A FISCALLY RESPONSIBLE GREEN STIMULUS

AUTHORS:
AJAY SHANKAR AND TCA AVNI

THE ENERGY AND RESOURCES INSTITUTE
Creating Innovative Solutions for a Sustainable Future

Suggested format for citation

Shankar Ajay and TCA Avni. 2020.
A Fiscally Responsible Green Stimulus.New Delhi: The Energy and Resources Institute.

Acknowledgements

We are deeply grateful to Dr Ajay Mathur, Mr Girish Sethi, Mr S Vijay Kumar, Dr Preeti Madan, Mr A K Saxena, Mr Ashvini Kumar, Mr Thomas Spencer, Mr Sunil Dhingra, and others for their valuable feedback and suggestions. We would also like to thank Mr Saurabh Kumar, Managing Director, EESL for his valuable feedback.

For more information

Project Monitoring Cell
T E R I
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003
India

Tel. 2468 2100 or 2468 2111
E-mail pmc@teri.res.in
Fax 2468 2144 or 2468 2145
Website www.teriin.org
India +91 • Delhi (0)11

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 EXECUTIVE SUMMARY

This paper suggests measures for a green stimulus. These measures would lead to demand and job creation and accelerate India's transition towards cleaner air and a lower carbon economy. Recognizing that government revenues have fallen sharply and that there are many urgent claims on their limited resources, the paper explores ideas which can both create economic demand and jobs, and result in substantial private investment primarily through policy and regulatory interventions. By focusing on demand-side interventions, the proposals aim to support initiatives which would become independently viable, and which will, in turn, be able to generate employment. Some of the measures, such as those which aim to increase access to clean and reliable energy in rural areas, will also help power rural enterprises, creating virtuous cycles of investment and employment. By creating additional demand in the market, the measures being proposed would enhance the utilization of the liquidity created through the stimulus package the government has announced.

The proposals are summarized below:

a. Incentivizing Cleaner Transport

Vehicular traffic is a significant contributor to air pollution and of $PM_{2.5}$ emissions. Incentivizing fleet modernization of existing vehicles to BSVI, use of electric vehicles and provision of buses for public transport are proposed.

The following measures are recommended:

1. Introduction of a 50% rebate on vehicle taxes (including GST) on purchase of new BSVI vehicles in exchange for scrapping of older vehicles.
2. Government credit guarantee for purchase of buses to meet the shortfall of public transport in the country.
3. Transition to (i) use of electric buses for inner city transport and (ii) use of electric vehicles only by government for inner city use. Charging infrastructure to be put by Distribution Companies.
4. The implementation is to be spread over the next five years.
5. The potential stimulus would be ₹160,000 crores per annum.

b. Renewable Energy from Agricultural Residues

Announce a commercially viable procurement price for the next five years for briquettes made from crop waste. Briquettes would be used as fuel for co-firing, up to 10%, in thermal power plants.

The stimulus potential is ₹22,470 crores per annum.

c. Renewable Energy from Animal Husbandry Waste

   Introduce a commercially viable feed-in tariff for purchase of electricity generated from animal husbandry waste (excreta from cattle, poultry, pigs, etc.) by Distribution Companies. The slurry waste can be additionally sold as organic manure.

   The full use of animal waste may take 6-8 years. This has an investment stimulus potential of ₹88,000 crores.

d. Promoting Solar Generation in Rural India

   Announce a commercially viable feed-in tariff for purchase of electricity generated from rural areas in the kW range by Distribution Companies.

   Farmers would get more income and the Distribution Companies would save around ₹3 per unit.

   Assuming 1 MW potential in a village, the national potential is 600GW. It may take up to 10 years to achieve the full potential.

   This has a stimulus potential of ₹27,00,000 crores.

e. Green and More Competitive MSMEs

   The stimulus package envisaged by the government can be used to finance investments in the MSME sector for enhancing competitiveness through energy efficiency.

   India has around 700,000 registered factory sector manufacturing enterprises. Achieving an average of 15% savings through energy efficiency technologies and best practices in energy intensive units would result in estimated savings of ₹15,000 crores every year.

f. Creation of Domestic Manufacturing Capacity for Solar Power and Energy Storage

   Invite bids for solar power with-storage with the condition that manufacturing with full value addition would be done in India. This would result in self-reliance in this critical area.

   Capturing the domestic demand for solar equipment would be able to generate value of ₹2,94,000 crores by 2030 through import substitution.

The total stimulus being proposed would be approximately ₹40,00,000 crores (or 540 billion USD) which would be spread over the coming decade.

2 INTRODUCTION

On 24 March 2020, in order to curb the spread of the coronavirus pandemic, a 'total' lockdown was imposed in India. The closing of most major sectors of the economy, with only essential services being allowed to function, has had an adverse impact on the economy. While gradual easing of the lockdown began by the end of May, when the lockdown entered its 4th phase, it would take time for economic activity to return to normalcy, especially since the number of cases is still rising. And when they would peak is a matter of conjecture.

The first quarter of this financial year has seen significant economic contraction, with estimates of contraction ranging from 26% to 40% (Buisness Standard, 2020). The revenues of government, primarily tax collections, have fallen sharply. The Union Ministry of Finance's monthly macroeconomic report for June 2020 estimated that revenue receipts for April and May registered a negative growth of 68.9% (Department of Economic Affairs, 2020). As a consequence, the fiscal deficit is rising. The state governments are also under severe financial stress. The central government has permitted state governments to borrow an additional 2% of their state's gross domestic product. The year would end with negative growth. The IMF has projected a 4.5% contraction in India's GDP (Mishra, 2020). Till social distancing is mandatory, both the manufacturing and services sectors would find it difficult to revive. The plight of migrant workers and those at the bottom of the pyramid has been vividly seen. Enterprises, small, medium, and large are in stress. Better paid white collar jobs are being lost as layoffs by larger firms take place across the spectrum (Dash, 2020).

The government has put together a ₹20 lakh crore stimulus package. The thrust so far has been on increasing liquidity in the system through measures such as partial and complete credit guarantees for small and medium enterprises. The revival and restoration of health of NBFCs is being attempted. The RBI has been reducing repo rates and reverse repo rates even more, so as to get banks to lend and at lower interest rates. But banks can lend only if there is demand for credit. And demand for credit needs economic activity in the market place where credit can be profitably used. This in turn needs increase in demand for domestic goods and services which is not going to happen easily.

There has, therefore, been an increasing consensus that there is need for fiscal stimulus measures to increase demand. The traditional approach of trying to lower the fiscal deficit would need to be kept in abeyance till recovery takes place. Even monetization of the deficit has been advocated by many mainstream economists. The fact remains that just to keep government running will require the fiscal deficit to rise. Creating additional demand and employment through a fiscal stimulus would become imperative in the coming months. But even if the government is bold enough to monetize the deficit, there would still be limits on how far it could go in increasing the fiscal deficit. If the deficit is to be brought down after recovery then only short term, and not medium to long term, fiscal commitments should be made.

Globally, the pandemic has drawn sharp focus towards the impending catastrophe from climate change. Calls for not delaying action are gaining greater momentum. As a result, countries across the world are looking to use the crisis to promote greener, cleaner, and more resilient economies. A total of 17 EU countries, including Germany, France and Italy, have recommitted their countries to their previously announced Green Deal (Gewessler, *et al.*, 2020). The Green Deal envisages creating a comprehensive framework of regulations, legislations, and financial incentives to make Europe 'climate-neutral' by 2050, with goals for different sectors, including industry, construction, biodiversity, energy, transport, and food. In the US, the Democrats in the Congress have been trying to get consensus on an infrastructure spending bill built on the principles of the 'Green New Deal'. South Korea's New Green Deal provides for substantial investment in renewable energy, and reduction in fossil fuel use through carbon taxes and phased reductions of coal financing by public sector institutions (Huang, 2020).

While a Green Deal similar to what other countries have put together would be difficult for India to consider now in view of the absence of fiscal space, a Green Stimulus would be good for India; both for making the transition to a green economy as well as for a speedier economic recovery. Can a stimulus be provided without fiscal resources? Can it be done with other policy instruments? Are there feasible regulatory measures which would work? Can demand be created without the government spending money (or by minimizing it)?

This paper follows this line of analysis. It suggests feasible measures for a Green Stimulus where with policy instruments and regulatory measures, demand is created in such a way that private investment for a green economy is made commercially attractive. By creating additional demand in the market, the measures being proposed would enhance the utilization of the liquidity created through the stimulus package the government has announced. The Green Stimulus being suggested turns out to be quite large. It would also be spread over some years. It would not only help in economic recovery, but would also continue to give greater momentum after the pandemic is over, and accelerate India's environmental transition.

