India should create an Environment and Health De-risking Mission to increase emergency preparedness, secure critical resources, and build resilient infrastructure and governance systems to counter tail-end risks.

4. Secure resources and build resilience against tail-end risks

India needs to invest in resilient infrastructure and governance systems to respond to lowprobability but high-impact tail-end risks. This is critical because, as the pandemic shows, such tail-end risks can bring the economy to a halt, imposing far greater costs than what would be otherwise spent to increase resilience.

Climate risks are non-linear and could trigger shocks across many parameters — food, water, heat stress, vector-borne diseases, extreme weather events, etc. — compounding the pressures on weak infrastructure. As a nation, we need to increase preparedness and secure our critical resources to counter such risks to, first, ensure the safety of our citizens during such catastrophic events, and second, facilitate recovery with minimum loss of lives and livelihoods.

In this section, we propose measures to build resilience in some critical areas:

- Create an Environment and Health De-risking Mission
- **•** Build capacity for emergency response and disaster management
 - Develop a nationwide Integrated Emergency Surveillance System (IESM)
 - Promote public-private partnership to build emergency preparedness infrastructure
 - Create a Unified Emergency Response Framework (UERF) for citizens
- Food security
 - Provide affordable access to safe and nutritious food for informal workers
 - Manage post-harvest loss of fruits and vegetables
- Water security
 - Provide plot-scale irrigation advisories to farmers to improve irrigation efficiency
 - Fast-track wastewater management
 - Ensure piped water supply, sanitation and sewerage connection to households
 - Build basin-scale info-base for all river basins for data-driven water management
- Energy security
 - Enhance oil and critical minerals security for the country
 - Improve cooking energy security for the household
- Strategic decarbonisation
- Improve air quality and keep a second COVID-19 wave at bay

4.1 Create an Environment and Health De-risking Mission







INR 5 Crore Estimated cost of developing a Climate Risk Atlas for India

Data points: CEEW analysis

The international environment is beset with traditional security concerns. But the biggest threats are no longer states, nor non-state terrorist groups. The gravest concerns are about tail-end risks, which have low probability but can be catastrophic.

The pandemic is one such risk; others include severe climate shocks. With growing environmental and health stress, such calamitous events are likely to occur more often and overlap with one another, overwhelming our capacity to respond.

In many sectors, regulations consider worst-case scenarios, such as, structural integrity of buildings in earthquakes, or capital reserves for insurance firms. On the battlefield, military strategists imagine the worst and prepare accordingly. Public health pandemics, food shocks, water scarcity, or electricity grid collapse demand similar approaches.

- PROBLEM Climate risks such as extreme weather events, impacts on health and infrastructure, or destruction of biodiversity are dangerous because these risks are non-linear, rising with time and triggering further collapse of ecosystems, leading to a long tail of disastrous consequences.
- SOLUTION Create an **Environment and Health De-Risking Mission** to focus on risks posed by climate change, air pollution, chemicals, and antimicrobial resistance.

Develop a **Climate Risk Atlas** for India covering critical vulnerabilities: coasts, urban heat stress, water stress, crop loss, vector-borne disease, and biodiversity collapse.

- Sy April 2021, develop a **National Environment and Health Risk Index**, with annual updates and improvements in methods.
- Add state-specific indices to the national index. States should update their action plans on climate change and air pollution with a deeper understanding of environment and health risks.
- To begin, draw up de-risking strategies at the national level and for five most vulnerable states. The Environment and Health Risk Index can then be linked to disaster risk reduction plans under national and state disaster management authorities.
- Involve insurance companies as investments in urban and coastal infrastructure need adequate recourse against more frequent extreme weather events.

To create a razor-sharp focus on tail-end risks:

- Apply the principles of risk assessment
 - Assess risks in relation to objectives, or interests i.e. what we wish to avoid
 - Identify the biggest risks and worst-case scenarios
 - Consider the full range of probabilities: an extremely low probability may correspond to an extremely high risk, if the impact is catastrophic
 - Use the best available information: a best estimate is better than no estimate
 - Take a holistic view: assess direct as well as systemic or compound risks, for example, how a water crisis could trigger food shocks, migration, and social instability
 - Be explicit about value judgments
- Broaden participation in the risk assessment process
- Involve leaders and decision-makers in defining objectives and interests
- Gather information and assess risk by involving:
 - Scientists, to lead the understanding of climate change and its direct impacts
 - Experts in risk from fields such as defence, intelligence, insurance, and public health
 - Economists, technologists, sociologists, and political scientists, to assess interactions across and impacts on various human systems
- Build capacity for the weakest links
 - The COVID-19 pandemic has exposed the limits to centralised decision-making without resilience and capacity of local officials. The weakest links can unravel the best planned responses. Report to the highest decision-making authorities but build district-level crisis response capacities, including decentralised infrastructure.

FISCAL	There will be minimal fiscal outlay for this. The estimated cost of developing a Climate Risk Atlas for India is INR 5 crore (USD 0.66 million).
TIMELINE	The first stage of the Environment and Health Risk Index should be completed by April 2021, with further revisions and updates on an annual basis.
IMPLEMENTERS	The Ministry of Environment, Forest and Climate Change (MoEFCC) and the Ministry of Health and Family Welfare (MoHFW) would have to jointly chair this Mission. A Mission Director and a co-Mission Director could be appointed by the respective ministries, with contributions from the Ministry of Earth Sciences (MoES), the Department of Science and Technology (DST), and the National Disaster Management Authority (NDMA). In addition, there would be a significant role of research organisations with the capability to collect, analyse and disseminate data on a range of environmental and health risks using the latest technologies. The results of the annual Environment and Health Risk Index exercise should be reported to a larger body comprising the Prime Minister's Office, the Ministry of Home Affairs (MoHA), MoF, Ministry of Defence (MoD) and MEA.
JOBS	The direct impact on jobs would be small since this is primarily a technical exercise.
GROWTH	Since 1990 India has encountered nearly 300 extreme climate events with INR 5.61 lakh crore (USD 79.5 billion) in damages ⁵⁶ . Loss and damage costs India INR 37,675 - 45,210 crore (USD 5-6 billion) each year. Investing in a low-cost Environmental and Health Derisking Mission could avoid billions of dollars in infrastructure and economic losses.
SUSTAINABILITY	In India, vulnerability is not well measured. Most losses from natural disasters, thus far, have been uninsured, which disguises the damage. Various risks can escalate insurance premiums and further exclude the poor. The Environment and Health De-risking Mission, the first of its kind in the developing world, would greatly increase resilience against future shocks. It would also boost India's leadership via the Coalition for Disaster Resilient Infrastructure.

4.2 Build capacity for emergency response and disaster management



The United Nations Office for Disaster Risk Reduction estimates that in the past two decades, India has suffered losses of INR 5.61 lakh crore (USD 79.5 billion) and INR 7.53 lakh crore (USD 100 billion) respectively due to extreme climate events and vectorborne diseases⁵⁷. The unprecedented scale of the COVID-19 pandemic has exposed the fragility of India's emergency preparedness and response systems and emphasised the vulnerability of lives and livelihoods to a range of risks ensuing from a single crisis.

Effective preparedness is a long-term, integrated and multifaceted approach to disaster and emergency management. It strengthens governance frameworks and community preparedness, and systematically builds resilience and adaptation.

India must evolve its emergency preparedness by building resilient physical and digital infrastructure, training relief personnel, and inculcating social and behavioural changes in citizens and communities.

