
TOWARDS A CLEAN ENERGY ECONOMY

Post-COVID-19 Opportunities for India's Energy and Mobility Sectors

BY NITI AAYOG AND ROCKY MOUNTAIN INSTITUTE



NITI Aayog



Towards a Clean Energy Economy



AUTHORS

NITI Aayog

Amitabh Kant
Anil Srivastava

Rocky Mountain Institute (RMI)

Clay Stranger
Ryan Laemel

RMI India

Akshima Ghatge
Jagabanta Ningthoujam
Ashpreet Sethi

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Green Stimulus and Recovery Series

This report is part of Rocky Mountain Institute’s Green Stimulus and Recovery Series. The series focuses on presenting insights on how countries around the globe can use stimulus and recovery investment to build back better after the COVID-19 crisis and advance us towards a cleaner, healthier, more just, and more resilient future for the one planet we all share. The reports provide a framework for planning and evaluating stimulus efforts along with recommendations for green stimulus and recovery investments and actions specific to the United States, China, India, sub-Saharan Africa, and the Caribbean that can help optimize efforts to rebuild in these countries and regions. Rocky Mountain Institute has partnered with NITI Aayog and RMI India for this report.



EXECUTIVE SUMMARY

India, along with the rest of the world, is facing significant social and economic challenges after implementing measures to contain the spread of COVID-19. To address these challenges, public and private sector leaders are considering short-term and long-term interventions to support economic recovery. In this context, India recently announced a Rs 20 lakh crore (US\$266 billion) relief package—one of the largest stimulus packages in the world as a share of gross domestic product (GDP). This package includes ongoing efforts by the government to boost healthcare facilities, measures by the Reserve Bank of India, and special packages that account for about 10 percent of the GDP.

The stimulus package, in its current form, focuses largely on economic recovery. As policymakers prepare interventions and industries consider changes to their business models and operations, there is an opportunity to prioritize efforts that work towards building a clean, resilient, and least-cost energy future for India, including electric vehicles, energy storage, and renewable energy programs. This report discusses how COVID-19 is beginning to influence the clean energy transition in India, specifically for the transport and power sectors, and identifies principles and strategic opportunities for the country's leaders to drive economic recovery and maintain momentum on the clean energy transition.



HIGHLIGHTS

- COVID-19 will present significant demand and supply-side challenges to India's transport and power sectors in the short and medium terms.
- India's transport sector can save 1.7 gigatonnes of cumulative carbon dioxide emissions and avoid about 600 million tonnes of oil equivalent (Mtoe) in fuel demand by 2030 through shared, electric, and connected passenger mobility and cost-effective, clean, and optimized freight transport (see Appendix for more details). Significant savings are also achievable in the power sector through the adoption of renewable energy, energy storage, efficiency, and flexibility.
- Short-term relief in the forms of providing adequate liquidity infusion to restore jobs and small industries, formulating guidelines and standard operating procedures for safe passenger mobility and freight transport, and supporting electricity distribution companies' (discom) health can help India's transport and power sectors with recovery.
- Strategic opportunities for economic recovery and green growth exist in India's clean transport and power policies and programs.
 - o In the transport sector, major opportunities include making public transport safe, enhancing and expanding non-motorized transport infrastructure, reducing vehicle kilometres travelled through work-from-home where possible, supporting national strategies to adopt electric vehicles in the freight and passenger segments, and making India an automotive export hub.
 - o In the power sector, major opportunities include improving electricity distribution business and operations, enabling renewables and distributed energy resources, and promoting energy resilience and local manufacturing of renewable energy and energy storage technologies.
- The following principles can help guide initiatives and investments in India's clean energy future at this time: 1) invest in least-cost energy solutions, 2) support resilient and secure energy systems, 3) prioritize efficiency and competitiveness, and 4) promote social and environmental equity.
- Now more than ever, India's clean energy transition must prioritize multiple benefits, especially clean air, resilience, and economic and social equity, while putting the economy on a recovery path.



INTRODUCTION

Current situation

Around the world, the COVID-19 pandemic has led governments to implement lockdown and social-distancing measures. On March 25, the Government of India instituted a nationwide lockdown to contain the spread of the coronavirus (Exhibit 1).

During the first phase of India's lockdown, there were a range of economic impacts, including:

- A shortage of workers in urban areas, which lasted beyond the first phase and could continue
- A reduction in agricultural harvesting and processing, despite a bumper crop and rising global commodity prices¹
- A significant reduction in auto manufacturing, with losses of Rs 2,300 crore per day²
- The grounding of passenger airlines, ending several years of double-digit monthly growth³

In May, interstate transport started opening. In the fourth phase of India's lockdown, several states started implementing relaxation orders from the Ministry of Home Affairs. Many others are considering longer timelines for reopening at containment zones. Beginning June 1, India introduced a new phase of unlock 1.0 where states have announced new measures to resume bus services, flight operations, markets, and offices.

While India's lockdown and social-distancing measures have reduced the rate of spread of the coronavirus, they have also caused severe economic consequences. Estimates suggest that the decline of economic activity during the lockdown is costing India about Rs 34,000 crore per day,⁴ impacting jobs and income in major sectors. Industries that have experienced significant economic loss include agriculture; auto; hospitality; travel; micro, small, and medium enterprises (MSMEs); restaurant; real estate; and the startup ecosystem. The Centre for Monitoring Indian Economy estimates that the unemployment rate has risen to 24 percent in April, up from about 8 percent in February 2020.⁵

When all of this is put together, India could potentially experience its greatest economic slowdown in the past three decades. Many organizations are projecting a significant reduction in the annual growth rate of India's GDP in the current fiscal year.

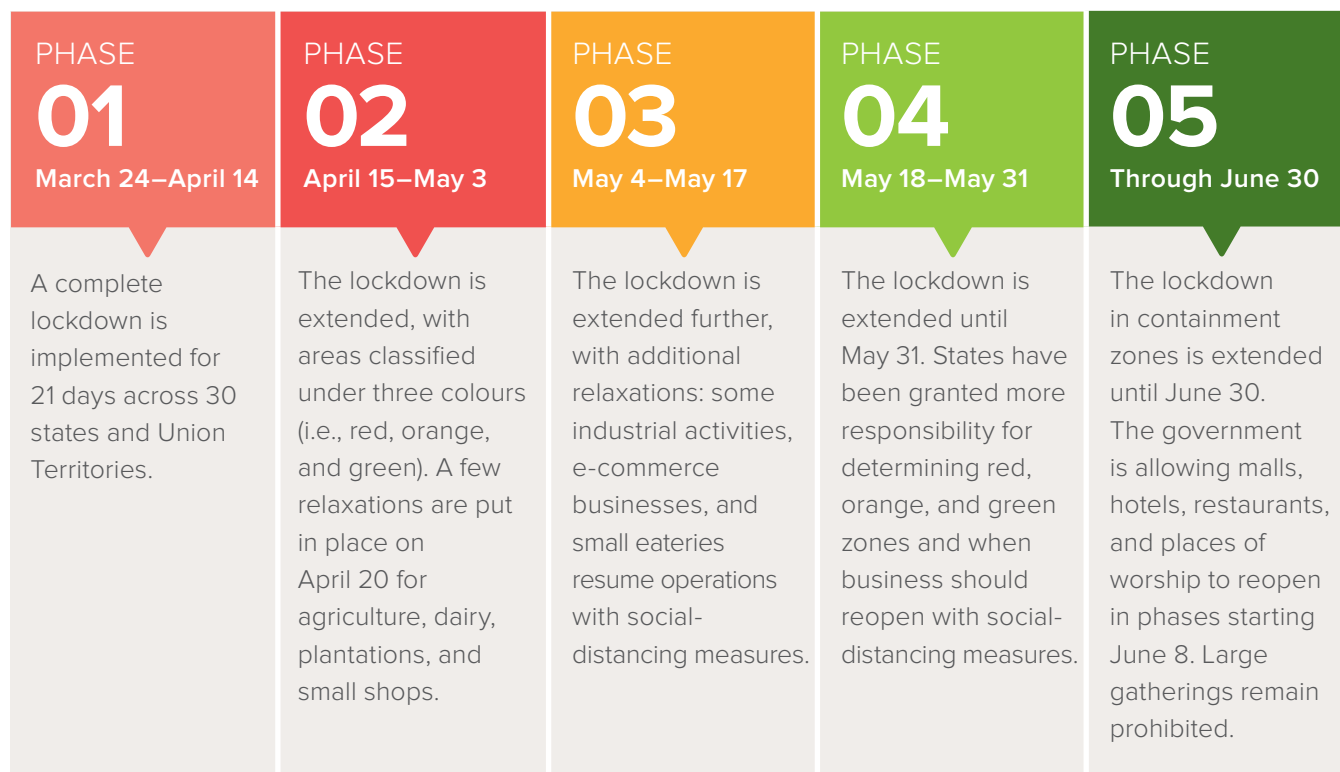


EXHIBIT 1: The Five Phases of India's Nationwide Lockdown

Influence on India's clean energy transition

Over the past five years, India has launched new efforts to advance its transition to clean energy and mobility, including its nationally determined contribution to install 500 GW of renewable energy capacity by 2028 and the Faster Adoption and Manufacturing of Electric Vehicles (FAME) II scheme (Exhibit 2) to support the adoption of 7,000 electric buses, 5 lakh electric three-wheelers, 55,000 electric passenger cars, and 10 lakh electric two-wheelers. Considering this momentum, how can India continue to advance its clean energy agenda in the aftermath of COVID-19, when priorities of economic recovery and health will take the front seat?

COVID-19's impact on the clean energy transition is complex and will continue to be so in the near term. On one hand, the decrease in fossil fuel consumption due to reduced demand in the power, transport, and industrial sectors has contributed to India's greenhouse gas emissions falling for the first time in four decades.⁶ Also, environmental consciousness may grow in a post-COVID India, as pollution has subsided in many areas.⁷

On the other hand, the economic slowdown that is positively impacting the environment is also creating new challenges for India's clean energy transition, including liquidity and financing constraints, supply-chain shortages, shifting priorities in the public and private sectors, reduced workforce, and job losses.

