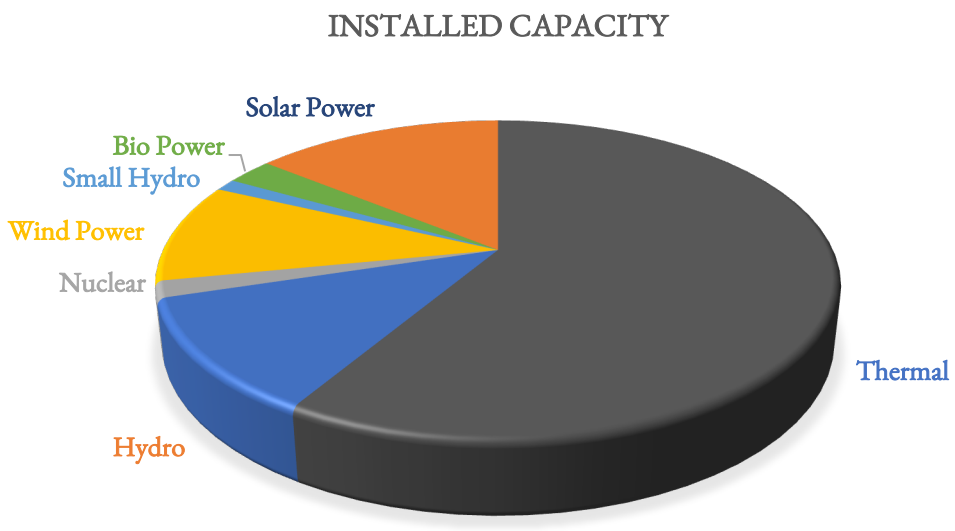
In line with the commitment of our country to reduce the total projected carbon emissions by one billion tonnes from now onwards until 2030, bio-reclamation of mined-out land has already been taken up on a big scale by all coal companies through massive tree plantation drives. In the next five years, the target is to cover more than 12,000 hectares of land for plantation, which will help in having carbon sink potential to the tune of more than one lakh tonnes per annum. Monitoring of such efforts is being done through remote sensing.

In order to contribute to our commitment to increasing, non-fossil energy capacity to 500GW by 2030, coal and lignite companies have planned to install an additional 5560 megawatts (MW) of renewable capacity with an investment of over Rs 15,000 crore. This will take the total installed capacity to 7 GW. Coal India alone has planned to install 3 GW of solar power in the next five years to achieve its net zero targets.

4.3 Power Sector

In the process of shifting towards a low-carbon path, the transition from fossil fuel-based power generation to non-fossil fuel-based power generation will play a critical role. Presently, the share of fossil fuels (coal, lignite, gas diesel) in the power generation accounts for 58.6% of the total installed capacity and non-fossil fuel (wind, solar, hydro, nuclear, and other renewable energy like biomass, etc.) accounts for 41.4% of the total installed capacity in India.

Figure 1: Category-wise Installed capacity



Source: National Power Portal (as of July 5, 2022)[8]

As of December 31, 2021, the total installed capacity for renewable energy in India is 151.4 GW. The government of India has set targets to reduce India's total projected carbon emission

by 1 billion tonnes by 2030, reduce the carbon intensity of the nation's economy by less than 45% by the end of the decade, achieve net-zero carbon emissions by 2070, and expand India's renewable energy installed capacity to 500 GW by 2030.

As per the Foreign Direct Investment (FDI) Data Cell, DPIIT, the Indian Non-Conventional Energy sector received approximately US$ 7.27 billion as FDI from the year 2014-15 up to June 2021. Of this, an FDI of US$ 797.21 million was attracted during 2020-21.

As part of the 2021-22 Union Budget, the Government of India announced an additional capital infusion of Rs 1,000 crore to the Solar Energy Corporation of India (SECI) and Rs.1,500 crore to the Indian Renewable Energy Development Agency (IREDA). The capital infusion of Rs. 1,000 crores will enable SECI to tender 15,000 MW of new solar energy generation capacity a year. This is estimated to attract an annual investment of more than Rs 60,000 crore, generate employment of 45,000 job-years, and reduce emissions by 28.5 million tons of CO_2 per year.

This same capital infusion will also enable SECI to deliver innovative projects with an investment value of around Rs. 17,000 crores. The Government of India's equity infusion of Rs. 1,500 crores to IREDA would support an extension of their loan facility of Rs. 12,000 crores to support renewable energy, in addition to IREDA's existing loan balance sheet of Rs. 27,000 crores.