Proposed solutions:

- Develop a nationwide Integrated Emergency Surveillance System (IESM)
- Promote public-private partnership (PPP) to build emergency preparedness infrastructure
- Create a Unified Emergency Response Framework (UERF) for citizens

4.2.1. Develop a nationwide Integrated Emergency Surveillance System (IESM)



INR 2 Crore Estimated cost of IESM software development and initial data digitisation



INR 6.76 Lakh crore Indicative national savings with better disaster and emergency preparedness over past two decades



Data points: CEEW analysis

PROBLEMDuring emergency/ disaster scenarios, relief agencies and citizens do not have access to
credible and updated information, which leads to misinformation, miscommunication,
and a lack of coordination between stakeholders.

SOLUTIONIndia should develop a nationwide, centralised, structured, and real-time digital
disaster/ emergency surveillance and management system. MoHA could scale up the
basic surveillance and tracking system of the national Integrated Disease Surveillance
Programme (IDSP) database and State Disaster Management Authorities (SDMA) to serve
the entire range of emergency preparedness activities.

The proposed **Integrated Emergency Surveillance System (IESM)** would provide information on:

- National and local accidents, disasters, and extreme climate events
- National and state-level response and relief efforts
- Targeted instructions for various authorities and citizens
- Government and aid agency services

Major features of IESM:

- Cloud and data analytics-based backbone
- Active database of disaster / emergency hotspots
- A comprehensive Climate Risk Atlas with geo-tagged interfaces of critical infrastructure such as police and fire stations, hospitals, relief help desks, shelter houses, and warehouses
- Nulti-user interface for central and state nodal agencies, and citizens
- **Facility to avail and monitor response services for post-emergency restoration**

The IESM would facilitate a systematic and sustained response to emergencies, ensure safety of lives and property, and lead to rapid restoration of business-as-usual operations. Citizens can voluntarily register on the IESM to receive real-time, hyper-local and customised information.

	States like Odisha and Kerala have managed the COVID-19 crisis more effectively than other states by using IESM prototypes. The Odisha Government's unified COVID-19 portal managed inflow of its migrant workers and allowed efficient contact tracing, restricting total cases of COVID-19 cases to 1269 with only 7 fatalities as of 25 May 2020, despite the onslaught of super cyclonic storm <i>Amphan</i> in mid-May.
FISCAL	The IESM software development and initial data digitisation cost is estimated at INR 2 crore (USD 0.27 million). Running costs include software / database maintenance and day-to-day operation of the IESM.
TIMELINE	Initiate IESM development within 3 months and complete roll-out within 12 months.
IMPLEMENTERS	Implementing the IESM requires the collaboration of several authorities:
	MoHA would be the nodal agency for IESM
	The NDMA would be the main coordinating agency to deploy the IESM in states and districts through SDMAs
	 IDSP and the Ministry of Health and Family Welfare (MoHFW) will be the health domain supporting agency
	National Informatics Centre (NIC) would provide info-tech related technical assistance to MoHA and NDMA to develop, maintain and streamline the ISEM, supported by State Informatics Centres
	State Disaster Management Departments (SDM) would be the state focal points
JOBS	All 720 districts of India with <i>Jan Seva Kendras</i> , should be equipped with a dedicated person to manage the local IESM on a 24x7 basis in 3 shifts. There should also be state- and central-level integration centres. Approximately 3500 direct jobs will be created from IESM management and maintenance .
GROWTH	As per the UN-IASC report on ' <i>Return on Investment in Emergency Preparedness</i> ', every INR 75.35 (USD 1) invested for preparedness saves over INR 150.7 (USD 2) in future response ⁵⁸ . Extrapolating this ratio to India's losses of INR 13.52 lakh crore (USD 179.5 billion) in disaster management ⁵⁹ in the past twenty years on extreme events and pandemics (<i>excluding</i> the COVID-19 crisis), the government could have saved close to INR 6.76 lakh crore (USD 89.7 billion) if such a system were in place . Similar savings are being forecast here, which may be directed to productive economic activities.
SUSTAINABILITY	The IESM will enable coordinated preparedness and response by national and sub- national agencies and enhance community awareness and resilience.

4.2.2. Promote public-private partnership (PPP) to build emergency preparedness infrastructure

PROBLEM	Approximately 79 per cent of India's districts are vulnerable to climate extremes and disasters such as floods, droughts, and storms ^{60,61} . India's emergency preparedness infrastructure depends largely on government funding, which is often inadequate and inefficiently deployed. This has led to major gaps in infrastructure and poor maintenance of existing systems, reducing emergency response to ad-hoc local action.
SOLUTION	India needs to invest in cost-effective technologies to build new emergency preparedness infrastructure and upgrade existing systems. The <i>National Disaster Management Act</i> provides for infrastructure development in PPP mode, using private funding to supplement government spending for critical infrastructure such as primary, community, district-level and private healthcare centres and hospitals; warehouses for relief equipment and essential goods (food, water, medicines), and shelter homes, camps, and community centres. A joint central-state provision can implement this through risk transfer mechanism ⁶² .
	During non-emergency situations, PPP centres can be used for state-sponsored schemes such as check-up and vaccination drives, maternity centres, and emergency treatment. Revenue could be generated from 70 per cent of the population using the facilities, with free treatments for the 30 per cent patients belonging to the Economically Weaker Section (EWS). Services for EWS families should be linked with the government's <i>Ayushman</i> <i>Bharat</i> scheme to enhance efficacy.
	For example, in Odisha, private partners have developed 62 per cent of the state's COVID-19 hospitals and quarantine centres in PPP mode by channelling corporate social responsibility (CSR) funds, which has greatly helped manage the outbreak in the state.
NON-FISCAL / STRATEGIC	This measure will enhance the emergency preparedness capacity of any state through a robust governance framework, operational efficiency, and increased asset creation. The PPP mode will enhance the governance framework and operational efficiency through private sector accountability. In addition, private finance will help in asset creation at a quicker pace.
TIMELINE	This measure can be initiated within six months post-lockdown.
IMPLEMENTERS	PPP projects require the collaboration of several authorities:
	NDMA would be the focal nodal agency facilitating and monitoring the PPP mode of infrastructure development in hotspots through SDMAs
	 MoHFW would support and monitor health-related infrastructure
	The state departments dealing with the industrial sector would support and coordinate with partners to facilitate PPP mode
	The private sector can partner with state governments to develop emergency infrastructure by expressing interest to NDMA and state industry departments

JOBS	A 50-bed facility provides 100 healthcare and allied services jobs; such facilities will generate employment for healthcare professionals and improve India's ratio of 1.34 doctors per 1,000 citizen ⁶³ (2017). Similarly, other facilities will provide jobs for local and specialised personnel.
GROWTH	These facilities will expand the reach of affordable and efficient healthcare and relief services to people, and allow rapid recovery from emergency scenarios, thus directly improving productivity of individuals and authorities.
SUSTAINABILITY	Improving emergency preparedness infrastructure would help meet India's UN sustainable development goals (SDGs), in particular, Goal 3: Good Health and Well-being, and Goal 11: Sustainable Cities and Communities.