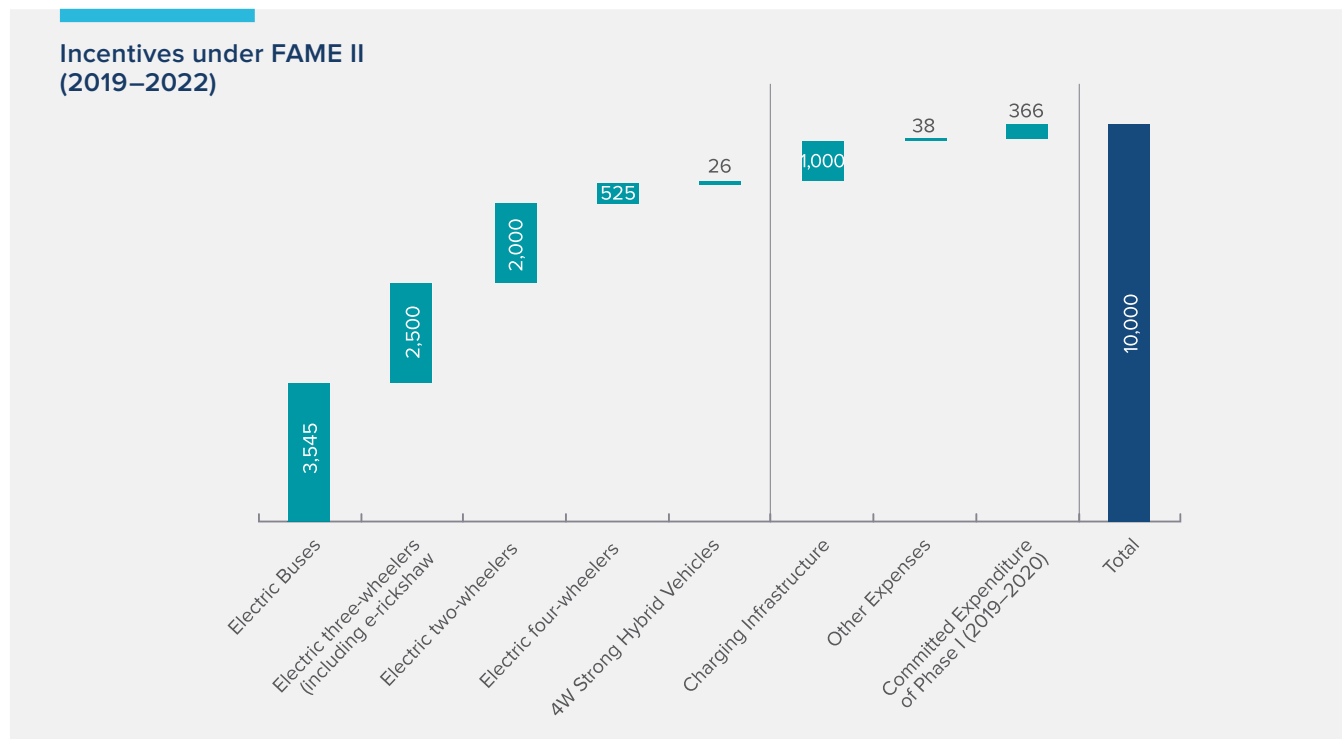


EXHIBIT 2: Incentives under FAME II (2019–2022). Source: FAME II Notification from DHI. Note: Amounts in Crores Rs

In the transport sector, emerging challenges include:

- **Demand rebound versus sustained behaviour change:** As passenger demand rebounds, how can India ensure that a share of the passenger mobility demand reduction that it experienced during the lockdown can be sustained for portions of the population that can work from home?
- **Private vehicle ownership versus non-motorized, shared, and public transport:** As demand patterns for private and public transport shift, with a likely short- to medium-term decrease in passenger mobility demand and an increase in demand for private vehicles at affordable price points due to reduced incomes, how can India ensure that non-motorized, shared, and public transports continue to be the backbone of India’s mobility system, despite concerns around health and safety?
- **Internal combustion engines versus electric vehicles:** As government priorities shift in the short term and auto manufacturers face financial challenges, how can India ensure that the auto industry continues to invest in electric vehicle (EV) research and development, manufacturing, and sales?
- **Inefficient supply chains versus clean, optimized logistics:** As e-commerce experiences short-term disruptions in demand patterns, how can India ensure that it makes its freight transport system more cost-effective, energy efficient, and optimized?
- **Short-term supply disruptions versus long-term resilient supply chains:** As supply chains experience disruption, especially for EVs, how can the ecosystem address short term challenges with EV manufacturing and convert them into long-term opportunities for local, resilient EV supply chains?

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In the electricity sector, emerging challenges include:

- **Fossil fuels versus renewables and distributed energy resources:** As distribution companies (discoms) have experienced demand reductions of almost 25 percent versus 2019 levels since the start of the lockdown, they face potential revenue losses of 8–10 percent. With the central government additionally looking into reforms related to the privatization of coal mining, how can India ensure that it continues to build momentum towards a renewable energy future?
- **Regulated electricity markets versus competitive wholesale electricity markets:** As discoms' current liquidity crunch exacerbates underlying structural issues—such as high technical and commercial losses, distorted tariff structures, and overreliance on subsidies—how can regulators and discoms work together to create and ensure participation in competitive wholesale electricity markets that support a higher penetration of renewable energy while helping discoms manage their immediate financial situation and protect jobs across the power sector?

These challenges will likely affect demand for clean mobility and renewable energy, making the clean energy transition in India's power and transport sectors more challenging. However, turning each challenge into a strategic opportunity can leverage clean energy for economic recovery and a more resilient Indian economy.

Opportunity to leverage clean energy for economic recovery and building resilience

On May 13, Prime Minister Narendra Modi announced a Rs 20 lakh crore (US\$266 billion) relief package, one of the largest coronavirus-related stimulus packages in the world as share of GDP (Exhibit 3). This package includes ongoing efforts by the government to boost healthcare facilities, measures by the Reserve Bank of India, and special packages that account for about 10 percent of the GDP.⁸ These immediate stimulus announcements address liquidity and economic considerations.

While India starts recovering from the impacts of lockdown, it is important that the financial and policy efforts enable a green transition pathway. The gravity of this crisis suggests that today's policy measures will form the basis of tomorrow's political, institutional, and infrastructural frameworks, shaping society for decades to come. Therefore, the importance of making the green choice is essential to India's future.

“As we spend huge amounts of money to recover from the coronavirus, we must deliver new jobs and businesses through a clean, green transition,” stated United Nations Secretary-General António Guterres during the release of his six-point plan for world leaders designing COVID-19 stimulus packages. “Where taxpayers' money is used to rescue businesses, it needs to be tied to achieving green jobs and sustainable growth and fiscal firepower must drive a shift from the grey to green economy and make societies and people more resilient.”

As policymakers look at economic recovery and industries consider changes to their business models and operations, these efforts must continue to prioritize a resilient, clean, and least-cost energy future for India. Strategic public spending that prioritizes the environment will be critical to economic recovery.

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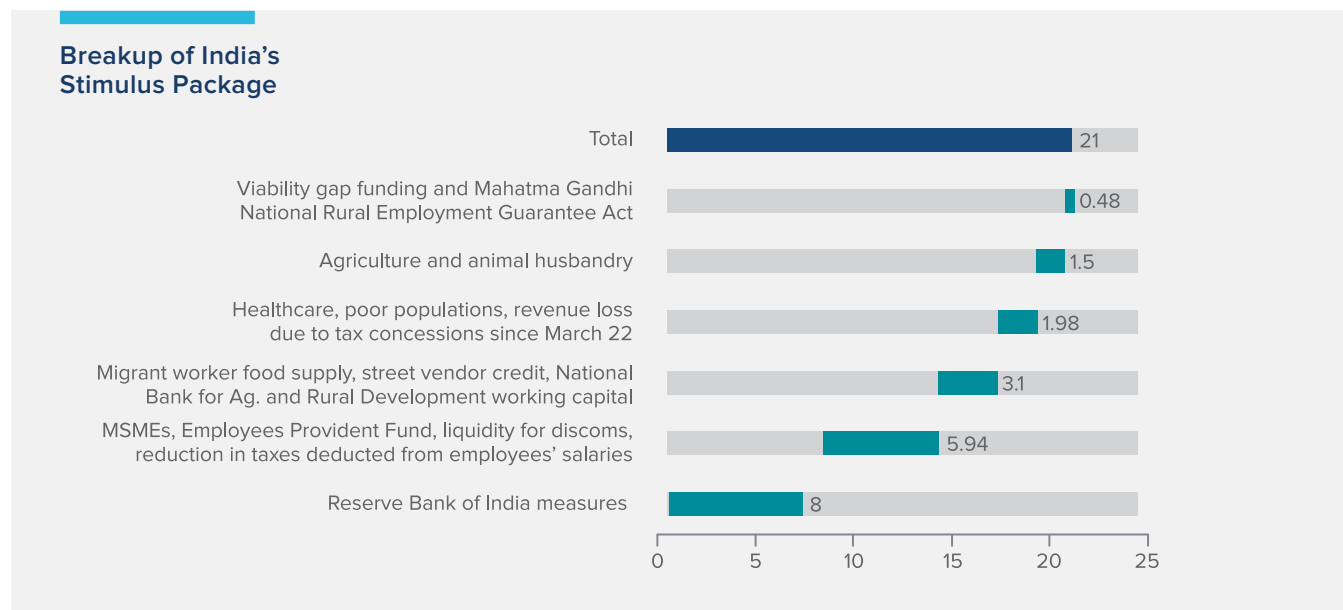


EXHIBIT 3: Breakup of India's Rs 20 Lakh Crore Stimulus Package (in Rs Lakh Crore)

Select highlights of India's stimulus package:

- **Agriculture:** Rs 30,000 crore of additional working capital will be made available through National Bank for Agriculture and Rural Development, along with a Rs 40,000 crore increase in allocation for the Mahatma Gandhi National Rural Employment Guarantee Act to create employment opportunities.
- **Contractors:** Central government agencies will provide extensions of up to six months for construction, public works, and goods and services contracts.
- **Discoms:** Discoms will receive a one-time emergency liquidity infusion of Rs 90,000 crore.
- **Migrant workers and lower-income groups:** Migrant workers will receive free food grains for two months. Industries and governments will set up affordable housing rental complexes and the housing subsidy scheme for middle-income families will be extended until March 2021. A Rs 5,000 crore special credit facility for street vendors and incentives for accepting digital payments will also be made available.
- **MSMEs:** The definition of MSMEs has been modified to include more businesses. The auto component manufacturing industry will be covered under the MSME domain and can make labour payments once the funds are disbursed. MSMEs will have access to Rs 3 lakh crore of collateral-free loans and Rs 20,000 crore of subordinate debt.
- **Public sector undertakings (PSUs) and the private sector:** The government will aim to privatize non-strategic PSUs and suspend new bankruptcy filings against companies.
- **States:** States' borrowing limits will be increased from 3 to 5 percent for 2020–2021, with a likelihood of granting extra resources of Rs 4.28 lakh crore.