3 CLEAN AIR: REDUCING AIR POLLUTION FROM TRANSPORT

Deteriorating air quality in India has assumed crisis proportions. According to the World Air Quality Report 2019 compiled by IQAir Air Visual, India had 21 of the 30 most polluted cities in the world in 2019. Air pollution is estimated to have been responsible for 1.2 million deaths every year (Health Effects Institute, 2019). It can be characterized as a national health emergency.

Vehicular traffic is a major contributor to particulate matter emissions. A source apportionment study conducted by TERI in Delhi showed that transport contributed 23% of the $PM_{2.5}$ emissions (TERI, 2018), $PM_{2.5}$ has been found to have one of the strongest associations with mortality and morbidity (Pope III, *et al*. 2011).

The government has taken steps for cleaner transportation by pushing for increased adoption of electric vehicles as well as by improving emission standards for conventional vehicles. The mandatory implementation of the much more stringent Bharat Stage (BS) VI (equivalent to the Euro 6 emission standards) started from 1 April 2020 both for new vehicles and for fuel across India.

Vehicular traffic is a significant contributor to air pollution and of $PM_{2.5}$ emissions. Incentivizing fleet modernization of existing vehicles to BSVI, use of electric vehicles, and provision of buses for public transport are proposed.

The following measures are recommended:

1. Introduction of a 50% rebate on vehicle taxes (including GST) on purchase of new BSVI vehicles in exchange for scrapping of older vehicles.
2. Government credit guarantee for purchase of buses to meet the shortfall of public transport in the country.
3. Transition to (i) use of electric buses for inner city transport and (ii) use of electric vehicles only by government for inner city use. Charging infrastructure to be put by Distribution Companies.

The implementation is to be spread over the next five years.

The potential stimulus would be ₹160,000 crores per annum.

While all new vehicles would be BS VI compliant and their emissions would be at European levels, the old ones would continue to pollute as using BS VI fuel does not materially lower emissions from vehicles which are BS IV or lower. As long as these vehicles are on the road, pollutions levels will remain high. In a business-as-usual scenario, the real benefits of BS VI will take many years to be experienced as the older vehicles go off the road over the next 10 to 15 years. The health crisis caused by air pollution does not permit the luxury of transition spread over a long period of time.

Further, the impact of the current crises on personal incomes and jobs is likely to exacerbate the pre-Covid decline in demand for new vehicles. Longer retention periods of existing vehicles and preference for purchase of older, more polluting cars over new clean non-polluting ones are more likely. The auto sector and its supply chain have a very large share in manufacturing, and the need for measures for increasing demand had been felt even before the lockdown was announced. The need is now more urgent.

In this scenario, a policy regime to encourage the purchase of new vehicles and the scrapping of old ones would meet the dual objectives of stimulating demand for the auto sector and saving jobs, and at the same time accelerate the transition to cleaner air and improvement of public health.

The following are proposed for consideration:

1. Fleet modernization for conventional vehicles
    a. Introduction of a 50% rebate in vehicle taxes (including GST) on purchase of new BS VI vehicles in exchange for an old vehicle with the old one being scrapped. A 50% rebate would amount to an over 10% reduction in price approximately. This incentive should generate additional demand.
    b. Licensed yards for scrapping would need to be set up with the assistance of state governments that would need to facilitate provision of land at reasonable rates and the requisite clearances. Digital traceability of actual scrapping would be necessary. These facilities should be state-of-the-art with recycling to the extent feasible.
    c. The 50% rebate in taxes being proposed can be seen as being revenue positive as it would generate additional demand which brings in at least 50% additional taxes instead of none.
    d. The scheme would work best if the carrot of the rebate is combined with a stick. For personal and commercial vehicles, this could be structured as follows:
        - Allowing no commercial vehicles which are more than six years old after, say, 31 March 2022 to run anywhere in India. These vehicles would lose their registration automatically. This would have a substantial impact on air pollution as commercial vehicles pollute the most.
        - For personal vehicles, the rational principle would be mandatory scrapping based on proper measurement of emissions and breach of prescribed norms. This is being done in Western countries. By the end of 2022, such modernization and real-time digital recording of emissions from testing of individual vehicles across the whole of India should be possible. Otherwise, age-based criterion of replacing all BS II and III vehicles by, say, 31 March 2023, and all BS IV by March 2026 can be considered.

A TERI study estimating the impact of a proposed progressive fleet modernization program for commercial vehicles (see Figure 1 for proposed strategy and projected reduction in emissions), analysed that the program could result in significant gains in reduced air pollutant emissions on implementation.

With the assumption the proposal can revive automobile sales to a 7% growth rate (the rate of growth averaged from 2014 to 2018), the measure would have the potential to provide an estimated stimulus of ₹138,000 to ₹240,000 crores every year (assuming that the stimulus is able to provide a growth of 7% over 2019-20 values instead of a year-long contraction of 20-40% in the current trajectory (see Table 1).

Phase	Implementing Year	Strategy	Reduction in Emissions	
			$PM_{2.5}$	NO_x
I	2020	All BS-I + All BS-II commercial vehicles transformed to BS-VI	40%	43%
II	2021	All BS-II + BS-III commercial vehicles between (2010-2013) transformed to BS-VI	58%	61%
III	2022	All BS-II + All BS-III commercial vehicles transformed to BS-VI	69%	72%
IV	2025	All BS-IV commercial vehicles transformed to BS-VI	79%	81%
Total cumulative reductin during 2020-40			1167 kt	18788 kt

Figure 1: Emission reduction potential of fleet modernization scheme in different years
Source: Sharma, *et al*., 2020

Table 1: Automobile sales and turnover trends

Year	Domestic Sales (in million units)	Exports (in million units)	Total Sales (in million units)	Gross Turnover (in million USD)
2014–15	19.72	3.57	23.30	58,909
2015–16	20.46	3.64	24.10	63,866
2016–17	21.86	3.48	25.34	67,724
2017–18*	24.98	4.04	29.02	76,520
2018–19*	26.27	4.63	30.90	81,111
2019–20*	21.55	4.77	26.31	69,447
2020–21* (assuming 7% increase)				74,309
2020–21* (assuming 20% contraction)				55,558
2020–21* (assuming 40% contraction)				41,668

Notes: *Projected increase
Gross turnover is calculated at a conversion rate of 1 USD = 74 INR

Source: (SIAM, 2020)

2. Electric mobility for public transport and inner-city travel
    a. Ramping up and revamping public transport
        - The public transport facilities of most, if not all, major cities had even before the current crises experienced a significant shortfall in capacity. Delhi, for example, had only 5700 buses against a sanctioned strength of 11,000. Requirements for social distancing would imply an even further shortfall in capacity.

- The central government should finance this procurement of additional buses to bridge the gap through a mix of grant and concessional loans. Governments should also stipulate that all inner-city buses be only electric. There is zero air pollution from the running of electric vehicles. This could be a conditionality for central financing.
- While the initial capital outlay for electric buses would be higher than that of conventional vehicles, the lower fuel and maintenance costs would mean that the life cycle costs of electric buses would continue to be lower– a LBNL report estimated that electric buses would be able to pay back the extra upfront investment in about 3 years, while the life cycle savings per electric bus would range between ₹67 lakhs and ₹132 lakhs (Khandekar, Rajagopal, Abhyankar, *et al*. 2018). The authors further argued that complete electrification of bus fleets could offer savings in the range of 126% to 248% of the annual loss that state road transport corporations in India suffered. Moreover, sustained public tendering would also allow the technology to mature and gain economies of scale, allowing increasingly competitive prices to be discovered, and would further reduce the life cycle costs.
- Assuming that the nation-wide shortfall in public transport capacity is of 50,000 buses (which would possibly be a significant underestimate given that even Delhi has a shortfall of almost 5000 buses), making up even just the capacity shortfall would provide a stimulus in the range of 35,000 to 45,000 crores (assuming that the cost of purchase when procured outright would be similar to those discovered previously by Kolkata and Lucknow under the FAME scheme (Khandekar, Rajagopal, Abhyankar, *et al*. 2018))

b Increased push for electric mobility in government inner-city travel

- There should be a mandate that government departments should purchase only electric vehicles for inner-city travel. Further, contracts for hiring taxis by the government should be given only to companies which can supply electric vehicles, with the expectation that all cars which are primarily meant for inner-city travel be eventually transitioned to electric vehicles.
- EESL (a joint venture under the Ministry of Power) for example, estimates that replacing the 500,000 cars deployed in government offices across the country with electric vehicles over a 3-4 year period would lead to fuel savings of about 83.2 crore litres per year and 22.3 lakh tonnes of CO_2 reduction (EESL, n.d.). And when the numbers of cars hired by state governments, institutions, and PSUs are added in, the number of conventional vehicles which can be potentially replaced with electric vehicles rises even further– just the central

government employees above Joint-Secretary rank (who are entitled to a personal staff car for official use) in Bangalore, Chennai, Greater Mumbai, Hyderabad, and Kolkata alone, for instance, are 7000 in number. Moreover, since a significant portion of government travel is for inner-city driving, and since government vehicles have designated parking in government offices, a significant portion of government travel is for inner city driving. Government vehicles already have designated parking spaces. These would be natural spaces to set up the charging infrastructure.

