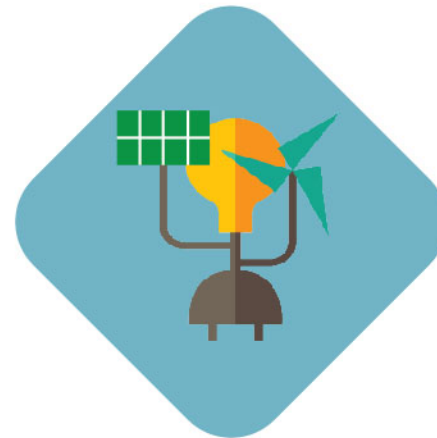
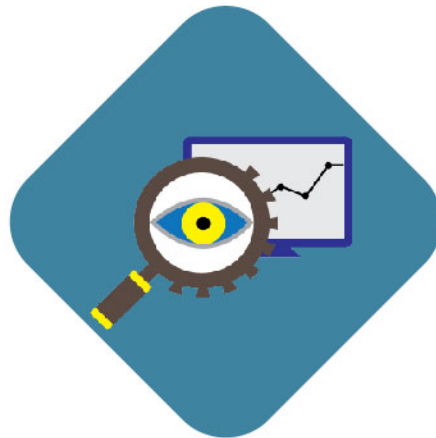
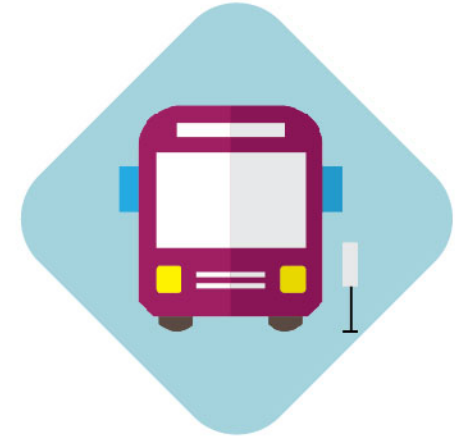
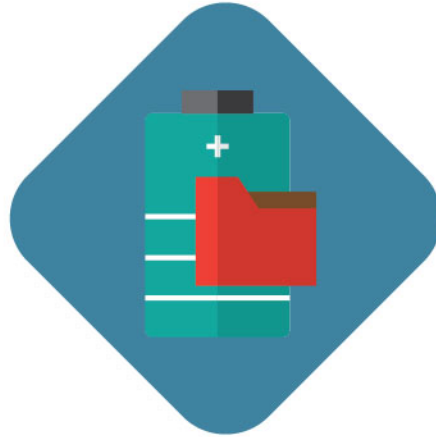
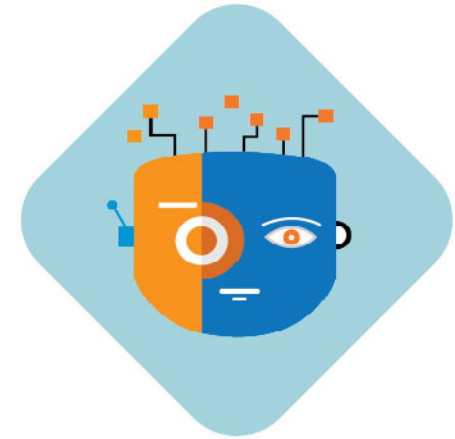
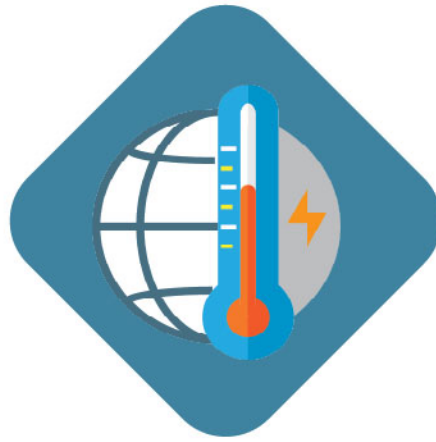


# ANNUAL REPORT |

## 2018 - 2019



Center for Study of  
Science, Technology & Policy

# CHAIRMAN'S MESSAGE



**“At CSTEP, we have already begun our pursuit of AI, focusing on human development and social welfare.”**

When Neil Armstrong landed on the moon, he exclaimed how the surface felt familiar because of the computer simulation he was trained in. Inspired by his words, I helped set up an Artificial Intelligence (AI) laboratory for the Defence Research and Development Organisation (DRDO) in Bengaluru. While the programme was robust, it was not powerful enough to emulate human thoughts and actions.

Things have changed since then, both in computing machinery and software. We are very close to mirroring human thinking. At the Center for Study of Science, Technology and Policy (CSTEP), we have already begun our pursuit of AI, focusing on human development and social welfare. As part of the programme, we have come up with a solution to detect malnutrition in children, and address it through quality nutrition at anganwadis. We are excited by the possibilities being thrown up, and look forward to an intense pursuit of this programme, for greater social good.

We are also equipped to meet other pressing challenges of the day, including global warming and air pollution. Thus, as we move into other exciting areas of research, besides Energy, our hands are full. The Center has expanded to more than 100 researchers and engineers, and the projects have grown by almost 20%. However, we continue to maintain a motivating environment at work. I take this opportunity to congratulate the CSTEP family for building an inspiring environment for research and innovation, and look forward to more exciting possibilities.

- Dr VS Arunachalam  
Chairman & Founder

# MISSION

To enrich policymaking with innovative approaches, using science and technology for a sustainable, secure, and inclusive society.