GUIDING PRINCIPLES



1 Supporting Economic Recovery through Clean Energy

To facilitate a sustainable economic recovery, RMI has developed a set of principles and a prioritization framework to guide global response around green stimulus and recovery.⁹ They centre on growing the economy and creating jobs through green investments; supporting public health, including through reduced air pollution; enhancing economic, energy, and climate resilience; and decarbonizing. Based on those principles, NITI Aayog and RMI offer the following principles to help guide India's clean energy-related programs and economic recovery efforts at this time:

Four principles for India's clean energy and economic recovery programs

1. Invest in least-cost energy solutions: The steeply falling costs of clean energy technologies present an opportunity to pursue an economically viable clean energy transition. For example, the Unnat Jyoti by Affordable LEDs for All (UJALA) program decreased the unit cost of LED bulbs by over 75 percent in 18 months.¹⁰ Other examples include solar and wind emerging as India's lowest-cost electricity sources, even without subsidy, and electric buses beginning to present lower total cost of ownership than that of diesel buses for city bus services.¹¹ Savings from avoided fossil-fuel costs and stranded assets should be considered in current investment decisions. The economic savings associated with a clean energy future can be redeployed to support critical development priorities. This pathway must be carefully planned and executed to protect existing jobs and create future job growth.

2. Support resilient and secure energy systems: As climate change accelerates, the likelihood of pandemics and extreme weather shocks will likely increase, making the need to build a resilient future critical. Resilience could involve selecting industries, technologies, or systems that help adapt to unexpected shocks or crises. In India, future growth will demand resilience on multiple fronts, such as energy system design, urban development and transport design, industrial growth and supply-chain management, and the livelihoods of the underprivileged. India can gradually reduce its exposure to commodity imports and foreign supply chains through distributed energy systems and the promotion of domestic manufacturing.

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3. Prioritize efficiency and competitiveness: Given India’s scale and stage of development, efficient and thoughtful use of resources is essential. India’s manufacturing prowess and technology leadership present an opportunity to leverage Make in India to turn India into a more self-sufficient economy and globally competitive export hub over time. Circular economy solutions should become a core feature of India’s future economy.

4. Promote social and environmental equity: Given India’s position as one of the world’s largest and fastest-growing economies, albeit with large social inequalities, additional weight on social and economic equity must be considered when applying these principles in the Indian context. India’s decisive response to the current pandemic has helped avoid some of the most devastating potential effects. But the situation has emphasized the need to support investment in the country’s public health infrastructure. Beyond health infrastructure, a priority exists to address social and environmental externalities, especially air pollution. Research estimates that air pollution reduces the average lifespan of an Indian citizen by almost 2 years and up to 10 in cities like Delhi.¹² Investments to address these externalities should be mindful of the need to make equity a priority and offer support to the most affected and vulnerable populations.

Prioritizing ‘green’ in the recovery efforts

The rubric for decision-making across the principles should be based on an assessment of investment required, job growth, and environmental impact (in terms of greenhouse gases and local air pollution). It is also recommended that a temporal framework should help guide and prioritize economic recovery efforts (Exhibit 4).

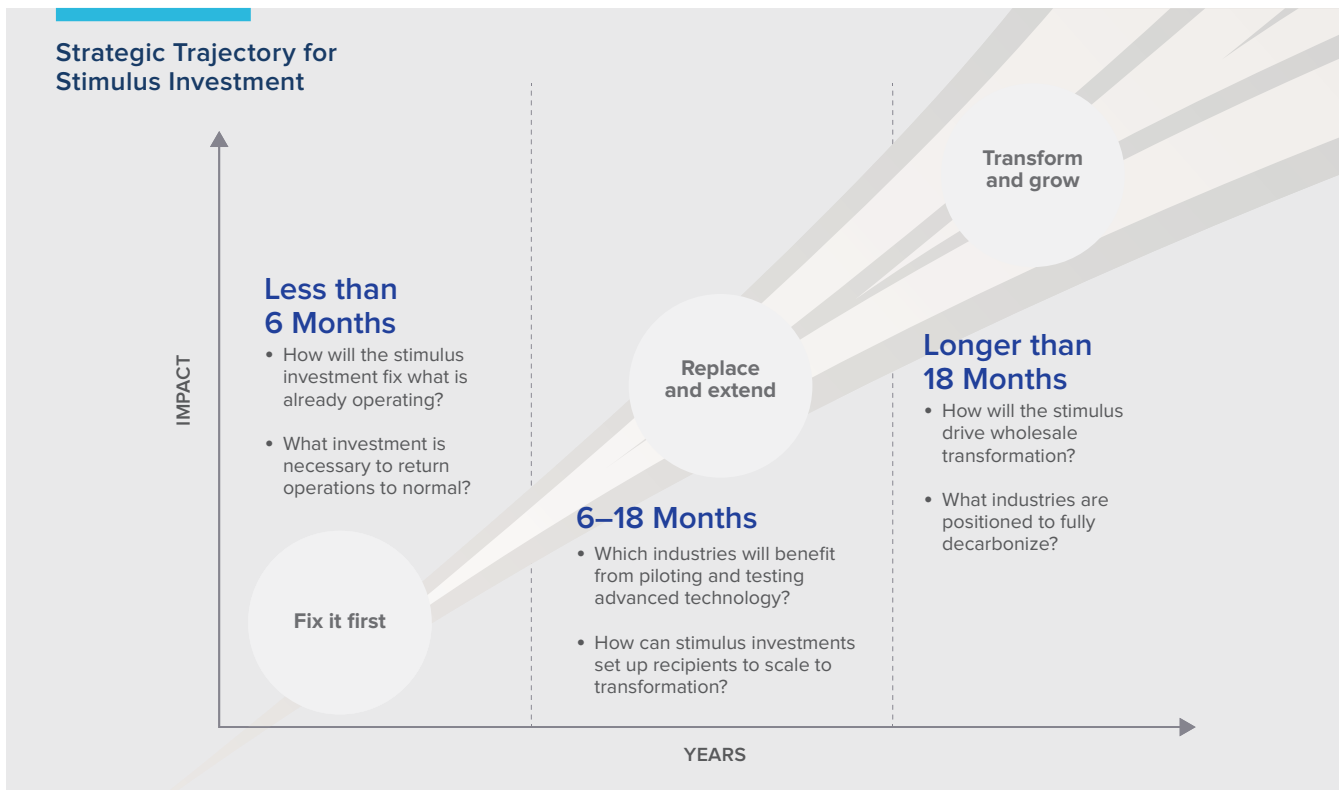


EXHIBIT 4: Strategic Trajectory for Stimulus Packages: Fix It First, Replace and Extend, and Transform and Grow (RMI)



TRANSPORT



2 Shifting to Clean Passenger and Freight Movement

Background and size of the prize

Transport accounted for 4.9 percent of India's gross value addition in 2016–2017 and 14 percent of the country's greenhouse gas emissions in 2019.¹³ In passenger mobility, considering India's low rate of car ownership (22 cars per 1,000 people),¹⁴ high share of non-motorized transport and shared mobility, and rapidly growing domestic innovation ecosystem, the country has an opportunity to leapfrog over a car-centric paradigm to a shared, electric, and connected passenger mobility future.

In freight transport, considering India's skewed modal share (71 percent of India's freight transport is road-based, whereas only 17 percent is rail-based), less fuel-efficient vehicles, and low operational efficiency, India has an opportunity to shift to a cost-effective, clean, and optimized freight transport system.

India's policy leaders have shown a strong commitment to electric passenger mobility through the FAME II scheme, the National Mission on Transformative Mobility and Battery Storage, guidelines on EV charging and charging infrastructure from various ministries, and the announcement of state EV policies in eight states. A supportive policy environment has also been created in the freight segment through Make in India, an initiative to encourage domestic manufacturing; Digital India, a program to transform India into a digitally empowered society; and the Logistics Efficiency Enhancement Program, which aims to improve infrastructure, procedures, and information technology.

Business leaders are capitalizing on these emerging markets by creating new products and business models. New models in the electric two- and three-wheeler segment, indigenous mobility as a service and food delivery service platforms have been instrumental in India's move towards clean mobility. The Auto Expo held in February unveiled new models of electric four-wheelers and two-wheelers that will hit the Indian market in 2020, and experts believe that despite the COVID-19 impact, EV market growth will continue in light-mobility segments, such as two-wheelers, rickshaws, and autos.

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To maintain its momentum in clean transport, India must continue to prioritize shared, electric, and connected passenger mobility and cost-effective, clean, and optimized freight transport. Together, India's passenger and freight transport sectors can avoid about 600 Mtoe of oil equivalent (Rs 20 lakh crore of oil import savings) and 1.7 gigatonnes of tailpipe carbon dioxide emissions by 2030 (Exhibit 5).