4.2.3. Create a Unified Emergency Response Framework (UERF) for citizens

PROBLEM	The <i>National Disaster Management Act</i> is restricted to emergency service providers and government agencies in terms of instruction and implementation. There is no formal percolation of this information to the public, resulting in on-ground confusion and chaos during emergencies. This has been demonstrated during the COVID-19 crisis as many people did not follow government instructions for social distancing, leading to aggravated spread of the infection, and increased fatalities. Public services, workplaces, and community hubs have been forced shut for a prolonged period as citizens remain at high risk due to low awareness and compliance of safety precautions.
SOLUTION	The Government should create a Unified Emergency Response Framework (UERF) , comprising a set of standard operating procedures (SOPs) for the public. This should be mandated in school and university curricula, as well as community, corporate, and institutional training.
	Emergency preparedness creates an understanding of risks and inculcates behavioural adaptation to stress situations among citizens, resulting in improved community resilience and minimising loss and damage to life and property.
	For example, following the Fukushima Daiichi nuclear accident in 2011, Japan developed a standardised nuclear emergency guideline for medical institutions, residential complexes, government and non-government officials. Training and drills are mandated under a standardised sectoral response guideline for school children, medical professionals, and citizens ⁶⁴ .
NON-FISCAL/ STRATEGIC	This measure will have the dual benefits of enhancing community resilience and a smooth emergency response system ensuring quick restoration to the business as usual scenario. Clear demarcation of roles and responsibilities of the authorities and citizens will aid smooth information flow and coordination during any disaster/pandemic.
TIMELINE	This measure should be initiated within six months and implemented nationwide within a span of 18 to 24 months. Behavioural change will take longer to observe and, therefore, a lot of public communication and nudge strategies would have to continue for longer.
IMPLEMENTERS	Creating and deploying the UERF requires several authorities:
	MoHA would be the nodal ministry for the UERF
	The Ministry of Human Resource Development (MHRD) would mandate and coordinate with the institutions under it to ensure timely implementation of UERF
	Authorities such as the National Skill Development Council (NSDC) would ensure the deployment of the UERF via their affiliated organisations
	The NDMA and the respective SDMAs would be the central and state level coordinating and monitoring agencies for the UERF

JOBS	Community experts such as emergency workers, teachers, social workers, self-help groups (SHGs) and resident welfare associations (RWAs) could be trained as trainers to permeate this knowledge. Certified trainers may be given a government stipend or allowed to run private courses.
GROWTH	Informed and adaptive citizenry can minimise the impact of people-related issues during emergencies by practicing safety-first measures. Positive behavioural changes and increased resilience could reduce insurance premiums in vulnerable areas, if risk evaluations find that the ability of communities to prevent disasters or cope thereafter is increasing.
SUSTAINABILITY	Systematic information dissemination and training will increase community resilience to withstand disasters.

4.3 Food security



The COVID-19 lockdown has disrupted food supply chains across the country, but the impact has been especially devastating on the informal workers and urban poor, who lost their livelihoods and were displaced from their homes – and often forced to journey for thousands of kilometres back to their villages. It has also led to a crisis in the wholesale food sector, with widespread wastage of fruits and vegetables due to lack of retail offtake and storage facilities. This underlines the need for India to build capacity to ensure access to food and proper storage and supply network of harvested crops.

Taking this into account, we have suggested recommendations to:

- Provide affordable access to safe and nutritious food for informal workers
- Manage post-harvest loss of fruits and vegetables

4.3.1 Provide affordable access to safe and nutritious food for informal workers

		ဂိဂိ
60,000 canteens Estimated to serve three meals a day to about 30 million urban poor workers	INR 26,500 Capital investment required to set up 60,000 canteens and 8200 kitchens	1.2 million Potential jobs, with each canteen employing 20 people to serve 500 beneficiaries
		Data points: CEEW analysis
PROBLEM As the pul proportion	blic health and consequently the macroe n of urban poor, in particular, informal w	conomic crises prolong, a significant vorkers would continue to struggle

	to gain affordable access to safe and nutritious food. Poor accessibility to food would aggravate malnutrition-induced comorbidities, making the population more vulnerable to COVID-19 and other infections. Among adults, 23 per cent of women and 20 per cent of men are considered undernourished in India ⁶⁵ . Further, malnourished adults are less able to work, leading to loss of productivity and wages.
SOLUTION	Large-scale deployment of state-supported canteens to provide hygienic, affordable and nutritious cooked food at affordable rates can be operationally budget-neutral. These canteens should incorporate low-cost, but nutritious and environmentally sustainable food items in the plate, providing a clear demand signal for diversification of food production through assured procurement.
IMPLEMENTERS	State governments will support the programme with implementation by Urban Local Bodies / Municipal Corporations, in collaboration with local non-governmental organisations (NGOs) and private entities as service providers.
FISCAL	Serving food three times a day to all urban migrant workers (~30 million), particularly daily wage labourers, would require a capital investment of about INR 26,500 crore (USD 3.5 billion) for an estimated number of 60,000 canteens and about 8,200 kitchens ⁶⁶ .
	However, the food can be priced in a manner that the operating expenses are entirely covered. Initial estimation suggests that the food could be priced at about INR 15 (USD 20 cents) per meal. ⁶⁷
TIMELINE	The programme should be implemented in a phase-wise manner starting from now for the next two years, first covering areas with a high population of vulnerable migrant or low wage workers.
JOBS	Each canteen serving meals to 500 beneficiaries could employ around 20 people on average, generating 1.2 million jobs to serve the 30 million migrant workers ⁶⁸ .

GROWTH	The canteens would help provide affordable, nutritious and safe food to the vulnerable population, thus improving their health and general well-being and avoiding loss of productivity due to under-nourishment.
SUSTAINABILITY	The initiative would contribute towards equitable access to food while helping improve the diversification in food production and dietary patterns. Procurement of agricultural produce from farmer collectives or farmer producer organisations (FPOs) by assuring market offtake at pre-determined prices will stimulate demand for high nutrient coarse cereals like millets, sorghum, etc. which have a lower adverse environmental impact. This will contribute towards reducing our excessive reliance on low nutrient staple crops and increase the awareness of nutritious diets among consumers. Over time, the procurement levers can further nudge farmers towards more sustainable approaches, such as natural farming, etc.
TRADE-OFFS	The initiative may lead to adverse impacts on informal food vendors in terms of loss of sales/livelihoods. Some of them could be absorbed as employees in the canteens themselves, providing them with greater job security. Others may need to be upskilled to enable them to move to more remunerating jobs or livelihoods. Land constraints could be a barrier to establish canteen facilities, especially in Tier 1 cities.