- Replacing government cars intended for inner-city travel with electric vehicles would provide a stimulus potential of ₹75,000 crores (assuming that the electric vehicle would be purchased at a capped cost of ₹15 lakhs).

While the government has also been pushing for greater adoption of electric vehicles through the FAME (Faster Adoption and Manufacturing of [Hybrid &] Electric Vehicles) scheme, a critical component required for the extensive adoption of e-vehicles for personal and commercial use, however, would be a robust charging infrastructure. A TERI analysis estimated that of the cost of putting up the charging infrastructure for Delhi's 29,000 kms of roads as per the recommendations of the Ministry of Power would be somewhere between ₹114 crores and 170 crores – a back of the envelope calculation estimates that investments in charging infrastructure across the country's urban and highway network would require approximately ₹6,000–₹9,000 crores. The Distribution Companies may through a policy directive be mandated to put up the charging infrastructure in cities. For the aforementioned proposals for both public transport and government vehicles (for whom designated parking is already a necessity), for example, bus depots and government offices, respectively, would be natural spaces for charging infrastructure to be set up. In the rest of the city as well, DISCOMs could be mandated to put up the charging infrastructure at appropriate spaces which would maximize their utilization.

The investment may be treated as part of distribution capital expenditure and the State Regulatory Commissions would then be required to give return in this investment. This can be done through a combination of tariff increase across consumer categories, and through the unit electricity charges for the electric vehicles. By costing the electricity supplied through the charging networks at rates equivalent to commercial tariffs, electric mobility would provide financially beleaguered Distribution Companies a viable, steady source of revenue. Moreover, given the cost differential between the mileage possible in electric and ICE vehicles, costing electricity at even commercial rates would continue to provide a substantial reduction in running costs for electric vehicles as shown in Table 2.

Table 2: Cost comparison of Electric and ICE Car and City Bus

	Conventional Vehicle (Low End)	Electric Vehicle (Low End)	City Bus (CNG)	City Bus (Diesel)	City Bus (Electric)
Investment Cost (₹)	480,000	336,000	6,000,000	6,000,000	4,500,000
Battery Cost (₹)	0	576,625	0	0	4,900,000
Fuel Economy (kWh/100 km)*	39	14	91	322	94
Fuel Price (₹)	₹ 80/l petrol	₹ 10/kWh	₹ 43/l CNG	₹ 80/l Diesel	₹ 10/kWh
Fuel Price Escalation (% yoy)	4%	2%	4%	4%	2%
Non-Fuel O&M Costs (₹/km)	5	2.5	10	10	5
Lifetime km Travelled**	200,000	200,000	657,000	657,000	657,000
Total Cost of Ownership (₹/km)	**14.13**	**13.51**	**44.13**	**53.10**	**37.64**
Of which fixed costs (₹/km)	3.43	6.51	14.58	14.58	22.84
Of which variable costs (₹/km)	9.12	3.98	29.55	38.52	14.80

*Fuel Economy for ICE Vehicles is calculated using the energy density (8.8 kWh/l for Petrol, 3.02 for CNG and 10.72 for Diesel)

**Assuming lifetime ownership of 10 years

Source: TERI modelling

This is in the nature of a conventional fiscal stimulus. A feasible way of financing this would be for the central government providing an interest subsidy of, say, 5% with the state government guaranteeing the debt of the agencies which run the city bus services. With a government guarantee, these buses could be purchased entirely on debt and so no immediate outgo from the budget would be required. The advantage of an interest subsidy is that the subsidy claims would begin after a few quarters by when the fiscal situation should start improving.

Stimulus Potential

1. Fleet modernization is estimated to provide a stimulus of ₹138,000 to 240,000 crores every year
2. Making up even the capacity shortfall would provide a stimulus in the range of 35,000 to 45,000 crores
3. Replacing government cars intended for inner-city travel with electric vehicles would provide a stimulus of ₹75,000 crores

Assuming the lower order range of each of these estimates, the annual stimulus potential adds up to ₹160,000 crores (or 800,000 crores over the projected 5-year horizon).

4 RENEWABLE ENERGY FROM AGRICULTURAL WASTE

Announce a commercially viable procurement price for the next 5 years for briquettes made from crop waste. Briquettes would be used as fuel for co-firing, up to 10%, in thermal power plants.

The stimulus potential is ₹22,470 crores per annum.

The net cropped area in India is 141.4 million hectares (Mha), (Ministry of Agriculture and Farmers Welfare 2017.). Harvesting of various crops generates large volumes of agricultural waste both on and off farms.

India's crop residues are estimated to be around 600 million tonnes every year, with generation being the highest in Uttar Pradesh (responsible for 17.9% of total biomass generated), followed by Maharashtra (10.52%), Punjab (8.15%) and Gujarat (6.4%) (TIFAC, 2018). The use of crop residues varies across the country. The residues of most cereals and pulses are used for fodder, while the remaining woody residues have potential for use as fuel. The mechanization of harvesting and the pressure to clear the field of residue in time for the next crop, often results in farmers using open burning to clear their fields. An estimated 140 MT of crop residues are burnt in India every year (TIFAC, 2018). The burning of these residues creates an air pollution crisis in northern India during the harvest of the Kharif crop. An estimated 39 million tonnes of paddy straw are being burnt every year in Haryana, Punjab, Uttar Pradesh, and Rajasthan. (TERI, 2020). Crop burning results in a sharp spike in the level of air pollution– a 2019 study on the impact of crop burning on air quality in New Delhi estimated that $PM_{2.5}$ levels increase by nearly 60% in the post-monsoon season (TERI, 2019), (Jethva, et al., 2019). This creates a health crisis every year.

Making the crop waste a commodity with a price that gives farmers a margin over the cost to pull out the crop residue would put an end to the burning of the crop residue in the fields. The Supreme Court had suggested as much during hearings on the air pollution crisis last year. This would then get farmers to either purchase or rent the specialized machines such as balers to take out and collect the crop waste and sell it.

The crop waste can be used for value addition through densification of residues into briquettes. These pellets can be used in industrial boilers for process heat. They can also be used by thermal power plants for power generation by adding it to coal (Purohit & Chaturvedi, 2018). The National Thermal Power Corporation (NTPC) has shown that up to 10% crop waste briquettes can be successfully blended with coal, allowing co-firing in power plants. The NTPC, which procured pellets through open tenders also found that the cost of pellets was similar in terms of calorific value to that of the coal they were using. Hence, the cost of power generation did not go up when coal was replaced to the extent of 10% by pellets made from crop waste; a renewable source.

As a result, the CEA has issued an advisory to all public and private power generating companies to endeavour to co-fire 5% to 10% biomass pellets along with coal in their thermal power plants (CEA, 2018).

Commitments to buy all the production of pellets made from crop waste at a viable price would act as the trigger for private investment. This commitment has to be there for at least the next five years (using the assumption that the private investor can fully recover capital cost through amortization in this period). With this risk mitigation through a pre-announced procurement price for all the pellets that are brought for sale, a large number of entrepreneurs would emerge who would buy the crop waste, convert these into pellets, and then supply pellets to power plants. The state governments would, through the district administrations and Panchayats, need to facilitate provision of land at reasonable rates on lease/rent for the pellet-making plants on a decentralized basis. This would be a case of state policy creating demand which in turn would create supply through private investment.

In order to promote the use of biomass pellets, all fluidized bed and pulverized coal units (coal-based thermal power plants) of public and private power-generating utilities could be mandated to use 5%–10% blend of biomass pellets, primarily agro-residues, along with coal. Assuming 2.75 lakh tonnes of biomass pellets are needed for 7% blending in a thermal power plant of 1000 MW capacity, power plants running at plant load factors of 60% will be able to absorb 1.65 lakh tonnes of pellets. With the overall thermal power generation capacity of 205 GW (CEA, 2020), the estimated daily biomass pellets requirement would be about 87,898 tonnes. This would utilize about 32.1 Mt of crop residues annually, which is about 23% of the total annual surplus crop residue in the country (TERI, 2020). Valorizing agricultural residues would substantially reduce the carbon emissions– estimated at 8.57 Mt of CO and 141.15 Mt of CO_2– that crop burning releases (Jain, Bhatia, & Pathak, 2014).