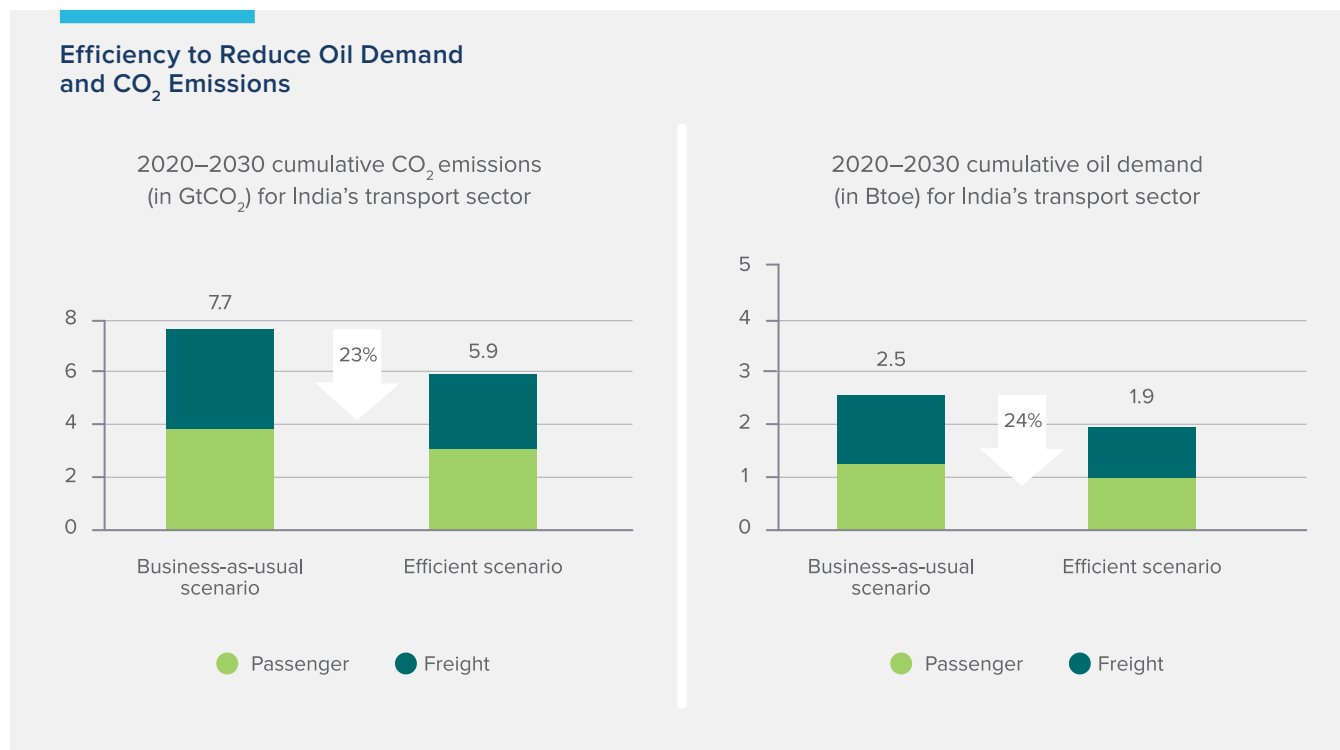


EXHIBIT 5: Oil Demand and Tailpipe Carbon Dioxide Emissions in India's Passenger and Freight Transport Sectors for Business-as-Usual and Efficient Scenarios (Niti Aayog and RMI analysis). *Note: Numbers in the graph and text may not match due to rounding.*

Reductions in passenger mobility, fuel demand, and emissions can come from reducing demand for motorized mobility through non-motorized transport, working from home for those populations who can do so, and shifting to more efficient modes of transport such as public transport and shared mobility. Additionally, switching to EVs while improving the efficiency of internal combustion engine vehicles that remain on the road will be important. Reductions in freight transport fuel demand and emissions can come from shifting long-haul freight from road to more energy-efficient and less carbon-intensive rail, making vehicles more efficient and electrifying them where it makes economic sense, and optimizing logistics and operations.



Emerging situation and challenges in the context of COVID-19

COVID-19 has and will continue to disrupt business as usual in the mobility sector. COVID-19's impacts on passenger and freight segments, as well as the auto industry, raise questions like:

- Will the overall demand for mobility fall in the short to medium term?
- Will public and shared transport modes see declining ridership?
- Will private modes be preferred?
- Will a lack of auto sales cause a severe hit to the supply chain?
- Will a growing call for self-sufficiency lead to a push to create local supply chains?
- Will it push back the electric mobility transition?
- Will the Prime Minister's call for domestic manufacturing and localisation attract investments at a time when a recession is looming?
- Would the new mobility ecosystem propelled by startups be able to survive the crisis?

Impact on passenger mobility

Complete lockdown and several extensions have severely impacted passenger mobility across segments. Google's COVID-19 Community Mobility report for India shows a 57 percent decline in mobility trends in public transport between March 28 and May 9 compared with normal activity levels.¹⁵ State and city-level data also show significant declines in public transport ridership. This could add pressure on cash-strapped state transport undertakings (STUs). According to Central Institute of Road Transport (CIRT)'s data STUs faced losses as high as Rs 16,409 crore (US\$2.18 billion) in 2016–17.¹⁶ In fact, airlines and airports could be looking at losses of about Rs 25,000 crore (US\$3.3 billion) due to the lockdown, with significant effects in railways as well. Walking and driving activity have also decreased significantly, down by about 60 percent (Exhibit 6).

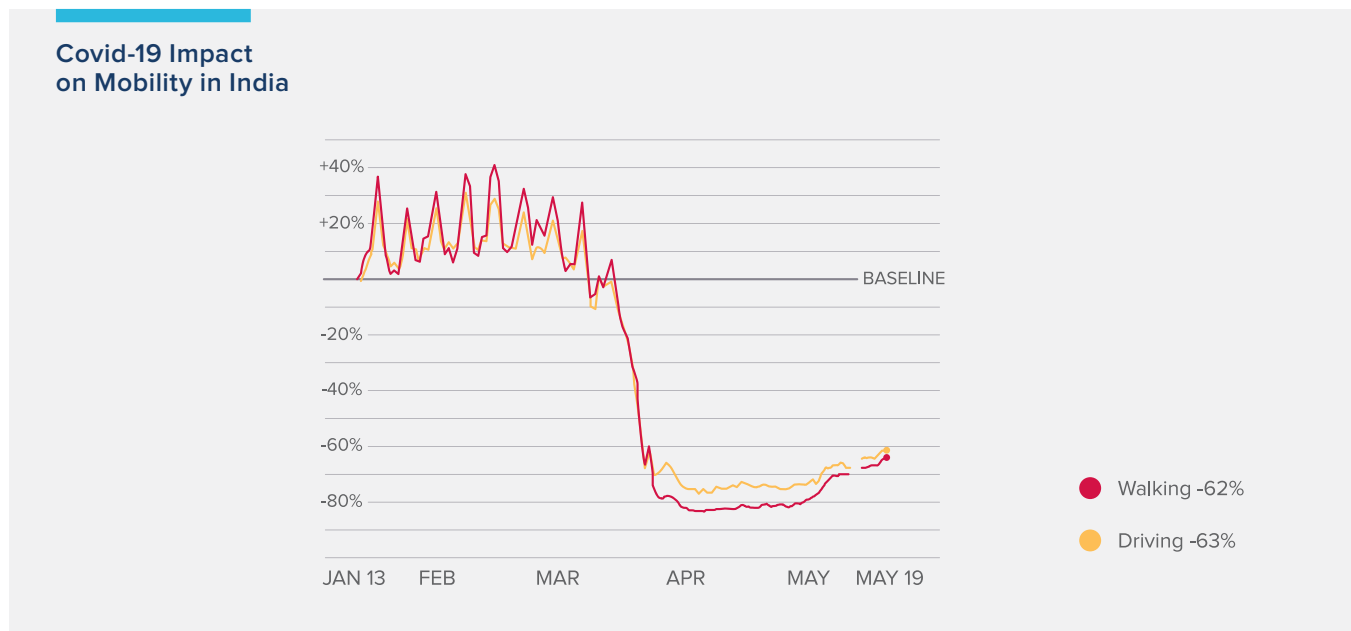


EXHIBIT 6: Apple's COVID-19 Mobility Trends Report, India, January to May 2020¹⁷



The shared transport sector has also been impacted. On one hand, autorickshaws, ride-hailing platforms, employee transport services, and some first- and last-mile modes are experiencing significant demand reductions. For example, many cities and states are requiring autorickshaws to ferry single passengers, affecting travellers and driver incomes, and ride-hailing companies like Ola are focusing their resources on cutting costs and providing minimal services, such as ferrying essential workers and government officials. On the other hand, micromobility companies like Yulu and car-sharing companies like Zoomcar are preparing for demand growth as preferences shift to more private modes of transport.

Impact on freight supply chain and urban deliveries

Since the start of the lockdown, freight demand has been shifting, with online food orders dropping by 20 percent and demand for grocery deliveries on the rise.¹⁸ The overall effect of the lockdown has been lower consumption, leading to reduced freight demand. BNEF predicts that India's freight demand will fall by 20 percent in 2020.¹⁹

As a result, many operators are adding surcharges for deliveries and other increases to cover rising costs. Logistics costs are rising due to lower utilization, with the average daily distance travelled by trucks down by 15–20 percent, as well as supply and manpower shortages.²⁰ As transporters try to conserve cash, they have been seeking a variety of cost-saving measures, including lower fuel prices in the medium to long term.

With EV companies revising their strategies to include more affordable electric two-wheeler products in their portfolios, final-mile logistics firms and e-commerce companies could continue their path to final-mile electrification.

Impact on the auto industry and electric vehicles

Auto sales could decrease by as much as 45 percent in the financial year 2020–21. EV production could be affected in the short term due to lower demand and supply-chain disruptions with BNEF estimating an 18 percent decrease in global EV sales in 2020. However, their forecast also mentions that countries like India, where EV adoption has been slower, could see better than average EV sales in the medium term if governments and early adopters continue to lead on procurement.

The EV market may experience other shifts. For example, there is an expectation of demand for more affordable EV products. This potential shift in consumer preferences may affect manufacturers' investment and production decisions. Ultimately, resuming production levels for conventional vehicles and EVs will depend on demand revival, supply-chain reactivation, and access to the labour force.



New challenges

There will be many new challenges and opportunities in a post-COVID era. The table below highlights some prominent barriers and the current situation on the ground.