4.3.2 Manage post-harvest loss of fruits and vegetables

PROBLEM	The COVID-19 lockdown has disrupted the supply chain of agriculture and horticulture produce, crashed farm-gate prices of fruits and vegetables, and led to closure of markets, causing farmers to lose thousands of crore worth of produce. Even before the pandemic, gaps in cold chain infrastructure and inadequate post-harvest management solutions such as drying units, processing units, and storage facilities at farm-gate and FPO level posed major barriers to managing perishable commodities. Post-harvest losses amount to 16 per cent of India's total fruit and vegetable produce ⁶⁹ .
SOLUTION	The government should work with NABARD to extend a refinancing package to banks to provide preferential 'post-harvest management' loans to farmers and FPOs. These loans should be utilised to procure low cost, energy-efficient, and preferably, renewable energy (RE)-powered post-harvest technologies such as:
	Solar dryers to dehydrate and process excess fruits and vegetables to increase the shelf life of perishables, and provide value additions in the form of processed produce,
	Cold storages to extend the shelf life of the horticulture produce, thereby avoiding distress sales by the farmers and enhancing their bargaining capacity, and
	 Agro-processing units, such as solar-powered grading and sorting machines, multi- purpose food processors, etc. to enhance the value of produce and thus, increase local incomes.
	These solutions, costing between INR 15,000 - 15,00,000 (USD 200 - 20,000) based on the capacity and specifications of the system, can be implemented by FPOs across all the states. The loan amount could be capped at INR 5,00,000 (USD 6,641) for smaller FPOs (up to 20 farmers) and up to INR 15,00,000 (USD 20,000) for larger FPOs.
	Standardised and simple assessment (Excel-based) tools can be created to familiarise bankers with these technologies and speed up viability assessments and loan disbursals.
IMPLEMENTERS	Ministry of Food Processing Industries (MoFPI) and Ministry of Agriculture and Farmers' Welfare (MoAFW) should notify NABARD to extend refinancing package to RRBs as well as scheduled commercial banks for them to extend loans to FPOs, who could adopt such post-harvest management solutions.
NON-FISCAL	This intervention has no fiscal implication for the government and the refinancing should be extended through NABARD.
TIMELINE	The scheme should be made available within the next three months for two years.
JOBS	Direct and indirect job creation through demand impetus to small scale agro-processing equipment manufacturers, particularly of energy-efficient or RE-powered variants. Further, additional jobs would be created in the operations of these post-harvest management activities.
GROWTH	Cost-effective, small scale post-harvest management solutions would not just arrest current loss in income due to wastage of some produce, but would also help to increase and diversify farmers' incomes, through greater value addition.
SUSTAINABILITY	The interventions will make India's agricultural and food system more resilient, while reducing the wastage of high-value perishable commodities, and consequential adverse environmental impact.

4.4 Water security



India is grappling with increasing water security and governance related issues. Most of India's water management institutions were developed during a water surplus era and are struggling to keep pace with evolving water challenges⁷⁰. A complex institutional structure comprising multiple departments of assorted ministries further complicate water management. In the wake of the COVID-19 pandemic, it will be crucial to reassess our water systems and reprioritise water governance to address the vulnerabilities of various stakeholder groups.

The principles of Integrated Water Resources Management (IWRM)⁷¹, also adopted by India's National Water Mission, form the basis of our recommendations. IWRM focuses on "coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment". These have been sequenced as measures to support the immediate priorities for economic recovery and the systemic changes for better water governance:

- Provide plot-scale irrigation advisories to farmers to improve irrigation efficiency
- Fast-track wastewater management
- Ensure piped water supply, sanitation and sewerage connection to all households
- Develop basin-scale info-base for all river basins for data-driven water management

4.4.1 Provide plot-scale irrigation advisories to farmers to improve irrigation efficiency

PROBLEM	In India, 80 per cent of surface and groundwater is used for agriculture. Investments in construction of irrigation systems over the past 60 years has increased major and medium Irrigation Potential Created (IPC). However, there is a 23 per cent gap between IPC and Irrigation Potential Utilised (IPU), indicating low returns on high capital investment in surface irrigation ⁷² . The lack of regular monitoring of irrigation canal conveyance and supply efficiency and assessment of the seasonal demand of water for irrigation as per the cropping calendar exposes farmers to the risks posed by climate change. It is imperative to communicate this information to farmers on a regular basis to ensure adequate irrigation supply and protect farmers' livelihoods, especially now as we prepare to enter a post-COVID-19 recovery phase	
SOLUTIONS	Provide plot-scale irrigation advisories for farmers to improve irrigation water use efficiency in command areas. This is an opportunity to affect a major shift towards demand-side efficiency in water use in agriculture . Measures include:	
	Emphasise demand-based irrigation supply through state irrigation departments, Water Users' Associations (WUA), mapping of farms in command areas using satellite imagery, and cropping calendars using remote sensor-based crop identification techniques	
	Use Wireless Sensors Network (WSN) of Internet of Things (IoT) devices to monitor soil water content, soil nutrients, evapotranspiration and water level in irrigation command areas to facilitate adoption of deficit irrigation techniques using crop productivity models	
	Provide advisories via SMS to small holder farmers, informing them of crop water demand, canal discharge schedule and rainfall predictions to maximise water use efficiency	
	Encourage MSMEs and start-ups to participate in these efforts to establish timely local support for calibration and maintenance of instruments	
	Invite inputs from academia and research through multi-stakeholder groups	
FISCAL	This will be a fiscal measure, however budgetary outlay has not been assessed yet. There could be provision for reallocation of budget under the <i>National Hydrology Project</i> (NHP).	
TIMELINE	This effort should be completed by March 2022, the period during which small and marginal farmers are likely to face additional stress over market uncertainty.	
IMPLEMENTERS	Ministry of Jal Shakti, state irrigation departments, Indian Meteorological Department (IMD), Ministry of Agriculture, and Indian Council for Agricultural Research (ICAR).	
JOBS	Promotion of MSMEs and start-ups in the water sector could generate new jobs for skilled labour. The details of total jobs should be assessed and jobs census in this sector should be conducted.	
GROWTH	The solution caters to the needs of vulnerable farmer communities for timely weather inputs which could support farmers improve productivity and growth rates in agriculture.	
SUSTAINABILITY	These interventions would build resilience against immediate water stress and non-linear climate risks and their impacts on agricultural productivity.	

4.4.2 Fast-track wastewater management

PROBLEM	Almost 80 per cent of water supply flows back into the ecosystem as wastewater. It is estimated that around 37.7 million Indians are affected by water-borne diseases annually, 1.5 million children are estimated to die of diarrhoea alone, and 73 million working days are lost due to water-borne diseases each year ^{73,74} .
	India's current capacity to treat wastewater is estimated at 37 per cent, or 23,277 million litres per day (MLD), against a daily sewage generation of approximately 61,948 MLD ⁷⁵ . Most STPs do not work at full capacity and do not conform to prescribed standards. Effluent discharge tax or fees and tradable effluent discharge permits are popular incentive-based options to reduce industrial pollution, but enforcement has been weak. The brunt of such inefficiencies is faced by the rivers.
	The COVID-19 lockdown has led to decreased effluent discharge, especially from industries, leading to visible improvement in water quality, which needs to be sustained and even improved. With the pandemic adding to the public health burden, it is critical that India reduces the health burdens imposed by water-borne diseases. The pandemic gives an opportunity to strategically prioritise wastewater management.
SOLUTIONS	Fast-track wastewater management to maintain river health. Measures include:
	Short-term (time-sensitive and based on latest scientific evidence)
	Ramp up efficiency of STPs: While limited evidence indicates that the COVID-19 virus is not infectious when contracted through wastewater, initial reports suggest that wastewater can be used to measure the virus circulation in a population; if India starts using sewage surveillance as a tool in the coming months, wastewater utilities will be pressed to improve efficiency ⁷⁶
	 Provide standard Personal Protective Equipment (PPE) to sanitation workers
	Separate treatment of wastewater from hospitals as a precautionary measure
	Long-term
	Set up common effluent treatment plants for industrial clusters, and levy penalties on high-polluting industries
	Ensure sewer connection or decentralised treatment for all domestic households
	Increase the number of monitoring stations and broaden the scope of monitoring from conventional compounds (such as Biological Oxygen Demand, total suspended solids, faecal coliform, and oil and grease), to non-conventional pollutants (such as ammonia, chlorine, and iron) that have hazardous health impacts
	Enable adoption of circular economy for wastewater in the long-term, only after efficient tertiary treatment
	Encourage economic viability of institutions to achieve the target of 100 per cent coverage in water supply and sewage connections
	 Encourage adoption of PPP models for water treatment, distribution and sewage treatment
	Set up independent state-level water pricing committees in each state to decide fair water pricing for drinking, industrial use, wastewater reuse, etc.