The additional equity will help improve IREDA's financial position, in turn supporting lower interest rates for IREDA and renewable energy project developers. This investment is estimated to support the financing of around 4,500 MW of renewable energy projects (valued from Rs. 180 to 19,000 crore), generate employment of 13,500 job-years, and reduce emissions by 8.55 million tons of CO_2.

In January 2020, a study by Pai said that India would need to scale up its current solar capacity to nearly 30 times (about 1,000 GW) to transition about half a million people directly working in coal mines. The Government of India is aware of the potential issues in the just transition of the energy sector as well. It has been pushing for renewable energy jobs, too.

The Union Government launched a 'Suryamitra Skill Development Programme' in 2015, aimed to train people for employability in the solar sector. (Aggarwal, 2021) Around 12 million man-days' employment is being created per annum in the sector. More than 40,000 Suryamitras have been trained in the last five years to cater to the growing needs of the solar energy sector and its service industry (MNRE Annual Report 2019).

4.4 Manufacturing Sectors

Five industries (basic metals, paper, paper-related products, textiles, and chemicals and chemical products) constitute 32% of the total workers employed in the organised manufacturing sector in the year 2018-19. The manufacturing of textiles constitutes the bulk of these, accounting for 11% of the total workers employed in the organised manufacturing sector.

These sectors and some other labour-intensive manufacturing sectors are also analysed on the basis of other parameters like employment, net value added, total export, etc. Details are provided in Table A.2 of the Appendix.

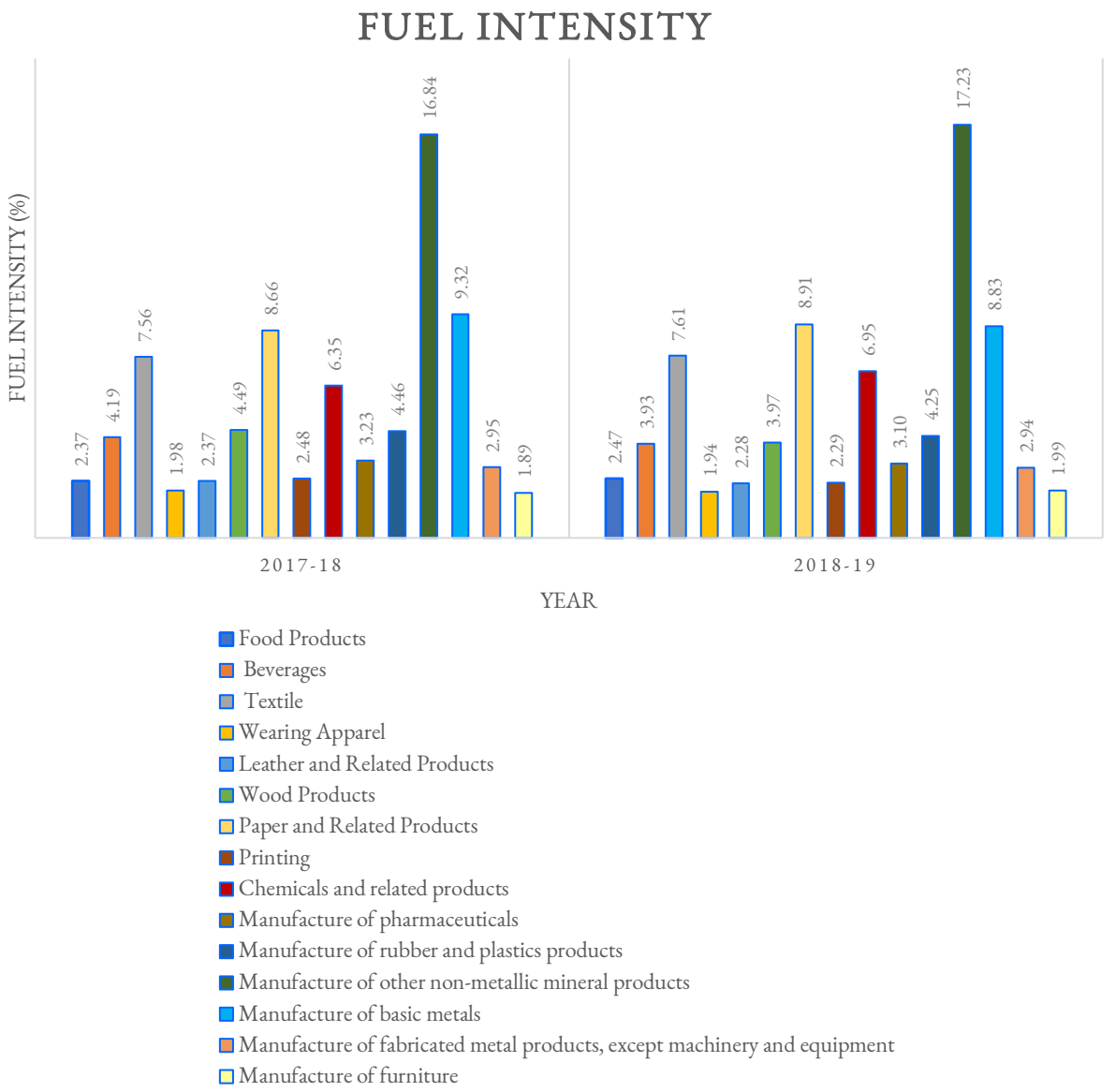
Manufacturing of Chemicals and Chemical Products constitutes 16% of India's total exports, and 5% of the total employment in the organised manufacturing sector in India. The sector is also important in terms of its total value-addition, accounting for 10% of the total value added by the organised manufacturing sector.