CHALLENGES	SITUATION ON THE GROUND
<p>Less interest in shared transport, more interest in private vehicles and modes</p>	<ul style="list-style-type: none"> • While ridership of public transport is expected to decline in the short term, this price-sensitive market may not be able to switch modes easily, making it important to strengthen and improve public transport options, especially bus systems and metros. • Indian consumers may seek to move away from shared mobility options and invest in two- and four-wheelers, as well as second-hand products, which are available at affordable price points.²¹ • Ridership of shared and ride-hailing services like Ola and Uber has dropped by as much as 60 percent during the work-from-home shift.²² • Car-sharing platforms, such as Zoom, expect a three-fold increase in demand as people will have higher safety perception.²³ • Last-mile modes will be affected due to lower passenger mobility demand and use of public transport, with shared modes like electric rickshaws and autos being the most affected.
<p>Less demand for EV products in the short term</p>	<ul style="list-style-type: none"> • Lower disposable incomes and a tendency towards cash saving will lead to reduced demand for EV products. • Under the gross cost contract model, e-bus operators may not have the capital to run buses; OEMs may not want to own and operate their own buses. • Some OEMs' customers are pushing back their EV business plans by two or more years. • That said, there is potential for several customer segments to pick up in the medium term, including corporate customers and last-mile logistics firms.
<p>Impacts on freight demand and the sector</p>	<ul style="list-style-type: none"> • Freight demand may have a medium-term impact, with The Energy and Resources Institute (TERI) estimating that heavy truck activity could decrease, while the urban freight segment has the potential to flourish.



CHALLENGES	SITUATION ON THE GROUND
Impacts on EV supply chains	<ul style="list-style-type: none"> • There may be delays in EV production as manufacturers focus on reviving demand and producing BSVI vehicles. • Curbs on imports of Chinese components may lead to disruptions in EV manufacturing.
Impacts of financing	<ul style="list-style-type: none"> • Without cash flowing through the system, a cash crunch is growing in auto components markets and auto companies. • Industry fears that banks may be wary of providing loans to EV owners. • There may also be declining venture capital funding in the EV and mobility startup space.
Impacts on policy change	<ul style="list-style-type: none"> • Many state EV policies and e-bus projects may be delayed due to other priorities and social-distancing challenges.
Unemployment	<ul style="list-style-type: none"> • Ola and Uber recently laid off 1,900 employees. • Swiggy and Zomato recently laid off 2,600 employees. • According to ACMA, the auto components industry could cut nearly 5 lakh jobs in the next quarter. • Several auto dealerships will be shutting shop. • About 13 lakh truck drivers have been affected by reduced freight demand and supply-chain disruptions.

Strategic opportunities for economic recovery

Short-term suggestions (6–8 months)

- **Liquidity:** Provide liquidity to the auto industry, STUs, and logistics providers, fleet aggregators, operators, and auto dealers. Make working capital available for salaries and other ongoing costs.²⁴
- **Safe public transport and freight operations:** Issue guidelines or standard operating procedures (SOPs) for safe operation of public transport services (i.e., metros and city bus services), including social-distancing measures and sanitation procedures, loading and unloading goods, and promoting digital trade documentation to ensure ease of doing business.

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- **Work-from-home:** Governments and companies can promote work-from-home for populations that can do so, helping to partially sustain passenger mobility demand reduction through working from home and work-hour staggering.



Medium-term suggestions (8–36 months)

- **FAME II:** Continue to implement the FAME II scheme and allocate demand incentives as planned to revive and grow EV demand. In addition, consult the EV industry, EV fleet operators, and EV corporate consumers to understand whether any changes might enhance FAME II and ensure that EV sales pick up soon.
- **State-level EV incentives:** Complement FAME II demand incentives with state-level subsidies to lower upfront cost and total cost of ownership, as well as non-fiscal incentives that make EVs easier to operate, such as green license plates or priority lanes.
- **Public transport rethink:** Create an initiative to rethink and restore confidence in public transport, including the procurement of more buses, the adoption of e-buses and new bus designs, the design of bus corridors and bus rapid transit systems, and the digitization of public transport. This should include alternative funding sources and revenue models, such as advertising and real-estate assets.
- **National-level strategy for freight optimization:** Develop a national strategy for optimizing and digitizing the freight sector and its supply chain
- **Electric delivery vehicles:** Issue guidelines to state governments to encourage the electrification of final-mile delivery vehicles as freight demand experiences an increase in the next one to two years. State governments could potentially push final-mile logistics companies to continue with their EV deployment plans and create awareness about the benefits of electrification among delivery operators.

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- **Mode shift of long-haul goods to rail:** Encourage shifting of long-haul bulk goods movement from road to rail-based transport.
- **Non-motorized transport infrastructure:** Create an urban road retrofit program to support more accessible walking, cycling, and electric micro-mobility solutions to offer clean, safe mobility alternatives and create jobs.
- **Scrappage policy:** An incentive-based policy has the potential to encourage scrapping vehicles older than 15 years.



Long-term suggestions (>36 months)

- **Vehicle and component R&D, design, manufacturing, and export:** Leverage Make in India to significantly grow India's share of research and development (R&D), design, manufacturing, and export of vehicles and components, especially for EVs. Relax localisation norms in the short term until the auto industry revives and promote local, resilient manufacturing and supply chains in the long term through tax incentives, lower land rent, and the promotion of local battery manufacturing.
- **Emissions norms:** Commit to implement the BSVI norms and to tighten CAFE norms over time to help domestic OEMs compete in an international market.
- **Freight corridors:** Encourage the development of several electric freight corridors to promote the electrification of the medium- and heavy-duty truck segment.



ENERGY STORAGE



3 Driving Competitiveness and Resilience

Energy storage technology will play a key role in the overall clean energy transition and has the potential to unlock economic and environmental benefits in a variety of markets. As the critical technology component in electric vehicles, batteries are at the centre of the electric mobility transition. In many cases, renewable energy's intermittence requires that it be connected to energy storage to compete directly with fossil fuels.

These two markets will drive substantial demand for batteries in India over the coming decade. According to recent analysis by NITI Aayog and RMI, India's energy storage market in 2030 is expected to be worth Rs 1 lakh crore across the electric vehicle, stationary storage, consumer electronics, rail, and defence sectors.

The scale of India's demand and its stage of development together present a powerful opportunity for India to emerge as a global leader in battery manufacturing. This opportunity could position India to achieve durable economic growth and global competitiveness over the coming decade. As India's battery manufacturing capacity grows, 60 percent or more of the total economic activity of domestic battery cell demand can be captured within the country, despite limited domestic reserves of raw materials.

Pursuing this opportunity will create substantial economic and environmental benefits including a reduced reliance on imported oil, improved air quality, and increased renewable energy supply. Further, the COVID-19 pandemic has signified the importance of diversifying supply chains and manufacturing locations for critical technology.

An export-competitive battery manufacturing industry creates an even bigger economic opportunity for Indian manufacturers. The National Mission on Transformative Mobility and Battery Storage, announced in March 2019, plans to establish a few gigawatt-scale, export-competitive integrated batteries and cell-manufacturing plants in India. This could support greater energy security, enhance energy system resilience, and position India for global leadership in energy storage technology and manufacturing.



POWER



4 Providing Clean, Affordable, and Reliable Electricity

Background and size of the prize

Electricity is India's largest greenhouse gas-emitting sector, accounting for 34 percent of total emissions (including LUCF) in 2016–2017.²⁵ Coal continues to dominate India's electricity supply, accounting for 55 percent of installed capacity and 72 percent of generation in 2019–2020.²⁶ However, renewables installed capacity and generation have experienced rapid growth, especially solar (Exhibit 7). To date, the country has installed almost 35 GW of solar and 38 GW of wind, constituting about 20 percent of grid-tied installed capacity.

In India, solar and wind have become the lowest-cost electricity sources, even without subsidy. Comparing countries, the cost of solar in India has consistently been among the lowest in the world. To build on this momentum, the government has established a national renewable energy target of 175 GW of solar and wind by 2022 and 500 GW by 2030. This target comes with a major challenge and opportunity for renewables in India: reducing renewable curtailment.

Annual Generation Growth (CAGR: 2011–2019)

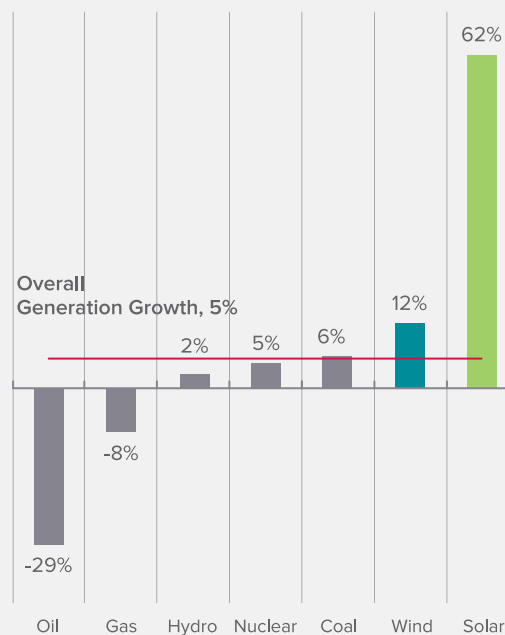


EXHIBIT 7: Compounded Annual Growth Rate (CAGR) for Various Energy Sources, 2011–2019. (CEA)

Towards a Clean Energy Economy



In addition to its renewable-energy efforts, India has achieved 100 percent household electrification through the Saubhagya scheme, with a plan for 24/7 power for all households. However, given many structural challenges, the fragility of electricity distribution remains clear and present. Most discoms are stuck in a debt cycle. Tariffs are partially non-rationalized. As subsidies to the rural customer base continue to expand, discoms have experienced worsening finances, despite early improvements in reducing the cost-revenue gap and losses through the Ujjwal DISCOM Assurance Yojana (UDAY) program.

As the electricity network is expanding, it is becoming difficult to maintain progress, increasing aggregated technical and commercial (AT&C) losses. Loss-making levels of revenue recovery results in growing debt and insufficient network investment that will be required to provide reliable and high-quality electricity service to all customers. Upgradation and digitization of the grid will be necessary to optimally integrate high levels of renewable energy at the lowest cost. Ultimately, discom health is a critical leverage point for the decarbonization of India's power sector.