NTPC in its pilot project has, by inviting bids, done price discovery. This price can be used as the base for announcing the procurement price for the purchase of all the pellets that entrepreneurs are able to make from crop waste. As per the recent tender by NTPC, the discovered price of agro-residues pellets is about ₹2/1000 kcal heat value. Assuming agro-residues pellets CV is 3500 kcal per kg, the price of pellets comes to ₹7000 per tonne. This results in total ₹22,470 crores of procurement of pellets annually by TPSs (NTPC, 2018).

In addition to being absorbed in thermal power plants, use of biomass briquettes could also be pushed in coal-intensive industrial activities such as brick kilns. The second largest consumer of coal in India, the brick sector consumes 62 million tonnes of coal every year (World Bank, 2020). Given the co-location of most brick kilns with regions that have high prevalence of agricultural residue burning (Assam, Bihar, Haryana, Punjab, Uttar Pradesh, and West Bengal account for 65% of brick production), substitution of biomass briquettes for coal would be able to absorb a significant portion of crop resides which would otherwise have been burnt in the fields.

Centralized procurement of biomass pellets could help make biomass pellets more widely available to the brick kiln enterprises, which are typically small and scattered. Greater availability would spur the replacement of coal in brick kilns and other enterprises.

As the procurement and usage process mature, bulk procurement and competitive market forces would drive movement down the cost curve through technological improvements and economies of scale in the manufacture of pellet making plants. There would also be optimization of the scale of the plant where there is a trade-off between size and the distance to which the crop residue which is voluminous is carried (see Annexure 1).

As a competitive pellet making industry structure with many entrepreneurs and plants gets established, other possibilities would open up. Briquettes could be utilized for other purposes such as in locally located manufacturing units for process heat generation, or to satisfy the local requirements of heating and/or cooking. Technology could evolve to see crop residues being used in the production of paper, tableware, fabric, etc. Some state funding for R&D, innovation challenges, and a supporting ecosystem would facilitate these developments.

A key necessity for the creation of value chains, however, and the ability of the valorization to become a more mainstream technology would be longer-term assurances and (more importantly) policy continuity over sufficiently long horizons. Disruptions and discontinuity weaken supply chains and increase risks associated with individual ventures. In the case of creating productive uses for farm waste for example, news reports found that farmers and entrepreneurs who had invested in baler-and-rake combos to uproot paddy straw and compress it into bundles for easy transportation, complained that the shut-down of the biomass-based power plant to which they supplied the straw left them stranded (Moudgil, 2020).

Stimulus Potential

The annual procurement of 32.1 Mt of biomass briquettes at a purchase price of ₹7000 per tonne would result in a stimulus potential of ₹22,470 crore every year. The overall stimulus over five years is estimated to be over ₹112,000 crores.

4.1 Annexure

Transportation and storage costs are significant (Purohit & Chaturvedi, 2018). Transporting the agricultural residue from the farm gate to the briquetting plant, and transporting the briquettes to the final consumer are a significant part of the total cost. However, given the volumetric compaction which happens on briquetting, overall costs of biomass pellets are more strongly influenced by the distance the unprocessed residue would need to travel – Figure 2 shows the impact of distance of farm gate to the briquetting plant. Hence, facilitating the setting up of briquetting plants in, or near, agricultural areas would reduce and therefore, the viable price for the purchase of briquettes for use by thermal power stations.

Scaling up of such initiatives would then allow the creation of value chains and result in economies of scale, as can be seen from Figure 2. The capacity of the processing plant has a significant impact on the unit costs of biomass pellets. Plants with greater processing capacity have lower production costs as compared to smaller plants.

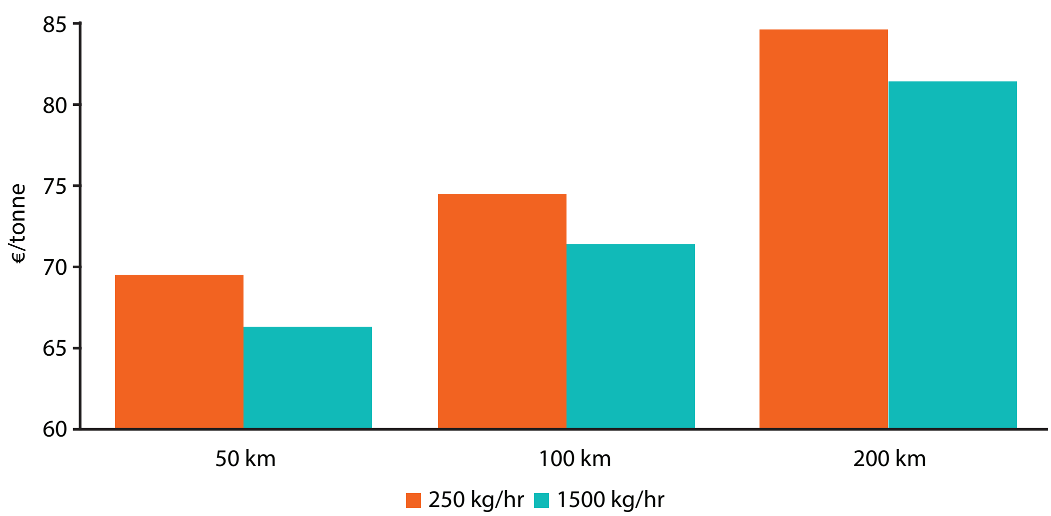

Figure 2: Unit cost of biomass pellet (€/tonne) at different biomass feedstock transportation distances

Note: (Purohit & Chaturvedi, 2018) estimate the unit cost of pellet production at €64 per tonne for a 1500 kg/h capacity biomass pellet unit, and €67 per/tonne for a 250 kg/h capacity plant. Due to economies of scale, the cost of production for smaller plants is greater than for larger ones. An average agricultural residue transportation cost of €2.5/tonne for a distance of 50 km is also incorporated in the unit cost of biomass pellet (1€=70 INR)

Source: (Purohit & Chaturvedi, 2018), based on (CERC 2015)

5 RENEWABLE ENERGY FROM ANIMAL WASTE

Introduce a commercially viable feed-in tariff for purchase of electricity generated from animal husbandry waste (excreta from cattle, poultry, pigs, etc.) by Distribution Companies. The slurry waste can be additionally sold as organic manure.

The full use of animal waste may take 6-8 years. This has an investment stimulus potential of over Rs 88,000 crores.

Programs for promoting biogas technologies date as far back as the 1970s. However, in spite of the recognition of the advantages biogas could offer, both in terms of enhancing rural energy access and enhancing livelihoods and through environmental, health and social co-benefits[1], the adoption and sustenance of biogas plants have had a poor track record in India. Studies have pegged the failure in functionality of established biogas plants in the range of 26% to 55% (Planning Commission, 2002) (CAG, 2015). Previous studies looking at barriers for both dissemination and sustenance of biogas have identified a variety of impediments including region-specific, technological, and informational challenges. For example, being sub-tropical, many parts of India are very conducive to the anaerobic processes which drive biogas plants without external heating. However, this is impacted by both seasonal variation in temperature (significant temperature drops during winters can impact the functionality of plants) and water availability (adequate supply of water throughout the year is necessary for the effective functioning of the plants). Thus, shortage of water, for example, was identified as an important reason for the non-functioning and low penetration of installed biogas plants in arid regions like Rajasthan (Mittal, Ahlgren, & P. R., 2017)

Moreover, issues of poor construction of plants and their improper sizing, lack of information and training on operating procedures, and on how to deal with common issues associated with the plants, inadequate access to technical assistance for maintenance, in addition to the administrative and policy problems of programmes, were common challenges (CEEW, 2015) (Mittal, Ahlgren, & P. R., 2017) (Moudgil, 2016).

An interesting criticism of the government biogas promotion programs has been the distortion of incentives which takes place with government subsidies. As a 2011 study by IIT Bombay found, an important reason for the success of the Community Biogas Plant (CBP) at Bhintbudrak village (Taapi district, Gujrat), against the backdrop of failures of similar plants in neighbouring villages, was that the project wasn't funded entirely by government subsidies, and had instead had the participating villagers contribute to the establishment, which in turn created a sense of ownership for the project (Nasery, 2011).