While analysing the fuel intensity (defined as the total fuel consumed as a share of the total output of the industry) of the Indian organised manufacturing industries (defined at the two-digit level of National Industrial Classification 2008), Figure 1 shows that the 'non-metallic mineral industry follows highly energy-intensive production techniques, followed by the manufacturing of basic metals, paper, paper-related products, textiles, and chemicals and chemical products.

This detailed analysis of the energy composition of these industries indicates that electricity purchased constitutes the bulk of the total energy consumed, followed by coal, petrol, and other fuels. Figure 2 shows that the consumption of coal is higher in the manufacturing of basic metals, followed by the manufacturing of other non-metallic minerals.

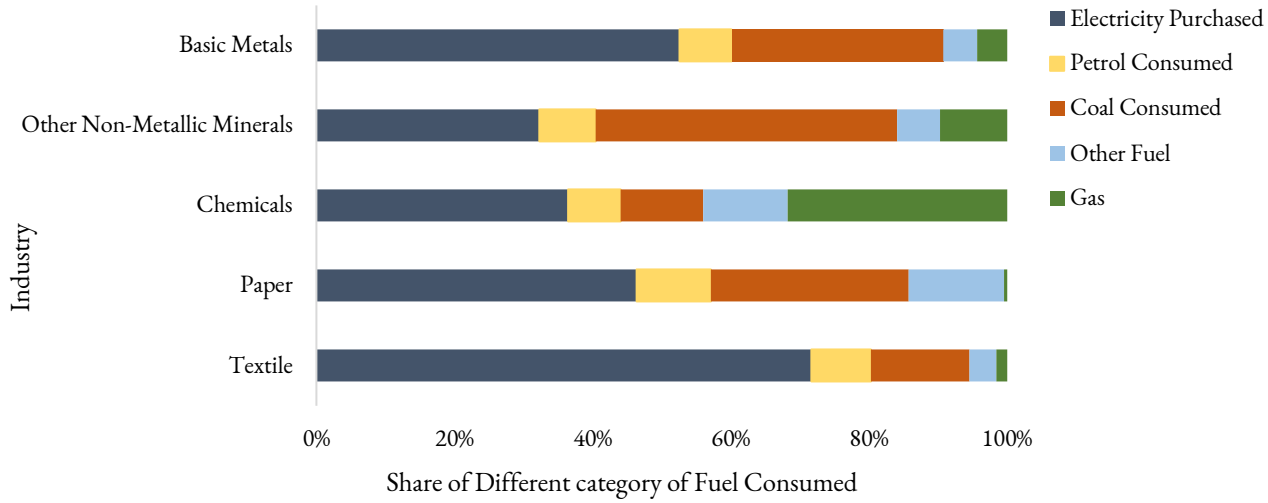
The other non-metallic mineral products (including glass and cement) sector, which follows a highly energy-intensive production technique, also accounts for 6% of the total employment in the organised manufacturing sector. The net value added by the sector, on average, for the two consecutive years 2017-18 and 2018-19 is 5%. It accounts for only 1.5% of the total exports of India.