Emerging situation and challenges in the context of COVID-19

The immediate impact of the current lockdown in the electricity sector has been the cessation of commercial and industrial (C&I) load. This demand loss has significantly impacted discoms' finances. A prolonged lockdown could have a negative impact of up to 8 percent or more of discoms' annual revenue, according to RMI analysis (Exhibit 8).

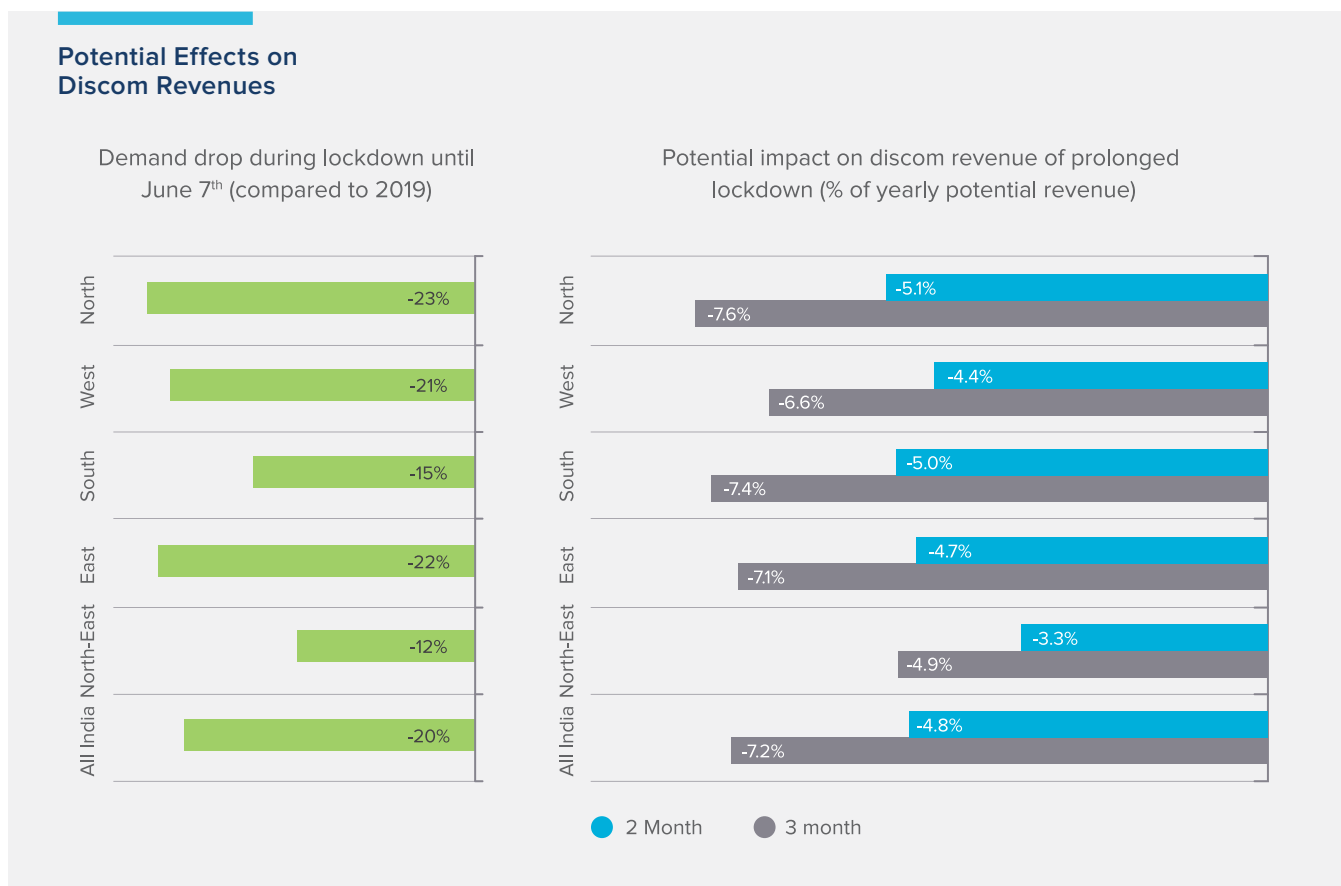


EXHIBIT 8: Discoms' Potential Revenue Losses Due to the Economic Effects of India's Lockdown Measures (RMI, PSOSOCO, discoms' tariff orders)

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In the medium term, the electricity distribution sector will have to endure a riskier operational environment (Exhibit 9). It will take time for electricity consumption to recover to pre-crises levels and then grow. Even with lower consumption, the need to encourage economic activity will result in pressure to reduce input costs, including power tariffs for C&I customers. Given the high level of cross-subsidy surcharges, it is likely that consumers will challenge the existing tariff structure.



EXHIBIT 9: C&I Share of Electricity Sales Revenue Vs. Average Cost of Supply-Average Realizable Revenue Gap (RMI, PSOSOCO, discoms' tariff orders)

There will also be higher offtake risk for renewable power developers in an era of depressed demand growth. In the aftermath of the lockdown, poor billing led seven to eight states to impose force majeure to absolve themselves from payment of fixed charges to generators. This new challenge comes at a time when power purchase agreements (PPAs) are already being challenged due to overcapacity in generation. Existing thermal plants running at low capacity factors, minimal use of power exchanges, and an increasing share of must-run renewables have led to uneconomic dispatch and higher power costs, with both planned and unplanned curtailment on the rise. In this environment, discoms are refraining from signing new PPAs, challenging the power sector's decarbonization goals.



Guiding green recovery of the electricity sector

The challenges that must be overcome for a green recovery of the electricity sector are short-term liquidity and medium- to long-term structural reforms. Four key areas can guide and enable green recovery in India's electricity sector: providing immediate liquidity infusion, improving business and operations, enabling least-cost energy supply, and preparing for the future. Decarbonization will depend on business and structural improvements, as well as clean technology deployment.

	FIX IT	REPLACE AND EXTEND	TRANSFORM AND GROW
Discom financial health	<ul style="list-style-type: none"> » Immediate liquidity support. 	<ul style="list-style-type: none"> • Improve discom operations—billing, metering, collection. » Ensure cost-reflective tariff and less distortionary subsidy scheme (e.g., DBT). • Identify and build discom readiness for new customer and revenues sources such as electric vehicles. • Enable cross-learning across discoms. 	<ul style="list-style-type: none"> » Rethink and implement new ways of electricity distribution—privatisation where applicable, distribution licensee, separation of rural and urban load, separation of content and carriage, National Electric Distribution Company (NEDC), etc. • Nationwide scale up of smart metering infrastructure.
Least-cost green electricity	<ul style="list-style-type: none"> » Ensure payment for renewable power producers. 	<ul style="list-style-type: none"> » Enable better payment guarantees and correct pricing of externalities. » Implement and encourage better participation in the wholesale power market. • Encourage data visibility and capacity building. 	<ul style="list-style-type: none"> • Focus on accurate forecasting and geographical smoothing of renewable generation. • Enable scaling of energy storage and demand response implementation through incentives and mechanism including building markets for ancillary services.
Resilience, equity, and security	<ul style="list-style-type: none"> » Ensure 24/7 power supply for all. 	<ul style="list-style-type: none"> • Continue to encourage C&I Open Access and residential rooftop solar programs. Address disincentives such as tariff distortion and discoms' fear of revenue leakages. 	<ul style="list-style-type: none"> • Strengthen energy access schemes like Saubhagya with elements of resilience—DRE, storage, and mini/microgrids.

CONTINUED



CONTINUED

	FIX IT	REPLACE AND EXTEND	TRANSFORM AND GROW
		<ul style="list-style-type: none"> • Encourage system-wide energy efficiency. • Encourage replacement of diesel gensets with renewables + storage. 	<ul style="list-style-type: none"> • Scale implementation of distribution automation systems (DAS), smart meters and energy storage. • Encourage gradual development of an indigenous energy supply chain.

Note: '»' indicates measures fully or partially addressed in recent developments

Providing immediate liquidity infusion

The government of India recently announced a discom sector stimulus of Rs 90,000 crore (US\$12 billion). It is a liquidity infusion that intends to help discoms with immediate debt repayments and delayed payments to generation companies. Its structure is in the form of long-term loans through the Power Finance Corporation (PFC) and Rural Electrification Corporation (REC). While this measure is important in the short term, business and operational improvements must complement it to guide public discoms on a pathway to financial viability.

Improving business and operations

Immediate operational improvement should focus on improving metering, billing, and collection efficiency. Although discoms have been enthusiastic about smart-grid deployment, the high capital cost of advanced metering solutions has made deployment challenging. Making these systems financially viable should be a priority for the ecosystem. In addition to advanced metering solutions, discoms should focus on streamlining business processes, organizational incentive structures, and the deployment of human solutions.

Other key aspects for improving the discom business are the adoption of cost-reflective tariffs and the reduction of cross-subsidies. How the government balances the pressure to reduce the C&I tariff while ensuring affordability in the residential and agricultural sectors will demand political will and creative thinking. A redesigned subsidy scheme focusing on direct benefit transfer (DBT) could be one such rethink to achieve welfare goals with fewer distortionary effects to discoms' finances. The Government of India has already introduced these reforms through the proposed amendments to the Electricity Act 2003. Further, reduction of cross-subsidy has been provided as one of the necessary conditions for states to access additional borrowing from the centre.

The distribution business will also need a rethink to help the sector operate as a profitable enterprise. While privatisation may be a potential model, local context matters. In most states, public discoms serve large geographies with varied consumer bases that must consider socioeconomic factors in addition to profit maximization. Other ideas include distribution licensees, city-based discoms (which can be privatized), separation of rural load from urban load, separation of content and carriage, and a National Electricity Distribution Company (NEDC), which can help transform state-run discoms.

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The proposed amendment to the Electricity Act and Tariff Policy, as well as the recent announcement for privatization of the discoms in Union Territories, draws on some of these models. Implementation, documentation of lessons learned, and replicability will be key to success.