FISCAL	India's wastewater treatment plant market stood at around INR 18,084 crore (USD 2.4 billion) in 2019 and can potentially reach INR 32,400 crore (USD 4.3 billion) by 2025 due to growing demand for sophisticated municipal water and STPs ⁷⁷ . Several central and state government programmes like <i>Namami Gange, Yamuna Action Plan</i> and <i>National River Conservation Plans</i> etc. are already allocating capital for improving wastewater management.
TIMELINE	Since schemes to manage piped supply, sanitation and hygiene already exist, this should be completed by March 2024, in alignment with the <i>Har Ghar Jal</i> scheme.
IMPLEMENTERS	Planning and alignment between schemes should be done by the Ministry of Jal Shakti, supported by the MoEFCC, Ministry of Housing and Urban Affairs (MoHUA) and Central Pollution Control Board (CPCB). A special COVID-19 task force should ensure efficiency of STPs and sewage surveillance.
	tion) should take up implementation, with regulation by SPCB.
JOBS	Privatisation of services will create more jobs for skilled labour. However, exact assessment of jobs needs to be carried out.
GROWTH	A CEEW study establishes that direct benefits of resources recovered from wastewater could make an economically attractive case for practitioners to adopt circular economy pathways to manage wastewater ⁷⁸ .
SUSTAINABILITY	Sewage management will lead to better water quality in rivers as well, thereby supporting <i>Namami Gange</i> and similar objectives for other major river systems. While the COVID-19 virus is not transmitted through sewage, ensuring wastewater management will safeguard the population from future public health shocks, including pandemics from water-borne diseases.

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4.4.3 Ensure piped water supply, sanitation and sewerage connection to all households

PROBLEM	The World Health Organisation (WHO) has reiterated the importance of hand washing as a measure to tackle COVID-19. This has brought the inequity in access to safe and sufficient water for sanitation to the forefront.
	According to the National Sample Survey Office's (NSSO) 76th round ⁷⁹ , only 22.6 per cent of rural households and 56.9 per cent urban households receive potable water through piped supply into their yards or homes. Additionally, around 29.3 per cent of urban and 72.4 per cent of rural households still rely on hand pumps, tube wells, public taps, piped water from neighbours, protected or unprotected wells, and private or public taps. The use of such public sources during a contagious pandemic leaves o.6 billion Indians vulnerable.
	Further, almost 50 per cent of rural households and 25 per cent of urban households did not have exclusive access toilets in their houses. To close the loop of the domestic water cycle, it is crucial to ensure connection of all households to either a centralised sewage treatment system or decentralised arrangements like septic tanks.
SOLUTION	Access to water services for the most vulnerable as an emergency relief measure and accelerated combined piped supply, sanitation and sewerage connection to all households should be implemented as a medium-term measure.
FISCAL	The total project cost is estimated to be about INR 3.6 lakh crore (USD 47 billion) to connect all rural households to water supply under the <i>Jal Jeevan Mission</i> , while estimates for urban connections are yet to be assessed. Moreover, India would have to invest INR 14 lakh crore (USD 186 billion) for clean water and sanitation by 2030 ⁸⁰ . The budget for water supply is already allocated under supply and sanitation – <i>Swacch Bharat Mission, Har Ghar Jal, Atal Mission for Rejuvenation and Urban Transformation</i> (AMRUT), etc. This is also a strategic solution to ensure safe and sustainable water access, sanitation and hygiene for all. Exact fiscal estimate for COVID-19 recovery has not been assessed.
TIMELINE	Within the next six months: Use innovative tools to identify vulnerable communities, especially in COVID-19 hotspots, with no or limited access to water and ensure emergency supply through ready low-infrastructure solutions like water tankers. Crowdsourced data through mapathons can help in the identification process. Mapathons are coordinated online mapping events often employed for disaster risk assessment to gather data at a low-cost.
	Medium-term
	 Align programmes like AMRUT, Swachh Bharat Mission, Har Ghar Jal, Namami Gange
	Continue rigorous implementation of <i>Jal Shakti Abhiyan</i> for 2020
	Make inclusive policies through comprehensive social assessments
	Integrate innovation and global best practices in research and development, data management, technology, administration and policy making

Augment water supply through rigorous demand-side water management, improved water efficiency and reuse. If farmers managed their inputs better to become more water productive, enough water can be saved and reallocated to provide water to all

	 Replace freshwater supply with reused water for non-potable purposes like landscaping and horticulture in urban areas, to free up fresh water for domestic supply
IMPLEMENTERS	The Ministry of Jal Shakti should create a committee to plan the alignment of the three utilities, comprising representation from states, MoHUA, MoEFCC, academia, NGOs, etc.
	 Central government should play an advisory and planning role, while state and local governments should take up implementation
	Local authorities led by the state governments should work on the immediate relief measures
	 On-ground NGOs should be leveraged to tackle issues related to identification of vulnerable communities, technological solutions, awareness building, and water supply
JOBS	These measures would increase the job opportunities in the water and sanitation sectors in immediate and medium terms. The International Water Association study assessed that there are severe Water, Sanitation and Hygiene (WASH) staff shortages in many developing countries due to a variety of reasons ranging from reluctance to invest in this component, rigidly imposed government staff quotas, poorly targeted education, unattractiveness of the sanitation sector, and the absence of continuous learning and professional development ⁸¹ . Similar assessments are crucial for India.
GROWTH	Specifically, investments in safe drinking water and sanitation have been shown to foster economic growth, with high rates of return ⁸² . Ensuring safe and sustainable water and sanitation will provide people the opportunity to focus on livelihoods, which is linked to growth. Equitable access to water and sanitation will provide relief to those who suffer from social exclusion and belong to disadvantaged groups and is critical to maintaining a healthy, educated and productive workforce.
SUSTAINABILITY	Access to clean water and sanitation is United Nations Sustainable Development Goal (SDG) #6. Safe water, sanitation and hygiene is a right and will assure prosperity of all citizens in the long run. This recommendation aims to ensure that water and sanitation become basic human rights and should be ensured despite short-term financial trade-offs. Moreover, reduction in water-related diseases would lessen the public health burden and increase productivity of the workforce.

4.4.4 Build basin-scale info-base for all river basins for data-driven water management

PROBLEM Managing water resources, at any scale, is strongly linked to the availability of data. This becomes particularly crucial now, as we enter the post-pandemic era, as robust water data would be crucial to support vulnerable communities who are already at risk due to climate change and now due to the pandemic. Basin-level water accounting and auditing provides a framework to systematically acquire, analyse and quality control water-related information and evidence⁸³. A water database to map temporal and spatial variation in water resource availability; forecast present and future water demands in a basin; monitor water use-efficiencies of projects and track environmental status and development pathways considering climate change impacts could substantially support marginalised communities like small and marginal farmers and small industries through informed allocation of water. **SOLUTIONS** Develop basin-scale information base for all river basins to initiate data-driven water management. This proposal would also tie in with the call for technology-based systems as one of the pillars for India's self-reliant recovery. Measures include: Develop water balance models using data from remote sensing, climate models and ground observations for all the river basins in India at basin or sub-basin scale Model transport of water pollutants and sediments to understand water quality data Downscale Global Climate Models (GCM) or Regional Climate Models (RCM) to basin-scale (preferably 250 or 500 metre spatial resolution) to assess the impact of climate change on water availability Complete assessment of future water demand scenarios till 2050 accounting for climate change scenarios, changes in land use, sectoral demand (domestic, irrigation and industrial) and environmental flow requirements Develop a policy for data collection and dissemination covering standardisation of site selection, instruments, measurement accuracy, calibration and validation protocols, and database management Encourage start-ups to participate in these efforts to establish timely local support for operation and maintenance activities and to promote capacity building and innovation in the water sector All water infrastructure related decisions like interlinking of rivers, development of irrigation command areas, water storage structures, hydropower dams or inland waterways should be based on comprehensive information and adaptive scenario analysis. FISCAL/STRATEGIC NHP is being implemented to expand the network of hydro-meteorological sensors, establishing real-time data collection networks for capturing data related to meteorology, surface water, groundwater, water quality, and storage⁸⁴. The project outlay is INR 3,680 crore (USD 488 million). Increased scope of this assessment may require additional budget. TIMELINE Whereas the lack of basin-level information has for long constrained water governance, the proposed solution should be implemented in at least five major river basins by March 2022, with the efforts continuing for other river basins subsequently.