Figure 2: Fuel intensity across organised manufacturing industries



Source: Authors' calculation based on ASI 2017-18 and ASI 2018-19 data

Figure 2. Energy Composition of selected organised manufacturing industries (2018-19)



Source: Authors' calculation based on ASI 2017-18 and ASI 2018-19 data.

The manufacturing of basic metals is the second-highest energy intensive sector. It is important to note that the share of coal in the total energy consumption is also very high. Moreover, the sector accounts for 6-7% of the employment in the organised manufacturing sector. The sector also accounts for 9-10% of the total value addition of the organised manufacturing sector. The sector is also important in terms of its export share: 5-6% of India's total export during both the periods of analysis, 2017-18 and 2018-19.

The manufacturing of paper and paper products is the third highest energy-intensive sector. In contrast to the manufacturing of other non-metallic mineral products and manufacturing basic metals, the paper manufacturing sector accounts for only 1% of the total employment in the organised manufacturing sector. Moreover, the share in India's total export has been also lower, accounting for only 0.5% in both 2017-18 and 2018-19, as shown in Table A.2 of the Appendix.

The Perform Achieve and Trade (PAT) Scheme is a key programme for large industries and establishments. This scheme aims to enhance the cost-effectiveness of energy savings, by upgrading technologies or by taking in-house actions to minimise energy consumption. The scheme provides mandatory targets for the identified large units and the excess energy saved by them is issued as Energy Saving Certificates, which are tradable instruments.

Different industries and establishments are assigned separate energy efficiency targets based on their levels of energy consumption and the potential for energy savings. By the year 2020, the scheme coverage has been extended to the 13 most energy intensive sectors in the country, including Cement, Iron and Steel, Fertilizer, Thermal Power Plants, Refineries, Petrochemicals, Railways, etc. This initiative is currently leading to energy savings of about 17 MTOE (Million

Tonnes of Oil Equivalent) and has resulted in the mitigation of about 87 million tonnes of CO_2 per year.

5. MSMEs

The Micro, Small and Medium Enterprises (MSME) sector has emerged as a highly vibrant and dynamic sector of the Indian economy over the last five decades. It contributes significantly to the economic and social development of the country by fostering entrepreneurship and generating large employment opportunities. The MSME sector occupies a position of prominence in the Indian economy, contributing to more than 45% of the industrial output and 40% of the country's exports in value addition terms.[9]

As per the National Sample Survey (NSS) 73rd round, conducted by National Sample Survey Office, Ministry of Statistics & Programme Implementation during the period 2015-16, there were 633.88 lakh unincorporated non-agriculture MSMEs in the country engaged in different economic activities[10], excluding those MSMEs registered under (a) Sections 2m(i) and 2m(ii) of the Factories Act, 1948, (b) Companies Act, 1956 and (c) construction activities falling under Section F of NIC 2008. Uttar Pradesh had the largest number of estimated MSMEs, with a share of 14.20% of MSMEs in the country.

The NSS 73rd round (conducted during the period 2015-16), shows that the MSME sector created 11.10 crore jobs[11] in the rural and urban areas across the country.

- The Micro sector, with 630.52 lakh estimated enterprises provided employment to 1076.19 lakh persons, accounted for around 97% of total employment in the sector.
- The Small sector, with 3.31 lakh estimated enterprises, and the Medium sector, with 0.05 lakh, provided employment to 31.95 lakh (2.88%) and 1.75 lakh (0.16%) persons of total employment in the MSME sector, respectively.
- Out of 1109.89 lakh people employed in the MSME sector, 844.68 (76%) are male employees, and the remaining 264.92 lakh (24%) are females.

Lack of access to the latest technologies makes this sector vulnerable to energy security and competitiveness in the global market. The poor energy and environmental performance are directly related to the lack of technical capacity in these enterprises to identify, access, adapt and adopt better technologies and operating practices.

In 2007, to recognise the importance of MSMEs in promoting energy efficiency, the 'National Programme on Energy Efficiency and Technology Upgradation of MSMEs' was flagged off by the Bureau of Energy Efficiency. Lack of access to finance for MSMEs is one of the stumbling blocks to implementing energy conservation measures and energy-efficient technologies.