Enabling a green, least-cost energy system

Reducing the cost of energy supply is the other side of the equation to improve the current situation in the electricity sector and support economic recovery efforts. Given the rapid decrease in the cost of renewables, especially solar and wind, decarbonization and cost-optimization do not have to be mutually exclusive. The LCOE of renewables has dropped so much over the past decade that solar and wind are now more cost-effective than coal, without government subsidy (Exhibit 10). The challenge is in a) successful integration of these variable renewable energy (VRE) sources given their intermittency and geographical concentration and b) ensuring optimal market condition to enable value maximization.

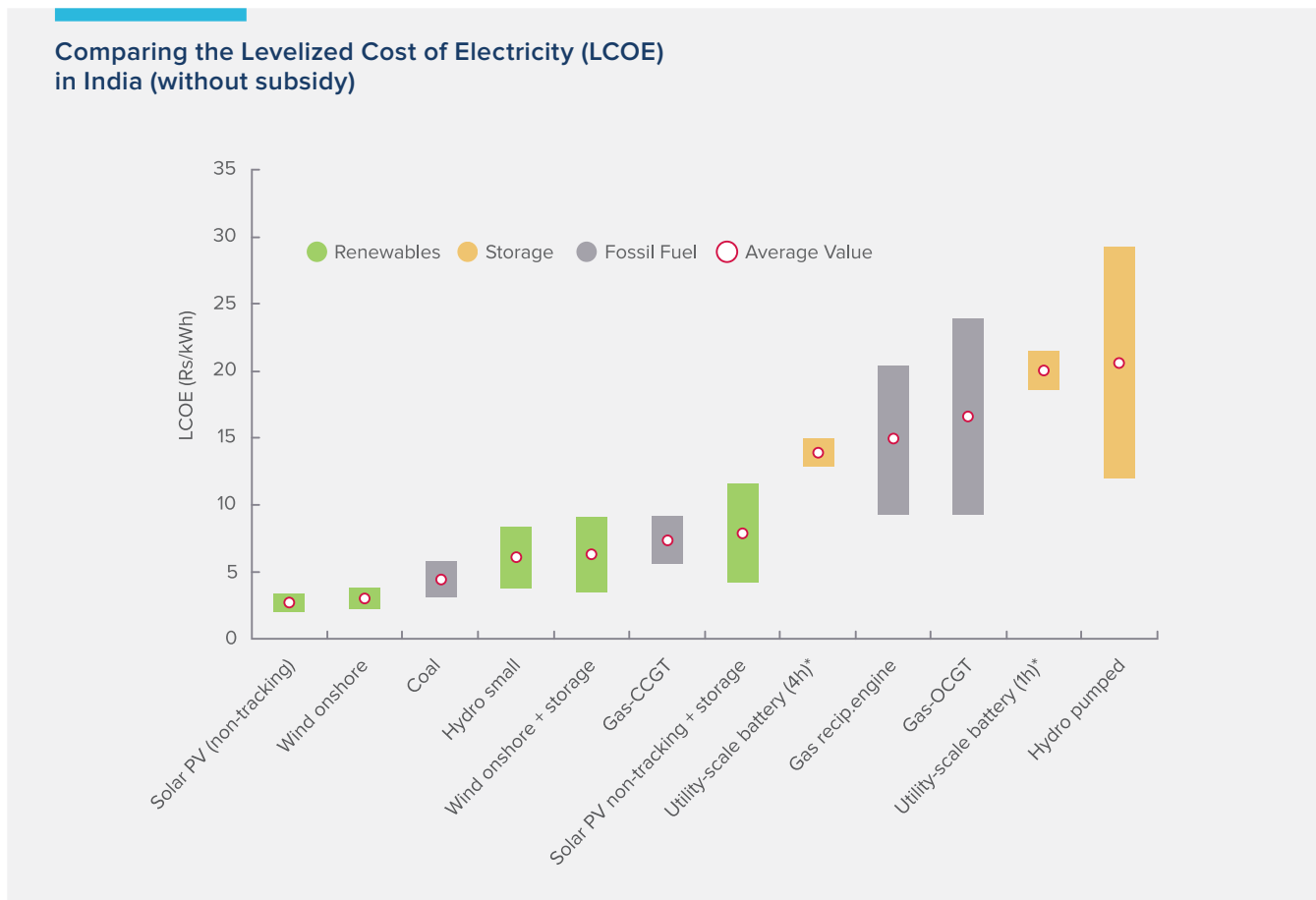


EXHIBIT 10: LCOE of Various Energy Sources in India in 2019 (BNEF, Levelized Cost of Electricity 1H 2020)

Note: * 4h and 1h indicates storage duration, which is the amount of time storage can discharge at its power capacity before depleting its energy capacity.

In the short term, technical solutions to reduce VRE curtailment will centre around the use of flexible thermal assets for balancing. Given the geographical concentration of VRE resources (in some states as high as 50 percent of generation in some days), the value of accurate generation forecasting, and geographical smoothing is critical.

Towards a Clean Energy Economy



Optimizing plant location, rapid scheduling and economic dispatch, dynamic use of interconnections, and other solutions can help ensure optimal VRE integration. As VRE penetration continues to increase, the flexibility that demand shaping and energy storage provide will become an increasingly important part of the solution set.

Proper incentive mechanisms must be in place to enable these technical solutions and unlock the economic value that they can create. Such mechanisms could include better payment guarantees for project developers, correct pricing of externalities (e.g., carbon pricing), the development of market structures to extract multiple value streams from the assets, and long-term policy signals around renewables and decarbonization.

The government and regulators have significant roles to play. Ambitious target setting through the National Electricity Plan and the expected National Renewable Policy can provide long-term policy signals to the market. The proposed amendment to the Electricity Act can enable contract enforcement and payment security. And the Central Electricity Regulatory Commission (CERC) can continue its efforts to transition to a real-time market and a redesigned ancillary services mechanism.

Building resilience, equity, and security in the design of the energy system

For emerging economies like India, resilience must be a feature of energy system design. Resilience can support access, equity, economic development, and decarbonization. Rural access programs, like the Saubhagya scheme, could consider a bottom-up approach to resilience as they mature. This bottom-up model could build on distribution reform, leveraging franchisee models, as well as renewables and DERs, especially in the form of mini- and microgrids.

Decentralized generation can offer greater flexibility and the ability to isolate in the time of grid disturbances, providing significant value to end-users. Siting generation closer to consumption centres can add further value by reducing transmission and distribution losses. Distributed renewables can be encouraged through reinforcing C&O Open Access and encouraging the Sustainable Rooftop Implementation for Solar Transfiguration of India (SRISTI) program, which aims to deploy 40 GW of rooftop solar PV capacity by 2022.

The potential of microgrid systems to support India's electrification and renewable energy goals:



Microgrids are small power systems that use local generation resources to meet local electricity needs. These energy systems collocate electric loads and electricity generation and have the capacity to produce electricity independently. Some microgrids are connected to the distribution grid, whereas others are islanded.

Today, most microgrids are a combination of solar photovoltaic modules and battery energy storage, control systems to manage islanding, and balance-of-system components to convert direct current (DC) to alternating current (AC). In some cases, fossil-fuel generation sets may provide a share of a microgrid electricity.



Potential use cases and benefits:

- **Electrifying new communities:** For communities that do not have access to electricity, microgrids can be more cost-effective than extending distribution lines. Pairing electrification with productive-use programs (i.e., revenue generating end-use energy applications) can help ensure the successful adoption and economic operation of such microgrids. For example, in Ethiopia, RMI analysis identified an Rs 30,000 crore economic opportunity from electrifying smallholder agriculture, while saving farmers money on diesel, improving the financial health of the utility through Rs 165 crores in annual revenue streams, and developing a local market for appliances.²⁷
- **Enhancing reliability for ‘undergrid’ communities:** For communities with partial electrification and connection to the distribution grid, microgrids can provide greater reliability at lower cost to utilities. For example, in Nigeria, RMI analysis demonstrated how implementing 4,000 undergrid minigrad projects could save Nigerian distribution companies Rs 225–450 crore per year while saving communities Rs 1,280 crore in annual energy expenditures.²⁸
- **Providing resilience for critical facilities:** For facilities that provide critical services, microgrids can offer resilient backup power through on-site or locally sited solar-plus-storage systems.

Lastly, an important element of ensuring resilience and security rests in creating an indigenous energy supply chain. India has realised a degree of self-sufficiency in wind-power component manufacturing, yet competitive indigenization of solar and battery manufacturing remains an opportunity. The government should consider strategies to encourage domestic manufacturing of solar and energy storage systems as a means of ensuring both energy security and decarbonization.

Making it work

These suggestions are not new. Some of them have been laid out as part of recent announcements and amendment. Many have been discussed in various forums and thought leadership engagements. The real challenge will be in financing, prioritization, implementation, and enforcement of these changes. This is where the framework hopes to help. Ultimately it will require resolute leadership both at the political as well as the organizational level, a willingness to experiment and change, careful management of state-centred sectoral co-jurisdiction and political economy issues on the ground, innovative financing through multilateral and other financial institutions and sharing of intellectual resources.



PATH FORWARD

While India's nationwide lockdown may have helped to slow down the spread of the coronavirus, it has come with significant economic consequences, disrupting business as usual across all sectors of the economy. Despite new short- and medium-term challenges for India's clean energy and mobility transitions, India's public and private sector leaders must continue to invest in a long-term clean energy future.

Opportunities in the transport sector include making public transport safe, enhancing and expanding non-motorized transport infrastructure, reducing vehicle kilometres travelled through work-from-home where possible, supporting national strategies to adopt electric vehicles in the freight and passenger segments, and making India an automotive export hub.

In the power sector, opportunities include improving the electricity distribution business and its operations, enabling renewables and distributed energy resources, and promoting energy resilience and local manufacturing of renewable energy and energy storage technologies.

Doing so will require a commitment to implement existing plans and initiatives, including flagship efforts like Prime Minister Narendra Modi's commitment to achieve 500 GW of installed renewable energy capacity by 2028, the Department of Heavy Industry's Rs 10,000 crore outlay to electrify over 15 lakh EVs under the FAME II scheme, and the National Mission on Transformative Mobility and Battery Storage to develop a domestic battery manufacturing industry.