[1] Properly implemented, as a CEEW report points out, biogas has enormous potential in "reducing the drudgery of women engaged in collecting firewood; improving the state of sanitation and waste management in rural areas; reducing pressure on local forests; the ability to impact GHG emissions arising from better management of animal dung and the co-benefits to soil fertility by the use of digested products from a biogas plant" (CEEW, 2015)

Thus, since a variety of pre-requisite conditions are necessary for the success of biogas plants (spanning geographical, infrastructural, and social factors), promoting biogas should see the government play the role of creating an enabling environment, instead of being the financier of projects and having programs driven by targets for plant set up.

In order to address the policy shortfalls of biogas generation, the government could consider changing its stance from being the provider of subsidy to ensuring that there is a demand for biogas plants. In general, feed-in tariffs, which are conceptually similar to the feed-in tariffs are demand side incentives- they act as incentives and nudges to support investment behaviour by guaranteeing minimum returns. They are conceptually similar to the Minimum Support Price for the procurement of wheat introduced for the green revolution. which launched the Green Revolution, act as incentives and nudges to support investment behaviour by guaranteeing minimum returns. Competitively priced feed-in tariffs have the potential to transform rural solar generation, much as minimum support price and procurement guarantees had transformed agricultural practices during the Green Revolution.

As electricity generated through biogas would be locally generated and consumed, there would be hardly any transmission and distribution cost, counter-balancing its higher cost of procurement.

A commercially viable feed-in tariff approved by the State Electricity Regulatory Commission would create demand. This demand would lead to private investments and increase in rural incomes. Moreover, since the digestate resulting from the operation of the biogas plant retains high content of organic matter, nitrogen[2](N), phosphorus (P), and potassium (K), as well as a range of other macro and micro nutrients, it can be further processed and sold as a fertilizer to improve both the fertility and structure of the soil. Previous studies using bio-slurry as fertilizers have reported their potential to act as full or partial replacement for synthetic fertilizers in a variety of cropping systems. Since bio-slurry composts are considerably cheaper than synthetic fertilizers to produce, the additional sale of surplus composed bio-slurry could provide a profitable additional source of income for biogas plant operators (Groot & Bogdanski, 2013).

In states where the potential is possible to realize, the electricity to be purchased from biogas-based generation could be a separate part of the Renewable Energy Purchase Obligations of DISCOMs.

The theoretical potential for electricity generation from biogas in India is substantial – the livestock census estimated that India had a bovine population of over 300 million in 2019 (Department of Animal Husbandry and Dairying, 2019) – assuming an extremely conservative measure of 5 kg of dung produced per animal per day[3], the total dung generation per day would be 1.5 million tonnes. Using the estimate that 200 tonnes of dung can be absorbed per 1 MW generation capacity, a conservative generation potential comes to approximately 7.5 GW (Harsdoff, 2014). A 2014 ILO study also found that even at current valuations, producing and commercially selling electricity and compost yielded the highest values of fresh dung (Figure 3) (Harsdoff, 2014).

[2] The slurry from dung digestate retains the same amount of nitrogen, but makes it more bio-available for plants compared to raw dung; the process of digestion also lowers/ eliminates pathogens (Kartha, Leach, & Rajan, 2005)

[3] Average production of dung by adult cows and buffalos ranges between 10 kg and 20 kg every day (Kaur, Brar, & Kothari, 2017), with average occurrence of dung being around 10 kg/day for cows, 5 kg/day for calves, and 15 kg/day for buffalos (Harsdoff, 2014). However, total population figures include both young and adult animals; moreover, collection efficiency is likely to be imperfect. Assuming at least 50% of the dung can be collected, dung availability can be considered as 7.5 kg/day/animal. In the paper, 5 kg dung/day/animal has been assumed for calculation purpose.

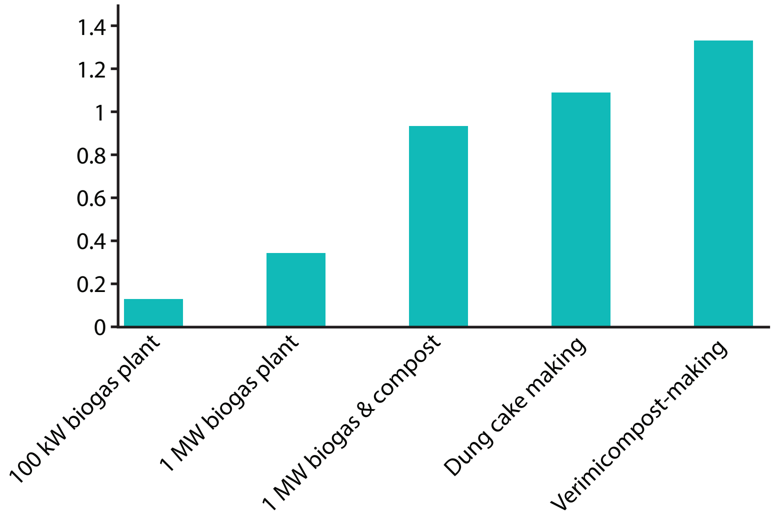

Figure 3: Value of 1 kg of fresh dung in final products (cake, biogas, electricity, and compost)
Source: (Harsdoff, 2014)

As per the 2019-20 tariff order of the Central Electricity Regulatory Commission (CERC, 2019), the normative capital cost for a biogas-based power project is ₹11.85 crore/MW. Using this estimate, even if just all the bovine dung can be used to set up biogas-based power plants, it would add up to a potential investment of up to ₹88,875 crores through capital investment alone. The combination of the sale of electricity with co-generation of value-added products such as manure would lead to additional gains. If the entire generation potential is tapped into by 1 MW plants, for example, the total employment generation could be of over a million jobs for the operation of the plants and the conversion of slurry into compost (Harsdoff, 2014).

Stimulus Potential

The set-up of biogas-powered power plants is estimated to have an overall stimulus potential of ₹88,875 crores.

6 SOLAR POWER GENERATION IN VILLAGES

India has completed the gigantic task of completing village and household electrification. The grid has been taken to every village. Providing 24×7 reliable quality supply of electricity to every household is the next goal. As consumption and demand rise, the transmission and distribution infrastructure would need to be continuously upgraded.

For Distribution Companies, the average cost of supply was around ₹7/kWh in 2015-16 and has increased at an approximate average rate of 6% per year (Prayas Energy Group, 2018). They lose around ₹4–5 for every unit of electricity supplied to lower income households. The provision of free electricity for agriculture puts great strain on Distribution Company finances as well as on industrial and commercial consumers, who have to bear the burden of high cross-subsidies. While deeper reforms would be needed to resolve these issues, encouraging decentralized solar generation in rural areas would help reduce the cost of supplying power to these areas.

> Announce a commercially viable feed-in tariff for purchase of electricity generated from rural areas in the kW range by Distribution Companies.
>
> Farmers would get more income and the Distribution Companies would save around ₹3 per unit.
>
> Assuming 1 MW potential in a village, the national potential is 600 GW. It may take up to 10 years to achieve the full potential.
>
> This has a stimulus potential of ₹27,00,000 crores.

A feed-in tariff mechanism for decentralized solar power generation in the kW range in rural India can be implemented. This has been envisaged in the Finance Minister's Budget Speech in 2020 when she said that farmers could be encouraged to set up solar power generation capacity on their fallow/barren lands and sell it to the grid. A feed-in tariff of, say, ₹4.50 should be attractive enough for private investment in decentralized solar power generation. The Distribution Companies would need to get the feed-in tariff approved by the State Electricity Regulatory Commission. It would also need to indicate the points in its distribution network including the consumer end where it would be willing to take the maximum quantum of power on a first come first serve basis. About 1 MW could be the maximum that the Distribution Company should be willing to take from a village. A feed-in tariff regime would then create open-ended demand and lead to a surge in private investment.

Rooftop solar generation would also be incentivized. A feed-in tariff is better than net metering for both the producer as well as the Distribution Company. The advantages would be as follows:

1. The mechanisms of payment for both the prosumer and the DISCOM would be more transparent, and the settlement could be done on the same cycle as the billing for the monthly electricity bill

2. By making the scheme independent of the retail supply tariffs, it would not further distort either the cross-subsidy regime or the specific subsidy schemes which aim to provide cheap power to the poorest consumers
3. Moreover, by delinking the consumption and generation of electricity, the scheme will be complementary to the government's efforts to promote smart net metering.

Thus, the expansion of solar power generation in rural areas could enable DISCOMs to supply reliable electricity for residential and agricultural purposes more cost effectively during the day time. Reliable access to electricity would also help power local enterprises and industries. A reliable electricity infrastructure could help support, for example, food processing and cold storage facilities near the farm gate, increasing the shelf life and value of produce, as well as support non-farm cottage industries. By generating complementary, but non-agricultural employment, there would be a multiplicative impact on rural incomes. Additionally, as the cost to Distribution Companies to supply electricity reduces by ₹3-4 per unit in rural areas, the financial health of the Distribution Companies would improve.