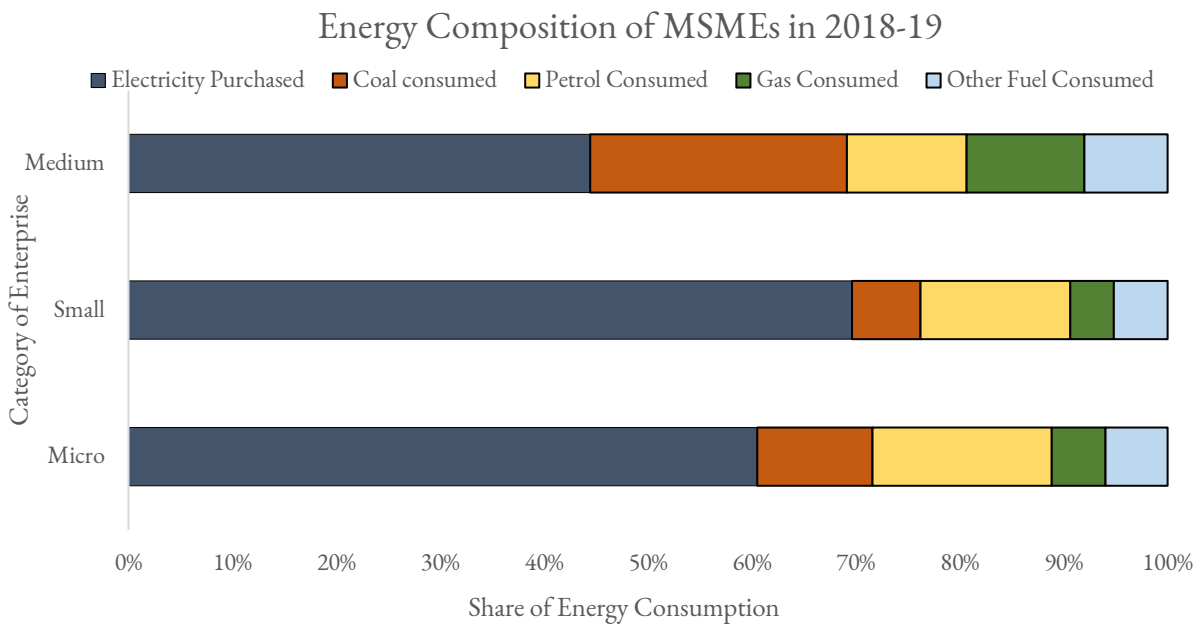
The Bureau of Energy Efficiency has also implemented EE technologies in energy-intensive clusters of India with the support from Global Environment Facility through UNIDO and World Bank. The project "Financing of Energy Efficiency at MSMEs" is part of the Global Environmental Facility (GEF) Programmatic Framework for Energy Efficiency in India, with an objective to increase demand for energy efficiency investments in target clusters, and to build their capacity to access commercial finance.

With climate change intensifying, the transition towards an energy-efficient economy is highly imperative for the manufacturing sector, including MSMEs, which account for a large part of the world's consumption of resources. While analysing the energy composition of MSMEs in the organised manufacturing sector, information regarding the electricity purchased, coal used, petrol used, gas used, and other fuel consumed by each manufacturing plant was extracted from the ASI unit level data 2018-19. The energy requirement across some of the MSME clusters is reported in Table A.3 of the Appendix.

From figure 3, it can be observed that MSMEs are highly dependent on electricity: 69% of the total energy used by **small enterprises**, 60% of the total energy used by th**e micro-enterprises,** and 44% of the total energy used by the **medium enterprises** comprises of electricity purchased.

In contrast to micro and small enterprises, coal used by medium enterprises is higher: approximately 25% of the total energy used. In micro and small enterprises, the share of coal is 11% and 6% of the total energy mix respectively. The share of gas used by medium enterprises is also higher than the micro and small enterprises. However, the share of petrol consumption in the total energy mix is higher in micro and small enterprises as opposed to medium enterprises.

Figure 3. Energy Composition of the MSMEs in the organised manufacturing sector



Source: Authors' calculation based on ASI 2018-19 data.

6. Conclusion

In light of India's COP26 commitment of reaching net zero by 2070, it is important to understand how India could ensure a 'just transition.' The process of transitioning to a low-carbon economy will affect sectors like coal, mining, power, formal manufacturing, and MSMEs. The study attempts to understand which sector may suffer or gain from efforts to transition. It looks at each of the sectors in terms of their employment, energy intensity, value-added, and export competitiveness. It also highlights different efforts and sector-policy measures taken up by the Government of India to accelerate the process of transition.