IMPLEMENTERS	This requires collaboration between the of Jal Shakti, MoEFCC, IMD, Central Water Commission, Central Ground Water Board, National Remote Sensing Council, CPCB and SPCB, Pollution Control Committees, MoAFW.
JOBS	Promotion of start-ups in the water sector could generate new jobs for skilled labour. However, there is no specific assessment of this.
GROWTH	The most important growth benefit of this exercise would be to reduce water-related risks when making investment decisions for large infrastructure, whether in agriculture or industry. India can pioneer water management solutions and extend services to other countries, thus generating revenue. Better data will lead to better water governance and cost savings. Investment in research and development activities and capacity building in the water sector will reduce dependence on development loans and international agencies.
SUSTAINABILITY	Data-driven water governance will prevent misuse of this precious resource by various consumers in industry, households and agriculture, and allow for balancing water use between socioeconomic activities and ecosystems. It will increase equity and efficiency in water resource and service allocation and distribution.

4.5 Energy security



India's energy security depends on the availability of adequate quantities of critical resources at prices that are affordable and predictable, with minimum risk of supply distortions, to ensure sustainability for the environment and future generations.⁵² For citizens, energy security starts with energy access. India's energy transition involves access to safe, reliable and affordable energy for millions of Indians.

In this section, we focus on strategies to:

- Enhance oil and critical minerals security for the country
- Improve cooking energy security for the household

4.5.1 Enhance oil and critical minerals security for the country



INR 1.13 Lakh crore Amount saved by India per USD 10 decline in oil prices



84% Share of oil imported by India in 2019; target is 67% by 2022



5.3 MT India's total underground petroleum reserve capacity

Data points: CEEW analysis

PROBLEMS

India's energy security scenario is in constant flux due to four main issues⁸⁶:

Availability of adequate quantities of critical resources: India imports nearly 84 per cent of its oil, a rising share despite efforts to reduce oil import dependence to 67 per cent by 2022. Supply is threatened by shifting energy geopolitics, and reliability is affected by frequent change in suppliers.

West Asia currently supplies 55 per cent of India's oil imports (Iraq 25 per cent). Iran was a top three supplier in 2016, but slipped down as India received its first-ever US crude in 2017. Prior to 2015, India's main crude suppliers were Saudi Arabia, Iraq, Nigeria and Venezuela.

Lack of affordable and predictable energy prices: India's oil import bill varies significantly from year to year (Table 1). This makes it difficult to budget for tax revenues or fossil fuel subsidies (INR 1.27 lakh crore (USD 16.8 billion) in FY2015, INR 70,829 crore (USD 9.4 billion) in FY2018). Such variations also affect industrial competitiveness, especially where the share of energy input cost is high.

Imported gas prices have further complicated the equation. The gas glut has plunged Asia's spot market prices to under USD 4 per metric million British thermal units (MMBTU). India, locked in to procure 8.5 MT gas from Qatar at USD 9-10 per MMBTU, is trying to renegotiate contracts. Table 1 India's oil imports, 2014-20

India's oil import bill (FY)	INR lakh crore	USD billion
2014 - 15	8.51	113
2015 - 16	4.82	64
2016 - 17	5.27	70
2017 - 18	6.63	88
2018 - 19	8.43	112
2019 - Jan 2020	6.63	88

Source: Petroleum Planning and Analysis Cell, Ministry of Petroleum and Natural Gas. 2020. "Imports/Exports". Government of India. https://www.ppac.gov.in/content/212_1_Import-Export.aspx

 Supply disruptions: Safe passage for energy security involves maritime security cooperation. In future it may also include technological challenges, political implications, and stability and security of maintaining trans-border electricity grids if India increases trade of (non-fossil) electricity.

	Energy transition-related risk of stranded assets: The world's largest investors are shaping a new reality: in December 2019, 631 non-American investors representing INR 2788 lakh crore (USD 37 trillion) in assets urged governments to elevate climate action; the next month, BlackRock, which manages assets worth INR 527 lakh crore (USD 7 trillion), announced its intent to exit investments with 'high sustainability-related risk'. This has grave implications for oil exporters: in a 2°C scenario, the world's 13 largest oil companies would lose INR 21 lakh crore (USD 360 billion) in value (INR 67 lakh crore (USD 890 billion) in a 1.5°C scenario).
	Coal will be harder hit, as less than a quarter of the remaining coal reserves can be burnt in a 2°C scenario. Coal mining companies have lost 74 per cent of value since 2011. India, despite pronouncements to increase coal production, needs to seriously assess the risk of stranded assets and determine at what stage investment in new coal capacity will become unviable.
SOLUTIONS	India has been investing in strategic oil reserves to avoid supply disruptions. The three underground petroleum reserves at Vizag (1.3 MT), Mangalore (1.5 MT) and Padur (2.5 MT), at full capacity can provide fuel security for nine days. Only about 55 per cent of this capacity is full; remaining 45 per cent will now be filled with excess crude supplies of state oil refiners created by the drastic fall in demand due to the COVID-19 lockdown. This is an opportunity to fill up the reserves at lower prices.
	But our understanding of secure storage must evolve beyond vast underground caverns. Evolution of battery technologies will influence options, in particular by speeding up electrification of millions of MSMEs that cite poor electricity quality as a top concern. Batteries will also impact the share of renewables in the electricity mix, increase prevalence of distributed electricity, and add to the resilience of the grid-based system. Towards this end, India must also develop a circular economy and strategic reserves for critical minerals ⁸⁷ , such as those likely to be used in energy storage applications.
FISCAL/STRATEGIC	The strategy outlined here is both strategic in nature and offers savings on government expenditure. Each USD 10 decline in oil prices saves India INR 1.13 lakh crore (USD 15 billion) in external payments ⁸⁸ . Similarly, developing a circular economy for critical minerals, to be used in energy storage, would shield India from the risk of supply shocks and also reduce external payment outlays.
TIMELINE	The actions to shore up strategic oil reserves should be undertaken within the FY2021 during which time the global oil prices are likely to remain depressed. The push for a circular economy on critical minerals should aim for at least 10 per cent reduction in import requirements against business-as-usual scenarios by end of FY2022.
IMPLEMENTERS	The Indian Strategic Petroleum Reserves Limited (ISPRL), under the Ministry of Petroleum and Natural Gas (MoPNG), would be the competent authority for the strategic oil reserves. NITI Aayog and Ministry of Mines (in coordination with MoEFCC) could drive the mission for self-reliance in critical minerals.
JOBS	There will be an additional jobs premium in promoting the recycling industry associated with batteries recycling, reuse, and harvesting of critical minerals.
GROWTH	Energy security will be central to India's growth prospects as it shifts from relative autocracy to deeper integration into global energy markets. It will be the most significant

player at the margin and shape the dynamics of energy markets for the next three
decades89.SUSTAINABILITYHistorically, energy security has been affected by shifts in either technologies, economics
or geopolitics. Now, there are transformations on all these fronts. India must frame the
debate to stay ahead of the game. India's energy future is going to be shaped within a
highly carbon constrained world and it would have to make strategic choices about its
energy mix and the policy imperatives associated with a secure and resilient energy
system.