It would accelerate the growth of decentralized solar power generation which is actually the least cost option as it does not need additional investments in transmission. India has succeeded with large solar farms but not yet with decentralized and rooftop power generation. This would provide an additional source of income to farmers and households, including low income ones. The set-up of solar panels need not interfere with the principal activity of agriculture; the panels can be located on barren land, land used for other ancillary purposes, or even on some part of the cropping area with slight modifications to design to minimize impact on crop growth, allowing those farmers who have land to generate greater value out of it.

Market forces could create a variety of models. An entrepreneurial farmer would invest with his savings and bank credit for a panel supplied with a performance guarantee and maintenance contract and get higher returns. Alternatively, he could initially take a lower return and get the panel on hire purchase where the panel provider takes most of the income from the sale of electricity. Or, land/rooftop could just be rented.

Stimulus Potential

India has about 6 lakh villages. With 1 MW solar power from each village, one is looking at a potential of 600 GW of solar power. Assuming that the normative capital cost would be between ₹4.5 crores (approximate cost of utility scale solar) and ₹6 crores (approximate cost of rooftop solar) per MW, the total investment potential of rural ground and roof-mounted solar generation from rural areas could be as much as ₹27 to 36 lakh crores.

Taking a lower order estimate, the stimulus potential from this proposal would be ₹27,00,000 crores over a horizon of 10 years.

7 GREEN AND COMPETITIVE MSMES

The core of India's non-agricultural economy is constituted by its micro, small and medium enterprises (MSMEs). Encompassing over 63 million enterprises, the MSME sector accounts for nearly half of India's exports and 28% of the GDP (PIB, 2019). It provides employment to over 110 million people (NSSO, 2017). The MSME sector in India is characterized with the presence of industrial clusters across the country. An analysis by TERI indicates that there are more than 200 energy intensive MSME clusters representing various sub-sectors such as ceramics, brick, glass, textile, foundry, forging metal finishing, chemicals, etc.

The stimulus package envisaged by the government can be used to finance investments in the MSME sector for enhancing competitiveness through energy efficiency.

India has around 700,000 registered factory sector manufacturing enterprises. Achieving an averaged 15% savings through energy efficient technologies and best practices in energy intensive SMEs would result in estimated savings of approximately ₹15,000 crores.

Since these enterprises have smaller scales of operation and a smaller capital base, they also often lack access to competitive financing and technology solutions. MSMEs bear disproportionately high energy costs as a portion of their total operating costs. This is because the industry in India cross-subsidizes agricultural and residential energy consumption, and more specifically as smaller enterprises pay even more per unit of electricity than larger industries (BEE, 2019). They find it difficult to implement capital-intensive energy efficiency solutions due to difficulty in accessing finance.

The following factors hinder the adoption of energy efficient technologies (EETs):

1. lack of access to easy, adequate credit at low interest rates, which is further compounded by the fact that efficiency investments do not generate additional revenue. They are thus often not seen as being 'bankable' by financial institutions (World Bank, 2019);
2. lack of sufficient information concerning specific technological options both in terms of new technologies and best operating practices;
3. lack of time and skilled staff in small enterprises to understand and implement new technology; and limited availability of local support services to help facilitate adoption.

Adoption of energy efficient technologies and best operating practices would have the twin benefits of reducing the operation costs of MSMEs and making them more competitive. It would also help decrease the emissions intensity of the Indian industry, a stated target of India's Nationally Determined Contribution (NDC) under the Paris Agreement.

Investments for energy efficient technologies by MSMEs can be supported through the credit guarantee scheme announced by the government as part of its stimulus package. By giving access to finance to implement energy efficient measures that are readily available and cost-effective, MSMEs could utilize the funds to implement technology upgrades, including replacement of energy inefficient boilers, pumps and motors as well as many other process specific upgrades in furnaces, reaction vessels, stenter, jet dyeing machine, hot air dryer, etc. TERI estimates that there is an energy saving potential of about 10-15% of total energy consumption in the MSME sector through the adoption of energy efficient technologies and best operating practices (Shekhar & Dhingra, 2015).

In the stimulus package, the government has guaranteed loans to SMEs from the banks. This allows MSMEs to make energy efficiency investment through bank credit. This credit can be utilized by MSMEs for upgrading their processes and making investments on energy efficient and renewable energy technologies. The credit may also be extended to implementation agencies such ESCOs (Energy Saving Companies) or other special purpose vehicles at cluster levels which may undertake aggregation and implementation of investment in clusters through specialized schemes. Such implementing agencies could work through or be supported by organizations like EESL, and other agencies of the central and state governments like the State Designated Agencies of Bureau of Energy Efficiency and MSME-Development Institutes of the Ministry of MSME. The energy efficient technology would be able to pay for itself through the reduced utility consumption by the enterprise. As demand recovery takes place, the lower costs of operation would make enterprises both more sustainable and more competitive.

TERI has undertaken energy efficiency studies in a large number of MSMEs across the country over the past many years. Under a World Bank supported program implemented by TERI, energy savings of around ₹67 crores were identified in about 350 SMEs spread over three energy intensive clusters in western India. Assuming that only 10% of the 7 lakh registered units in the country are energy intensive and adopt similar EETs and best practices, the total annual energy cost saving works to be approximately ₹15,000 crores each year.

8 INCREASED PUSH FOR DOMESTIC MANUFACTURE

> Invite bids for solar power with-storage for the next 10 years with the condition that manufacturing with full value addition would be done in India. This would result in self-reliance in this critical area.
>
> Capturing the domestic demand for solar equipment would be able to generate value of ₹2,94,000 crores by 2030 through import substitution.

India has made remarkable progress on the increase in solar power generation capacity and has emerged as the world's third largest market for solar. Increasing cost-competitiveness of battery technology and continued policy support are likely to enable similar progress in the uptake of electric vehicles. However, the Indian manufacturing industry has been unable to realize these gains.

Even though till 2011, India had been one of the largest exporters of best-in-class modules, the lack of consistent government policy, financial support, and other handicaps for manufacturing, including high input costs, resulted in Indian manufacturing rapidly losing ground to imports from China. With manufacturing scale, quality, and low prices, the Chinese have become dominant in the global market with the Indian market being no exception. Today, despite having an annual average demand of 20 GW, India's domestic manufacturing capacities of solar equipment are quite modest. These stand at 3.3 GW of solar cell manufacture and 8 GW of module making capacity. There is almost total import dependence with more than 80% of the manufacturing value chain coming from overseas. The critical technologies are in upstream polysilicon to ingot and then to wafer part of the supply chain.

A sustainable domestic solar equipment manufacturing industry can save USD 42 billion (approximately ₹2,94,000 crores) in equipment imports by 2030, provide equipment supply security, and create 50,000 direct and 125,000 indirect jobs in the next five years (Roy, 2020). However, in order for India to truly take advantage of its own domestic demand, the right set of measures would need to be put in place to get investment for the full supply chain and value addition within India.

The imposition of anti-dumping or increased import duties does provide relief to existing domestic industry and may even make them invest to enhance capacity. But these measures are unlikely to lead to a breakthrough or private investment for the poly-silicon to ingot to the wafer part of the supply chain.

Access to cheaper electricity, which compromises the highest and most significant portion of the cost for the upstream manufacturing, is essential for competitive manufacturing of the solar PV value chain. Developed land with ready availability of infrastructure facilities, and prior approval for necessary regulatory clearances especially environmental clearance, reduce the time taken for setting