The study analyses some of the important macroeconomic consequences of the transition in terms of employment intensity, energy intensity, total value added, and export competitiveness of the above-mentioned sectors. Using data from the Annual Survey of Industries for 2017-18 and 2018-19 and key informant interviews, the paper presents a sectoral analysis of the transition in the Indian context.

Since the transition raises several questions regarding who will benefit from it and who will lose out, this paper offers an assessment of the sectors that will be impacted most by the transition. In terms of employment, the power and the coal sector will be affected the most.

As far as fuel use is concerned, there are differences within the manufacturing sectors – while for all the sectors, electricity purchased constitutes the largest source of fuel, it is highest in the textiles but lowest in other non-metallic minerals sector. Similarly, the consumption of coal is highest in the other non-metallic minerals and lowest for chemicals.

Among the MSMEs, electricity purchased is the largest source of fuel but varies from 44% in medium firms to 69% in small firms. The use of coal is highest in the medium firms at 25% while lowest in the small firms at 6%.

The spatial dimension of the transition will also be very important, since certain districts producing coal will be affected the most. Coal is being produced in 51 districts across 13 states in India. Korba district in Chhattisgarh accounts for the highest coal production.

There are several dimensions of the policy that need to be addressed. As noted, certain policies have been enumerated above. However, there are some dimensions that need attention – first, certain sectors and certain regions will be impacted more than others. This aspect of the transition needs to be recognised by the policy. Second, the losers in the process of transition will have to be compensated; alternatives in the form of technology, livelihood, and paths will have to be explored to ensure that the transition is just.

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APPENDIX

Establishing concordance between ASI and WITS data

Since the industrial characteristics in the Annual Survey of Industries database (ASI) are reported following NIC-2008, and the trade data extracted from the WITS database for each industry are reported following the ISIC Rev 3, it is necessary to establish concordance between the two structures. The steps followed in establishing the concordance include the following:

1. First, the detailed structure of ISIC Rev 4 and ISIC Rev 3 has been studied. It has been observed that the NIC 2008 has been developed based on ISIC Rev 4. For the selected seven industries concordance was established between NIC 2008 and the ISIC Rev 3 structure Accordingly, the export value of each industry (defined at the 2-digit level NIC 2008) was mapped.

2. While establishing one-to-one mapping of industries defined at the NIC 2-digit level, the detailed industrial structure at the 4-digit level of industrial disaggregation for both NIC 2008 and ISIC Rev 3 has been compared. The comparison at the 4-digit level becomes important because with the revision of industrial structure over time, the codes have been revised to maintain parity with the International Standard of Industrial Classification – and either new industrial codes have been assigned or many industrial codes have been subsumed under one.

For example, as shown in **Table A.1**, manufacturing of basic iron and steel defined by single industrial code 2410 (defined under NIC2008) subsumes 9 industrial codes (defined at the 4-digit level of ISIC rev 3). The detailed concordance has been reported in Table A.1 of the appendix.

Table A.1. Concordance between ISIC- REV3 and NIC 2008

NIC-2008 (Corresponds to ISIC Rev 4)	Industry Description	ISIC Rev 3
13	**Manufacture of Textile**	**17**
1311	Preparation and spinning of textile fibres	1711(p)+1713(p)
1312	Weaving of textiles	1711(p)+1713(p)
1313	Finishing of textiles	1712+1714
1391	Manufacture of knitted and crocheted fabrics	1730(p)
1392	Manufacture of made-up textile articles, except apparel	1721(p)+ 1722 (p)+1725(p)
1393	Manufacture of carpets and rugs	1722(p)+ 1725(p)
1394	Manufacture of cordage, rope, twine and netting	1723(p)
1399	Manufacture of other textiles n.e.c.	1724+1729