The private sector and civil society can help deliver against these ambitious national goals and further the ambitions of the ecosystem with new technologies, business models, and ideas. For example, studies suggest that a circular economy development path—with a focus on resource efficiency, through the elimination of waste and continual use of materials—could build on India's clean energy agenda and create annual benefits of Rs 14 lakh crore (US\$218 billion) in 2030 and Rs 40 lakh crore (US\$624 billion) in 2050 compared to the nation's current development path.²⁹

The programs recommended here are by no means all-inclusive of the full breadth of programs that can drive a clean energy future, nor should the absence of other potential options suggest a dismissal of other opportunities. Rather, these ideas reflect our current perspectives on policy priorities and programs with potential for near-term job growth and a long-term transition to clean, resilient, and low-cost mobility and power systems.

As policymakers and business leaders discuss and identify ways to drive short-term recovery and long-term resilience, they can leverage investments in least-cost energy solutions, resilient and secure energy systems, efficiency and competitiveness, and social and environmental equity for a better, greener future for India.



APPENDIX



Overview of Impact Analysis for Transport Sector

To develop a path towards clean energy and mobility systems, India must transition towards shared, electric, and connected passenger mobility and cost-effective, clean, and optimized freight transport.

To quantify the potential impact of these transitions, analyses of oil, net energy, and net CO₂ emissions savings for India's passenger mobility and freight transport sectors was conducted for the 2020–2030 timeframe. Savings are calculated by comparing forecasts for “business-as-usual” and “efficient” scenarios.

Passenger, mobility, and freight transport

The efficient scenario in the passenger mobility analysis assumes reduced motorized transport demand, a high share of public and shared transport, high penetration of EVs, and high vehicle efficiency improvement. The projections for vehicle electrification are drawn from NITI Aayog and RMI's 2019 report, India's Electric Mobility Transformation: Progress to Date and Future Opportunities. Select drivers for these conditions include supportive policy frameworks, improved infrastructure, technology trends, better urban design, and other macro-economic factors.

For freight transport, the efficient scenario assumes a high share of rail, improved vehicle efficiency, high penetration of EVs in the light-duty segment, optimized freight movement, and efficient logistics practices.



Some key assumptions include:

	Passenger	Freight
Vehicle classes under consideration	Two-wheelers, three-wheelers, four-wheelers, and buses	Two- and three-wheelers, Light commercial vehicles (LCVs), Medium commercial vehicles (MCVs), Heavy commercial vehicles (HCVs)
2030 EV sales penetration	70% for commercial cars, 30% for private cars, 40% for buses, and 80% for two- and three-wheelers	80% for two-wheelers, 70% for three-wheelers, 65% for LCVs, 16% for MCVs, and 2% for HCVs
Other notes:	<ul style="list-style-type: none"> • Vehicle efficiencies improve by about 1% per year • Renewable energy installed capacity reaches 500 GW by 2030 • CO₂ emissions analysis is for tailpipe emissions • Crude oil price is US\$46/barrel for 2020 and US\$63/barrel for 2021 onwards • Rs-USD conversion rate is 75 Rs/USD 	



ENDNOTES

1. Singh, Jyotsna, "India's Coronavirus Crisis Hits Country's Farmers and Food Supplies," *Financial Times*, 22 April 2020, <https://www.ft.com/content/f9eb67f3-5cf8-42c4-be97-8dd36a7f1671>
2. Banerji, Sumat, "Coronavirus impact: Auto sales hit zero in April—first time ever," *Business Today*, 1 May 2020, <https://www.businesstoday.in/sectors/auto/coronavirus-impact-auto-sales-hit-zero-in-april---first-time-ever/story/402596.html>
3. "Record load factor highlights strong August demand," IATA, 1 October 2018, <https://www.iata.org/en/pressroom/pr/2018-10-01-02>
4. "Covid-19 lockdown estimated to cost India \$4.5 billion a day: Acuité Ratings," *Hindu Business Online*, 2 April 2020, <https://www.thehindubusinessline.com/economy/covid-19-lockdown-estimated-to-cost-india-45-billion-a-day-acuit-ratings/article31235264.ece>
5. "Unemployment Rate in India," CMIE, accessed 20 May 2020, <https://unemploymentinindia.cmie.com/>
6. "Analysis: India's CO2 emissions fall for the first time in four decades amid coronavirus," Carbon Brief, 5 December 2020, <https://www.carbonbrief.org/analysis-indias-co2-emissions-fall-for-first-time-in-four-decades-amid-coronavirus>
7. Karnad, Raghu, "The coronavirus offers a radical new vision for India's cities," *The New Yorker*, 13 April 2020, <https://www.newyorker.com/news/dispatch/the-coronavirus-offers-a-radical-new-vision-for-indias-cities-pollution>
8. "India's Rs 20 lakh crore Covid relief package one among the largest in the world," *Economic Times*, 15 May 2020, <https://economictimes.indiatimes.com/news/economy/finance/latest-stimulus-package-among-largest-in-the-world/articleshow/75701976.cms?>
9. *Global Stimulus Principles: The Economy We Rebuild Should Not Be the Same Economy We Decarbonize*, Rocky Mountain Institute, 2020, <https://rmi.org/insight/global-stimulus-principles-the-economy-we-build-should-not-be-the-same-economy-we-decarbonize/>
10. EESL, "India's Experience in Promoting Innovations for EE Technologies, Finance and Business Models," 5 June 2019, <https://pronto-core-cdn.prontomarketing.com/581/wp-content/uploads/sites/2/2018/06/Venkatesh-Dwivedi-India%E2%80%99s-Experience-in-Promoting-Innovations-for-EE-Technologies-Finance-and-Business-Models.pdf>
11. Khandekar, Aditya et al., *The Case for All New City Buses in India to be Electric*, Lawrence Berkeley National Lab, December 2018, <https://ies.lbl.gov/publications/case-all-new-city-buses-india-be>
12. "The impact of air pollution on death, disease burden, and life expectancy across the states of India: The Global Burden of Disease Study 2017," *Lancet Public Health* (2019); 3:e26–39, <https://www.thelancet.com/action/showPdf?pii=S2542-5196%2818%2930261-4>
13. *Road Transport Yearbook 2016–2017*, Ministry of Road Transport and Highways; *Brown to Green: The G20 Transition to a Low-Carbon Economy*, TERI, 2018, <https://morth.nic.in/sites/default/files/Road%20Transport%20Year%20Book%202016-17.pdf>
14. Bhatt, Amit and Chaitanya Kanuri, "Why India Must Not Even Think of Becoming a Car Country, Post Covid-19," *Swarajya*, 12 May 2020, <https://swarajyamag.com.amp/project.org/c/s/swarajyamag.com/amp/story/infrastructure%2Fwhy-india-must-not-even-think-of-becoming-a-car-country-post-covid-19>

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15. *COVID-19 Community Mobility Report*, Google, accessed 20 May 2020, https://www.gstatic.com/covid19/mobility/2020-05-09_IN_Mobility_Report_en.pdf
16. *Key statistics 2016–2017*, CIRT, <http://www.cirtindia.com/pdf/Key%20Statistics%202016-17.pdf>
17. “Apple COVID-19 mobility trends report,” Apple, accessed 20 May 2020, <https://www.apple.com/covid19/mobility>
18. Mamgain, Pramugdha, “India’s Zomato sees business opportunity in grocery amid COVID-19 crisis,” *Deal Street Asia*, 23 March 2020, <https://www.dealstreetasia.com/stories/zomato-groceries-covid-181071/>
19. “EV Outlook 2020,” BloombergNEF, <https://about.bnef.com/electric-vehicle-outlook/#:~:text=The%20Electric%20Vehicle%20Outlook%20is,two%2Fthree%2Dwheeled%20vehicles>
20. Divekar, Aditi, “Covid-19 impact: Biz environment gets tougher for ports, logistics firms,” *Business Standard*, 19 April 2020, https://www.business-standard.com/article/companies/covid-19-impact-biz-environment-gets-tougher-for-ports-logistics-firms-120041900547_1.html
21. *COVID-19 crisis: Impact on the automotive industry and navigating the turbulence*, PWC, April 2020, <https://www.pwc.in/assets/pdfs/services/crisis-management/covid-19/impact-on-the-automotive-industry-and-navigating-the-turbulence.pdf>
22. “Uber restarts partial operations in India, recovery will vary across geographies, says CEO,” *Economic Time Tech*, 9 May 2020, <https://techeconomictimes.indiatimes.com/news/mobile/uber-restarts-partial-operations-in-india-recovery-will-vary-across-geographies-says-ceo/75618073>
23. Goel, Samiksha, “Shared mobility to remain subdued, firms gear up for post-COVID phase,” *The Hindu Report*, 6 May 2020, <https://www.deccanherald.com/business/shared-mobility-to-remain-subdued-firms-gear-up-for-post-covid-phase-834378.html>
24. “Impact of COVID-19 on Indian Bus Operators,” UITP and World Bank, May 2020, <https://indd.adobe.com/view/d6dd8493-bfe6-473a-8823-667d66420dc6>
25. “CAIT—Country Greenhouse Gas Emissions Data,” World Resources Institute, accessed 20 May 2020, <https://www.wri.org/resources/data-sets/cait-country-greenhouse-gas-emissions-data>
26. Executive Summary on Power Sector, Government of India, Ministry of Power, and Central Electricity Authority, March 2020, <http://cea.nic.in/reports/monthly/executivesummary/2020/summary-03.pdf>
27. Borgstein et al., *Capturing the Productive Use Dividend*, RMI, 2020. https://rmi.org/wp-content/uploads/2020/04/capturing_productive_use_dividend.pdf
28. Graber et al., *Electrifying the Underserved*, RMI, 2019. <https://rmi.org/wp-content/uploads/2019/10/RMI-Electrifying-the-Underserved.pdf>
29. “India can add value to growth by adopting circular economy: UN watchdog,” *Economic Times*, 5 December 2016, <https://economictimes.indiatimes.com/news/economy/policy/india-can-add-value-to-growth-by-adopting-circular-economy-un-watchdog/articleshow/55817671.cms?>



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