4.5.2 Improve cooking energy security for the household

PROBLEMPMUY has provided LPG connections to 80 million socio-economically poorer households
to accelerate their transition towards cleaner cooking fuel. This has increased LPG
penetration to 97 per cent, but most rural and economically poor households continue to
rely on easily available, free-of-cost traditional biomass as their primary cooking fuel.

The COVID-19 pandemic has pushed millions of Indians into severe economic distress from income and/or livelihood loss. This cash crunch will make it even more difficult for PMUY consumers to pay recurring costs for LPG refills, further increasing their dependence on traditional biomass, and thus undermining the health benefits of PMUY.

SOLUTION As part of the COVID-19 relief for economically poorer sections of the society, the GoI has announced three free LPG refills for PMUY beneficiaries until 31 March 2021. The massive fall in global crude oil prices has created an opportunity for India to use the LPG subsidy savings to provide more free LPG refills to PMUY households in FY2021. This will increase their disposable income in these stressed times and further help them in their transition towards clean cooking fuel.

Due to the decline in crude oil prices, most of the allocated budget for LPG subsidy would remain unutilised, even after the government provides the announced three free refills to PMUY households (shown by the last set of columns in Figure 3). We recommend that the government should provide **three more free LPG refills to PMUY households i.e. six refills in FY2021**. These additional refills can be extended within the current LPG subsidy budget. Even in the worst-case scenario i.e. if global crude oil prices start increasing (on back of global economic recovery), and India does not recover economically (shown by all the dark grey bars in Figure 3), the next three LPG refills can still be provided at 50 per cent of the subsidised price to these beneficiaries within the existing budget.

The government should consider leveraging the Aadhaar enabled Payment System (AePS) to effectively implement this measure, as beneficiaries report significant challenges in accessing advance payments made in the bank accounts90. The oil marketing companies (OMCs) could forge a collaboration with India Post Payments Bank (IPPB) to enable easier payment for the refills.



Figure 3 LPG subsidy scenarios to extend additional support to PMUY households

CEEW analysis: Here we show the net fiscal savings across different scenarios of economic recovery and LPG subsidy provision. Each set of four columns represents a domestic LPG subsidy scenario. Each colour of the column represents different economic recovery scenario for India vis-à-vis the globe. Green bars represents the net savings where the oil prices remain constant at current level throughout the financial year due to no recovery in global oil demand. Dark grey bars represent a scenario where global recovery has led to a recovery in oil prices, but India does not recover, further depreciating the Indian Rupee. Light green and light grey bars show the scenarios in between. The net saving accounts for the additional margin by OMCs for the refills where the cost of the refill is lower than the estimated market price of the refill.

FISCAL

In the worst-case scenario, where oil prices increase consistently on the back of a global recovery in demand and India does not recover economically, the proposed recommendation of six free refills may require an additional subsidy of around INR 6,000 crore (USD 796 million), which is one-sixth of the current subsidy budget. These resources are already committed under PMGKY. In all other scenarios of global vis-à-vis Indian economic recovery, **this recommendation allows net savings between INR 5,500 crore (USD 730 million) and INR 25,000 crore (USD 3.3 billion)**. The net saving accounts for the additional margin by OMCs for the refills where the cost of the refill is lower than the estimated market price of the refill (for instance, as is the case in the month of May 2020).

TIMELINE The initiative can start in July-August 2020 when most PMUY households would end their current quota of three free LPG refills, and there would be greater clarity on economic recovery.

IMPLEMENTERS Under the guidance of the MoPNG, the OMCs will have to extend the additional advance cash into the PMUY beneficiaries bank accounts, which they can use for payment of the LPG refill. To ease the payment mechanism, OMCs should work with National Payments Corporation of India (NPCI) to enable AePS based direct deduction of the money from the beneficiaries' account or the OMCs can with the IPPB to facilitate refill payments from beneficiaries' accounts at the point of delivery. The MoF would need to approve the use of existing LPG subsidy budget to extend these additional free refills to PMUY beneficiaries.

JOBS	LPG promotion should be converged with livelihood promotion for women through the <i>National Rural Livelihood Mission</i> . The transition to LPG will save time spent by women in cooking, which can be used towards livelihood activities through SHGs. Further, livelihood opportunities are needed for migrant labourers choosing to remain in their villages. The government should extend interest-free MUDRA loans to microentrepreneurs to set-up small scale briquetting and palletising units to process locally available biomass into commercial fuel for local industries such as kilns, dhabas, etc ⁹¹ . Initial risks can be mitigated through the <i>Mahatma Gandhi National Rural</i> <i>Employment Guarantee Scheme</i> (MNREGS) to support workers in such plants for the first six months. Since freely available biomass is a major hindrance to sustained LPG use, these alternative value chains will generate employment and facilitate the transition to cleaner cooking fuel.
GROWTH	Despite a fiscal implication for only one year, the initiative would yield long term benefits in terms of increased LPG usage. It would save money and increase the number of refills for PMUY households and provide additional liquidity to the PMGKY by eliminating the need for additional funds to provide free refills. The LPG subsidy budget allocation for FY 2020-21 is sufficient to cover these additional free refills.
SUSTAINABILITY	Studies have found that providing free LPG fuel to women during pregnancy led to 85 per cent of those households buying the second LPG cylinder on their own post- pregnancy ⁹² . Utilising the current low crude oil prices to provide free LPG cylinders to PMUY households for a prolonged period will prevent households from backsliding to traditional biomass options, and also enable them to experience the health and convenience benefits of LPG over a longer period. This could potentially result in sustained LPG use and achieve the objective of eliminating exposure to indoor air pollution and consequential comorbidities among the population.



4.6 Strategic decarbonisation



INR 82,885 crore

Annual investment in India's RE infrastructure over past three years



2022

1.3 million Direct full-time equivalent jobs to be created if India achieves 160 GW of solar and wind power capacity by



INR 45,210 crore

Possible reduction in oil import bill per annum by 2030 if electric cars comprised 30% of total car sales

Data points: CEEW analysis

Decarbonisation is important to achieve sustainable development goals. India is
increasing the share of non-fossil energy in its electricity generation and reducing
emissions intensity through measures such as coal cess, enhanced energy efficiency
across sectors, and incentives for low-carbon vehicles.

PROBLEM Government support for low-carbon interventions, globally, has primarily been through fiscal incentives. During the imminent post-COVID-19 recession, there will be pressure to reallocate these budgets to urgent economic recovery measures. In India, government spending is likely to be constrained for at least two years and could lead to plans for a transition to a low-carbon economy being side-lined.

SOLUTION

Prioritise decarbonisation policies based on **budgetary cost** and **strategic imperatives**.