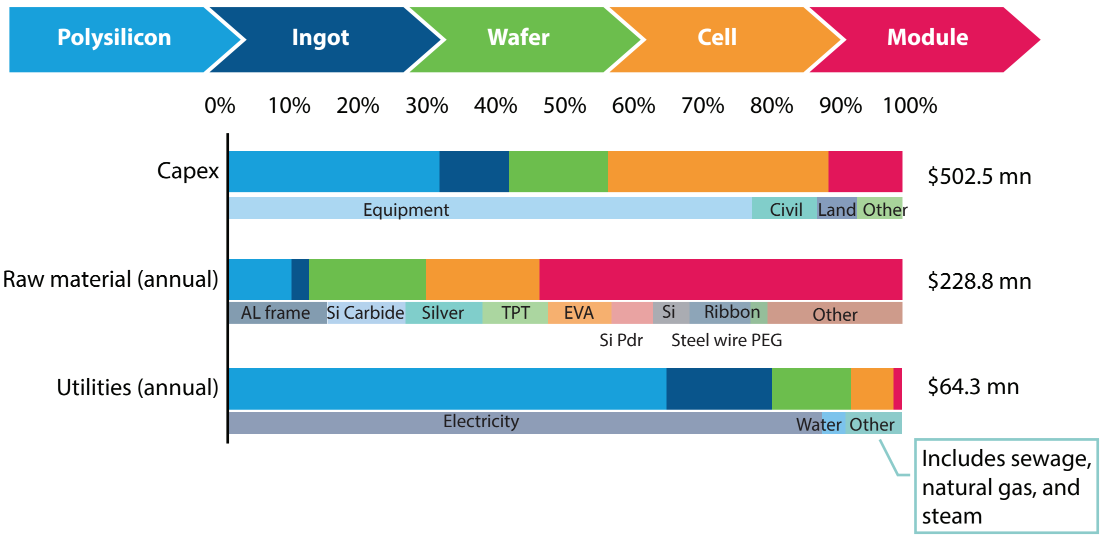

Figure 4: Share of costs in manufacturing process from polysilicon to module for Capex, raw materials and utilities
Source: (Indian Chamber of Commerce, 2017)

up a manufacturing plant. A special dispensation for duty-free imports of plant, equipment and spares would further reduce the cost of manufacturing. A state-of-art manufacturing plant in this capital and technology intensive sector should be globally competitive in price and quality (see Figure 4). The challenge is how to get such plants to be set up with private investment.

A good beginning has been made with the recent domestic manufacturing of cell and module condition-based solar project tenders of SECI. The price discovered has been attractive. The next set of tenders should have the requirement of full value addition in India for the solar project with supply of solar power commencing a few years down to enable the manufacturing plant to come up. The offer of land with clearances and cheap electricity as part of the bid process would lead to better competitive bids. Successful bidders could be given supply orders of 1-1.5 GW per year, with recurring fresh bids to continually discover lower prices.

Concurrently, the development of special manufacturing hubs for solar equipment should be undertaken with speed. In these, land would be provided with pre-existing infrastructure for power, water, waste water treatment, and solid waste handling. Duty-free imports of machinery and spares should be enabled to allow access to best-in-class technology, in addition to a special dispensation of having sales to the Indian market being considered as having fulfilled export obligations.

An essential requirement for these hubs would be to commit to providing access to cheap electricity, which is a major component of the cost of production of solar panels. While broader reforms for rationalizing electricity tariffs across consumer categories are urgently needed to boost manufacturing capacity, interim measures to promote solar manufacturing could be done through designating the hubs as deemed licensees, allowing them to procure power through the open markets, via long-term contracts and/or using captive coal plants while exempting them from the heavy cross-subsidy charges burdening the Indian industry.

Import duties could be introduced, with the duty being linked to the difference between the lowest accepted domestic manufacture-linked bid and the imported solar panels, subject to periodic revisions.

Similar initiatives could also be done for domestic battery manufacture. Round-the-clock solar power tenders, similar to those auctioned by SECI recently (Prasad, 2020), can be linked to the requirements of domestic manufacture of the energy storage systems (whether using grid scale batteries or other technologies). By shifting the all new grid-scale solar capacity to round-the-clock power, issues surrounding management of intermittent supply by renewables can also be addressed.

Simultaneously, investments in comprehensive R&D programs could help both improvement efficiency and cost parameters, as well as develop indigenous technologies to lessen technology gaps. Sustained research and close interactions between industry and academia would be essential to enhance and maintain the competitiveness of the industry, and transition it from one where all machinery and tools have to be imported to the one where they are also at least partially indigenously developed.

Stimulus Potential

Capturing the domestic demand for solar equipment would be able to generate a value of ₹2,94,000 crores by 2030 through import substitution.

9 CONCLUSION

Estimates of investment potential from the aforementioned proposals are as follows:

1. Cleaner Transport

   With the assumption that if the proposed incentives are offered over the next five years, they can revive automobile sales to a 7% growth rate (the rate of growth averaged from 2014 to 2018), the measure would have the potential to provide an estimated stimulus of ₹138,000 to 240,000 crores every year (assuming that the stimulus is able to provide a growth of 7% over 2019-20 values instead of a year-long contraction of 20-40% in the current trajectory.

   Additionally, addressing even just the shortfall in public transport capacity in the country could provide a potential stimulus in the range of ₹35,000–44,000 crores (when estimated using the presumption that the nationwide shortfall would be of at least 50,000 buses and using the cost of procurement figures of Kolkata and Lucknow). Replacing government cars intended for inner-city travel with electric vehicles would provide a stimulus potential of ₹ 75,000 crores.

   The sum of these measures would result in a stimulus potential of ₹ 160,000 crores per annum.

2. Renewable Energy from Agricultural Residues

   NTPC's price discovery exercise valued biomass pellets at ₹7000 per metric tonne (NTPC, 2018). Using this figure as an estimate, a government guarantee of purchase of biomass briquettes for the next five years would create a total potential from purchasing biomass pellets for all the agricultural residue which would otherwise have been burnt in the fields at an estimated cost of ₹22,470 crore every year.

3. Renewable Energy from Animal Husbandry Waste

   As per the 2019-20 tariff order of the Central Electricity Regulatory Commission (CERC, 2019), the normative capital cost for a biogas-based power project is ₹11.85 crore/MW. Announcing a competitive feed-in tariff for biogas-generated electricity for the next 5 to 10 years, which if it could capture just bovine dung, adds up to a potential investment of up to ₹88,875 crores.

4. Rural Energy Generation

   India has about 6 lakh villages. With 1MW solar power from each village, one is looking at a potential of 600 GW of solar power. Assuming a normative capital cost between ₹4.5 and ₹6 crore per MW, the total investment potential of rural ground and roof-mounted solar generation from rural areas over the next 8 to 10 years could be as much as ₹27 to 36 lakh crores.

5. Green and Competitive MSMEs

   India has around 700,000 registered factory sector manufacturing enterprises. Past studies have indicated that adoption of energy efficient technologies and best operating practices can result in potential energy savings of around 10%-15% in the MSME sector. Under a World Bank-supported program implemented by TERI, an energy saving of around ₹67 crores was identified in about 350 SMEs spread over three energy intensive clusters in western India. Assuming that only 10% of the 7 lakh registered units in the country are energy intensive and adopt similar EETs and best practices, the total annual energy cost saving works to be approximately ₹15,000 crores each year.

6. Successful Domestic Manufacture of Solar Equipment

   A successful manufacturing policy – one that is able to successfully capture domestic demand for solar equipment – would be able to generate a value of ₹2,94,000 crores by 2030 through import substitution (Roy, 2020).

The total stimulus being proposed would be approximately ₹40 lakh crores spread over the coming decade. This would be equivalent to 540 billion USD.

REFERENCES

BEE. (2019). *National Conclave on Energy Efficiency in MSMEs- Background Note.* New Delhi: Bureau of Energy Efficiency.

Buisness Standard. (2020, May 27). *India's Q1 GDP may contract 40%, states to lose ₹30 trillion: Report.* Details available at Buisness Standard: https://www.business-standard.com/article/economy-policy/india-s-q1-gdp-may-contract-40-states-to-lose-rs-30-trillion-report-120052701350_1.html

CAG. (2015). Chapter 8 - National Biogas and Manure Management Programme. In CAG, *Report No. 34 of 2015 - Performance Audit on Renewable Energy Sector in India Union Government, Ministry of New and Renewable Energy.* CAG.

CEA. (2018). *Technical Specification for Agro-Residue Based Bio-Mass Pallets for Co-Firing in Coal Based Thermal Power Plants.* New Delhi: CEA.

CEA. (2020). *All India Installed Capacity (in MW) of Power Stations.* New Delhi: Government of India.

CEEW. (2015). *Clean, Affordable and Sustainable Cooking Energy for India: Possibilities and Realities beyond LPG.* New Delhi: CEEW.

CERC. (2019). *Determination of levellised generic tariff for FY 2019-20 under Regulation 8 of the Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2017.* New Delhi: CERC.

Dash, S. (2020, July 28). India sees second wave of layoffs and pay cuts as companies grapple with COVID-19 pandemic. Details available at https://www.businessinsider.in/business/news/india-sees-second-wave-of-layoffs-and-pay-cuts-as-companies-grapple-with-covid-19-pandemic/articleshow/77212542.cms

Department of Animal Husbandry and Dairying. (2019). *Provisional Key Results of 20th Livestock Census.* New Delhi: Government of India.

Department of Economic Affairs. (2020). *Macroeconomic Report June 2020.* New Delhi: Ministry of Finance.