24	Manufacture of Basic Metals	27
2410	Manufacture of basic iron and steel	2711+ 2712+ 2713+ 2714+ 2715+ 2716+ 2717+2718+2719
2420	Manufacture of basic precious and other non-ferrous metals	2720
2431	Casting of iron and steel	2731
2432	Casting of non-ferrous metals	2732
10	**Manufacture of Food Products**	**15**
1010	Processing and preserving of meat	1511
1020	Processing and preserving of fish, crustaceans and molluscs and products thereof	1512(p)
1030	Processing and preserving of fruit and vegetables	1513(p)
1040	Manufacture of vegetable and animal oils and fats	1514
1050	Manufacture of dairy products	1520
1061	Manufacture of grain mill products, starches and starch products	1531
1062	Manufacture of starches and starch products	1532
1071	Manufacture of bakery products	1541
23	**Other Non-Metallic Mineral Products**	**26**
2391	Manufacture of refractory products	2692
2392	Manufacture of clay building materials	2691 (p)+2693
2393	Manufacture of other porcelain and ceramic products	2691(p)
2394	Manufacture of cement, lime and plaster	2694
2395	Manufacture of articles of concrete, cement and plaster	2695
2396	Cutting, shaping and finishing of stone	2696
2399	Manufacture of other non-metallic mineral products n.e.c.	2699
29	**Motor Vehicles, Trailers and Semi-Trailers**	**34**
2910	Manufacture of motor vehicles	3410
2920	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	3420(p)
2930	Manufacture of parts and accessories for motor vehicles	3430
22	**Manufacture of Rubber and Plastic Products**	**25**
2211	Manufacture of rubber tyres and tubes; re-treading and rebuilding of rubber tyres	2511
2219	Manufacture of other rubber products	2519(p)
2220	Manufacture of plastic products	2520(p)

12	Manufacture of tobacco products	16
1200	Manufacture of tobacco products	1600
20	**Manufacturing of Chemical and Chemical Products**	**24**
2011	Manufacture of basic chemicals	2330(p)+2411+2429(p)
2012	Manufacture of fertilizers and nitrogen compounds	2412
2013	Manufacture of plastics and synthetic rubber in primary forms	2413
2021	Manufacture of pesticides and other agrochemical products	2421
2022	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	2422
2023	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	2424
2029	Manufacture of other chemical products n.e.c.	2429(p)
2030	Manufacture of man-made fibres	2430
17	**Manufacture of Paper and Paper Products**	**21**
1701	Manufacture of pulp, paper and paperboard	2101
1702	Manufacture of corrugated paper and paperboard and containers of paper and paperboard	2102
1709	Manufacture of other articles of paper and paperboard	2109+3699(p)

Source: National Industrial Classification 2008 and 2004, MOSPI

Notes

[1] The database provides information on different trade indicators: export/import, tariff rates, and non-tariff measures across both industries (defined based on Standard international trade classification (SITC) and ISIC classification) as well as commodities (defined based on Harmonized Codes classification) for 223 countries over the period from 1962 to 2020.
[2] Data used for calculation is sourced from the RBI Reserve Bank of India and the metric for the gross domestic product at the national and sub-national level is GDP at constant prices.
[3] Based on stakeholder interactions.
[4] Ibid
[5] The post-transition period will vary by sector.
[6] https://coal.gov.in/sites/default/files/2021-01/productiondata_tenyear.pdf
Import:https://coal.gov.in/en/major-statistics/production-and-supplies#:~:text=%E0%A4%95%E0%A5%8B%E0%A4%AF%E0%A4%B2%E0%A4%BE%20%E0%A4%AE%E0%A4%82%E0%A4%A4%E0%A5%8D%E0%A4%B0%E0%A4%BE%E0%A4%B2%E0%A4%AF%20Ministry%20of%20Coal&text=Coal%20India%20Limited%20(CIL)%20and,a%20negative%20growth%20of%200.98%25.
Export: https://coal.gov.in/sites/default/files/2021-01/Export-of-Coal-last-ten-years.pdf
[7] Mining and Quarrying: https://www.rbi.org.in/scripts/PublicationsView.aspx?id=20408 (as accessed on 23.3.2022)
Trade data: https://tradestat.commerce.gov.in/eidb/default.asp
[8] As accessed on July 7, 2022.
[9] During the period 2014-15 to 2018-19 the contribution of MSMEs in total manufacturing (at current prices) has varied between 31-33%. According to the DGCIS report, the export of MSME sector in India's total export is 49.8% and 49.5% in the year 2018-19 and 2019-20 respectively. https://msme.gov.in/sites/default/files/MSME-ANNUAL-REPORT-ENGLISH%202020-21.pdf

[10] 196.65 lakh in Manufacturing, 0.03 lakh in Non-captive Electricity Generation and Transmission, 230.35 lakh in Trade and 206.85 lakh in Other Services.
[11] 360.41 lakh in Manufacturing, 0.07 lakh in Non-captive Electricity Generation and Transmission, 387.18 lakh in Trade and 362.22 lakh in Other Services.