Two strategic imperatives should remain in focus despite the fiscal stress:

	Competitiveness of Indian industry: India has one of the highest electricity prices for the industrial sector among major exporting nations, which severely impacts competitiveness. Lower electricity prices will boost manufacturing in India. Electrification of the industrial sector will also reduce greenhouse gas (GHG) emissions, and shift the burden to the power generation sector, where it is abated more cost-effectively.
	Energy security: A large proportion of India's imported oil is used for transportation. This import volume and expenditure will continue to rise as the number of vehicles increases, hence it is critical to continue laying the groundwork for a higher penetration of electric vehicles to offset this energy risk and cost.
NON-FISCAL/ STRATEGIC	The government should continue its push to increase RE capacity, specifically solar- based electricity, which is already cost effective compared to other fossil and low-carbon alternatives. Solar requires no fiscal support till its share in the electricity generation mix increases beyond 15 per cent; at that point, support for storage and other grid management interventions would be imperative.
	The government should also continue the Bureau of Energy Efficiency's (BEE) Perform, Achieve and Trade (PAT) scheme and superefficient appliances scheme given their robust administrative infrastructure and strong performance.
TIMELINE	Near term, after the COVID-19 lockdown is lifted.
IMPLEMENTERS	The Ministry of Power (MoP) and relevant state-level government departments would be instrumental for implementing electricity pricing reform. The Ministry of Heavy Industries and Public Enterprises should continue devising and implementing appropriate policies for creating an ecosystem for electric vehicles.
JOBS	Increased competitiveness of Indian industry will directly lead to job creation. India's targets of 100 GW of solar and 60 GW of wind power capacity are likely to generate about 1.3 million direct jobs on a Full-Time Equivalent (FTE) basis ⁹³ . The latest estimates suggest that 61,000 jobs have already been created in utility-scale solar and wind power sectors; the rooftop solar sector employs another 38,600 people ⁹⁴ . Domestic manufacturing of solar PV modules and wind components could employ an additional to 45,000 and 10,000 people, respectively ⁹⁵ .
GROWTH	Decarbonisation would reduce India's oil import bill, increase energy security, and provide long-term benefits of more resilient energy systems. For example, India's oil import bill could be reduced by INR 45,210 crore (USD 6 billion) per annum by 2030, and INR 2.86 lakh crore (USD 38 billion) per annum by 2050, if 30 per cent of car sales in India in 2030, and 50 per cent in 2050, are of electric cars (CEEW analysis). Further, over the past three years, approximately INR 82,885 crore (USD 11 billion) has been invested annually in India's RE infrastructure; with required investment upwards of INR 2.26 lakh crore (USD 30 billion), this sector is a highly attractive investment destination for the next decade ⁹⁶ .
SUSTAINABILITY	Directly helps to achieve India's renewable energy targets and SDGs.
TRADE-OFF	Government may prefer, at least in the near term, to utilise the budget allocated for decarbonisation for emergency relief and recovery measures.

4.7 Improve air quality and keep a second COVID-19 wave at bay



PROBLEM

Air pollution was responsible for more than 1 million premature deaths in India in 2017⁹⁷. Additionally, air pollution exerts an additional burden on the economy in the form of lost workdays and reduced crop yields. Estimates suggest that in 2018-19 India could have harvested an additional 40 million tonnes of wheat had the atmosphere been as clean as it was 50 years ago⁹⁸.

In 2017, approximately 80 per cent of India's population was exposed to $PM_{2.5}$ greater than 40 µg/m³, which is the limit recommended by the National Ambient Air Quality Standards (NAAQS) in India⁹⁹. This is particularly concerning as a growing body of research points at the insidious link between exposure to air pollution and increased mortality due to COVID-19.

Finally, we find that the emission control solutions for large stationary and mobile sources implemented by the Government are effective, but their benefits can get neutralised in a bid for rapid economic recovery post-COVID-19¹⁰⁰.

SOLUTIONS The natural rebound in the form of blue skies bears evidence to the fact that a significant reduction in emissions can almost immediately translate into improvements in ambient air quality.

The Union Budget, based on the recommendation of the 15th Finance Commission, has allocated INR 4,400 crore (USD 584 million) for formulating and implementing plans in million-plus cities. This allocation must be honoured and not repurposed for other relief measures. To ensure that India continues to breathe clean air, cities could spend the allocated money to:

Strengthen monitoring: Air pollution measurements are critical to identify sources and locations of concern and evaluate the effectiveness of measures to reduce emissions. To develop a monitoring network of comparable strength (to China and the West), India would need 4000 monitors at an estimated capital cost of ~ INR 4,080 crore (USD 540 million)¹⁰¹. A sizable share of the budget could provide for the installation of continuous air quality monitors in cities that are poorly studied and to create new evidence for action.

Augment strength and capacity of State Pollution Control Boards (SPCB): A 2016 Comptroller and Auditor General (CAG) report highlighted the acute shortage of technical workforce in SPCBs¹⁰². Compared to the California Air Resource Board's strength of over 1300 employees, the strength of Maharashtra PCB responsible for improving air quality in 18 non-attainment cities stands at less than 600 employees¹⁰³. In addition to increasing the strength of SPCBs, a significant share of the grant should be used to improve the capacity of existing Board employees through structured training programmes on monitoring, assessing, and reporting pollutant emissions in addition to analysing measured concentrations. Fiscal allocations aside, there is a need for explicit covenants that prioritise air quality as industrial activity is ramped up.

Link bailouts and support mechanisms in the post-lockdown period to stated and verifiable actions against air pollution: Bailouts for industrial units should be linked with explicit conditions of meeting emission standards. Continuous monitoring for larger industrial sources and improved reporting from smaller units (on energy use and emissions) would be critical to ensure that bailed out units do not exacerbate the pollution problem. Equally, in critically polluted areas, an informed decision on bringing back industrial activity to pre-lockdown levels must be carefully assessed.

FISCAL/ The budgetary provision exists, but the mechanism for payouts and monitoring **STRATEGIC** needs to be worked out. Implementation of the above solution warrants coordination across centre, state, city and regional levels. Both inter-department and cross-state coordination would be needed. TIMELINE The initial allocation to cities must be immediate, and SPCBs should develop a yearon-year monitoring expansion plan for the duration (till 2024) of the National Clean Air Programme (NCAP). **IMPLEMENTERS** MoEFCC and MoHUA will be the central coordinating agencies. Implementation will require a coordinated effort from state governments, state departments of environment and executing agencies including pollution control boards and urban/rural local bodies, state and city transport service providers and clean technology providers. **JOBS** Air pollution mitigation would create jobs in pollution monitoring, pollution control and steer innovations in air pollution research. For instance, the vehicle emission control industry alone supports 70,000 jobs in North America. In 2015, the U.S. environment industry supported 1.73 million jobs¹⁰⁴. Growth of clean energy, clean technology and

GROWTH Stringent emission standards for industries, power plants and automobiles could create a large market demand for clean air technologies. The air pollution control equipment market for stationary sources alone is expected to cross INR 780 crore (USD 104 million) by 2022¹⁰⁵.

clean transportation could potentially generate millions of jobs in India.

SUSTAINABILITY Addressing air pollution warrants a cross-sectoral mitigation strategy. In addition to technical emission controls for stationary and mobile sources, CEEW analysis finds that sustainable development measures including enhanced public transport, increased use of cleaner cookstoves, improved waste management and agricultural production practices can provide NAAQS-compliant air quality to about 85 per cent of the Indian population¹⁰⁶.