EESL. (n.d.). *Electric Vehicles*. Retrieved from Energy Efficiency Services Limited: Details available at https://www.eeslindia.org/content/raj/eesl/en/Programmes/ElectricVehicles/Dashboard.html

ET Now Digital. (2020, June 05). *Times Now News.* Retrieved from Govt won't entertain new proposals: Will India's COVID-19 fiscal tightening come at cost of development? Details available at https://www.timesnownews.com/business-economy/economy/article/govt-wont-entertain-new-proposals-will-india-s-covid-19-fiscal-tightening-come-at-cost-of-development/602088

Gewessler Leonore, Jørgensen Dan, Mikkonen Krista, Costa Sergio, Pūce Juris, Dieschbourg Carole, Wiebes Eric, Rodríguez Teresa Ribera, Lövin Isabella, Borne Élisabeth, Schulze Svenja, Hatzidakis Kostas, Budaj Ján, Bruton Richard. (2020, April 09). *Climate Home News*. Retrieved from European Green Deal must be central to a resilient recovery after Covid-19. Details available at https://www.climatechangenews.com/2020/04/09/european-green-deal-must-central-resilient-recovery-covid-19/

Groot, L. d., & Bogdanski, A. (2013). *Bioslurry = Brown Gold? A review of scientific literature on the co-product of biogas production.* Rome: Food and Agriculture Organization of the United Nations.

Harsdoff, M. (2014). *The Economics of Biogas: Creating Green Jobs in the Dairy Industry in India.* International Labour Organization.

Health Effects Institute. (2019). *State of Global Air 2019: A Special Report on Global Exposure to Air Pollution and Its DIsease Burden.* Boston, MA: Health Effects Institute.

Huang, C. (2020, May 15). *Nikkei Asian Review*. Retrieved from South Korea is using coronavirus stimulus to green the economy. Details available at https://asia.nikkei.com/Opinion/South-Korea-is-using-coronavirus-stimulus-to-green-the-economy

Indian Chamber of Commerce. (2017). *Report on Surya to Boost Solar Manufacturing in India.* New Delhi: Shakti Foundation.

Jain, N., Bhatia, A., & Pathak, H. (2014). Emission of Air Pollutants from Crop Residue Burning in India. *Aerosol and Air Quality Research*, 422–430.

Jethva, H., Torres, O., Field, R. D., Lyapustin, A., Gautam, R., & Kayetha, V. (2019). Connecting Crop Productivity, Residue Fires, and Air Quality over Northern India. *Scientific Reports*. Details available at https://doi.org/10.1038/s41598-019-52799-x

Kartha, S., Leach, G., & Rajan, S. C. (2005). *Advancing Bioenergy for Sustainable Development: Guideline for Policymakers and Investors.* Energy Sector Management Assistance Program.

Kaur, G., Brar, Y. S., & Kothari, D. (2017, June). Potential of Livestock Generated Biomass: Untapped Energy Source in India. *Energies*. doi:10.3390/en10070847

Khandekar, A., Rajagopal, D., Abhyankar, N., Deorah, S., & Phadke, A. (2018). *The Case for All New City Buses in India to be Electric.* Berkley: Lawrence Berkeley National Laboratory.

Ministry of Agriculture. (2014). *National Policy for Management of Crop Residues.* New Delhi: Government of India.

Ministry of Agriculture and Farmers Welfare. (2017). *Annual Report 2016-17.* New Delhi: Government of India. Details available at http://www.agricoop.gov.in/sites/default/files/Annual_rpt_201617_E_0_0.pdf

Mishra, A. R. (2020, June 24). *IMF reverses its optimism for India, sees 4.5% GDP contraction in FY21*. Details available at https://www.livemint.com/news/india/imf-reverses-its-optimism-for-india-sees-4-5-gdp-contraction-in-fy21-11593007996669.html

Mittal, S., Ahlgren, E. O., & P. R., S. (2017). Barriers to biogas dissemination in India: A review. *Energy Policy*, 361-370.

MoRTH. (2017). *Road Transport Yearbook.* New Delhi: Government of India.

Moudgil, M. (2016). *A Waste of Energy.* India Water Portal. Details available at https://sanitation.indiawaterportal.org/english/node/4924

Moudgil, M. (2020). *Why Punjab failed to douse farm fires.* Mongabay.

MSEDCL. (2018). *Mid Term Review Petition for FInal True Up of FY 2015-16 and FY 2016-17, Provisional True Up for FY 2017-18 and Revised ARR and Tariff for FY 2018-19 to FY 2019-20.* Mumbai: Maharashtra State Electricity Distribution Company Ltd.

Nasery, V. (2011). *Biogas for Rural Communities.* Mumbai: Center for Technology Alternatives for Rural Areas, IIT Bombay.

NTPC. (2018, February 08). *NTPC invites bids for Agro Residue based fuel as part of environment friendly drive in NCR Encouraging participation from start-ups*. NTPC Press Releases. Details available at https://www.ntpc.co.in/en/media/press-releases/details/ntpc-invites-bids-agro-residue-based-fuel-part-environment-friendly-drive-ncr-encouraging

ORF. (2018, November 1). NTPC to use biomass to co-fire coal-based power plants, cut emissions. *Energy News Monitor*.

PIB. (2019, July 22). *Press Information Bureau*. Retrieved from MSME Sector Contributes Significantly to Indian Economy. Details available at https://pib.gov.in/Pressreleaseshare.aspx?PRID=1579757

PIB. (2020 , January 9). *Year End Review 2019, MNRE.* PIB. Details available at https://pib.gov.in/PressReleseDetail.aspx?PRID=1598948

Planning Commission. (2002). *Evaluation Study of The National Project on Biogas Development.* New Delhi: Planning Commission. Details available at https://niti.gov.in/planningcommission.gov.in/docs/reports/peoreport/cmpdmpeo/volume1/185.pdf

Pope III C Arden, T. Burnett Richard, C. Turner Michelle, Cohen Aaron, Krewski Daniel, Jerrett Michael, M. Gapstur Susan, J. Thun Michael. (2011). Lung Cancer and Cardiovascular Disease Mortality Associated with Ambient Air Pollution and Cigarette Smoke: Shape of the Exposure–Response Relationships. *Enviornmental Health Perspectives*

Prasad, N. T. (2020, May 08). *Mercom India*. Retrieved from ReNew Power Wins SECI's 400 MW Round-The-Clock Renewable Tender at ₹2.90/kWh. Details available at https://mercomindia.com/renew-power-seci-round-clock-renewable-tender/

Prayas Energy Group. (2018). *Electricity Distribution Companies in India: Preparing for an uncertain future.* Pune: Prayas Energy Group.

PTI. (2020, January 02). *NTPC to procure 6 million tonnes agro residue-based pellets worth Rs 4,200 cr in 2020*. Details available at https://energy.economictimes.indiatimes.com/news/power/ntpc-to-procure-6-million-tonnes-agro-residue-based-pellets-worth-rs-4200-cr-in-2020/73063671

Purohit, P., & Chaturvedi, V. (2018). Biomass pellets for power generation in India: a techno-economic evaluation. *Environmental Science and Pollution Research*, 29614–29632.

Roy, A. (2020). *Can Aatmanirbhar Bharat Abhiyaan help India's solar manufacturing sector?* New Delhi: Observer Research Foundation.

Sharma, S., Goel, A., Bhattacharjya, S., Juneja, M., Bajpai, N., & Sharma, S. (2020). *Fleet Modernization: solution to achieve better air quality.* TERI.

SIAM. (2020). *Statistics*. Details available at http://www.siam.in/statistics.aspx?mpgid=8&pgidtrail=9

TERI. (2018). *Source Apportionment of $PM_{2.5}$ and PM10 of Delhi NCR for Identification of Major Sources.* New Delhi: TERI.

TERI. (2019). *Development of Spatially Resolved Air Pollution Emission Inventory of India.* TERI.

TERI. (2019). *Policy Paper on Solar PV Manufacturing in India.* New Delhi: The Energy and Resources Institute.

TERI. (2020). *Crop Residue Management: Solution To Achieve Better Air Quality.* New Delhi: TERI.

TIFAC . (2018). *Estimation of Surplus Crop Residues in India for Biofuel Production.* New Delhi: TIFAC.

ToI. (2020, June 6). *Times of India.* Don't initiate any new scheme, finance ministry tells departments. Details available at https://timesofindia.indiatimes.com/business/india-business/dont-initiate-any-new-scheme-finmin-tells-departments/articleshow/76226658.cms

World Bank. (2019). *Financing Energy Efficiency at SMEs.* Washington: World Bank.

World Bank. (2020). *Dirty Stacks, High Stakes: An Overview of Brick Sector in South Asia.* Washington, DC: World Bank.