# VISION

To become the foremost institution for policy innovation and analysis.



# EXECUTIVE DIRECTOR'S MESSAGE



**“CSTEP continues to be a vibrant workplace with researchers churning out innovative ideas and driving our research programmes.”**

The year 2018-19 was eventful and significant in many ways. CSTEP continues to be a vibrant workplace with researchers churning out innovative ideas and driving our research programmes. Our work in air pollution has gained momentum with the establishment of the Centre for Air Pollution Studies (CAPS) at CSTEP. This was facilitated by grants from MacArthur Foundation, Bloomberg Philanthropies and Shakti Foundation. CAPS is an inter-disciplinary centre, which will cater to the growing demand of air pollution studies from various cities in India and also South Asia.

Our emphasis on using technology for improving governance has led to the birth of an important initiative in Karnataka. CSTEP's technology-platform SNEHA is being piloted in various anganwadis in the state to address the issue of chronic malnutrition in new-born children. This is a major step towards developing our research programmes in Artificial Intelligence for social impact.

We are happy that CSTEP is working with NITI on supply-security roadmap for materials in strategic sectors, including lithium. CSTEP is also helping set standards for electric vehicle charging as part of Bureau of Indian Standards committees. We have expanded our research programmes in Bihar in the areas of energy and air pollution, with grants from MacArthur and Shakti Foundations. We are happy to collaborate with the Ministry of Environment, Forest and Climate Change (MoEFCC) in developing India's long-term carbon emission pathways and exploring the role of technologies in achieving India's Nationally Determined Contributions (NDCs).

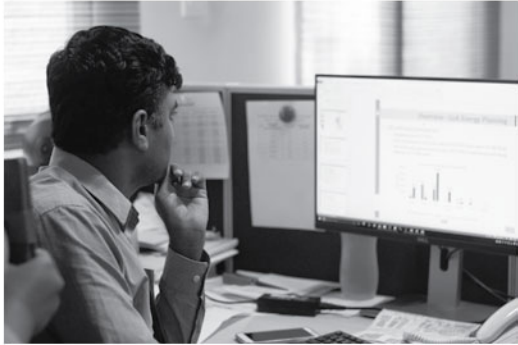
This year also marks the end of 10 years of core grant under the Think Tank Initiative (TTI) of IDRC. We got the grant when we were a fledgling organisation, with a handful of researchers. The core grant was instrumental in catalysing non-linear growth in the organisation and developing our research capacity, organisational functioning, and communications and policy engagement activities. The grant helped us make important policy contributions. This underlines the fact that think tanks need core grants to develop as credible and evidence-based knowledge providers. We gratefully acknowledge IDRC for the TTI programme and their faith in CSTEP. On a personal note, I also thank Dr Anindya Chatterjee and Dr Samar Verma for being great mentors and well-wishers of CSTEP.

Since we knew the TTI core grant was coming to an end, we invested considerable time and efforts in raising alternative grants, so that CSTEP's operations continue uninterrupted. We are happy and grateful that Hewlett, CIFF, Bloomberg, and MacArthur have stepped in with multi-year flexible grants, helping us continue our journey. We are also thankful to OAK Foundation for their continued support over the last several years.

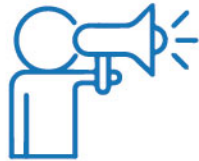
This year, we took a decision to strengthen our communications and visibility based on feedback from our stakeholders. We hired an external consultant to develop our communications strategy and identify areas that need strengthening. We are in the process of implementing the recommendations, and hope to significantly improve our visibility and profile in the coming years. We hope to continue this journey with positivity and enthusiasm.

- Anshu Bharadwaj  
Executive Director

# WORK MOODS



# HIGHLIGHTS 2018-2019



## PUBLICATIONS/ COMMITTEES/ EVENTS

### PUBLICATIONS

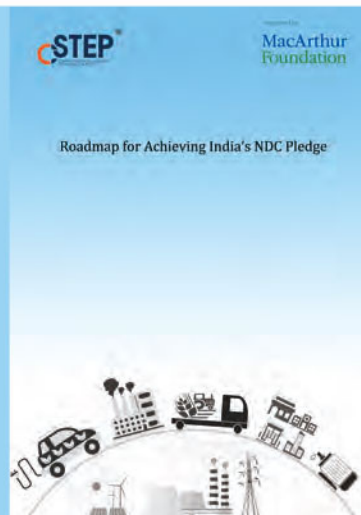
- Roadmap for Achieving India's NDC Pledge
- Benefit Cost Analysis of Emission Standards for Coal-Based Thermal Power Plants in India
- Indigenisation of Lithium-ion Battery Manufacturing: A Techno-economic Feasibility Assessment
- Sustainable Urban Planning Strategies for Cities in Karnataka

### PUBLICATIONS

- Dedicated Feeders for IPs Using Solar-Based Generation
- Institutional Integration of BMTCL-BMRCL
- Effect of Module Reliability on Techno-Economics of a Utility Scale Solar Photovoltaic Plant in India

### COMMITTEES

- Ministry of Environment, Forest and Climate Change
- Ministry of Housing and Urban Affairs
- Ministry of Petroleum and Natural Gas
- NITI Aayog
- Government of Karnataka- Watershed Development Department
- Government of Karnataka- Municipalities Best Practices



### EVENTS

- Launch of Shabda, noise-mapping app
- Panel discussion following the launch of our report on Roadmap for Achieving India's NDC Pledge
- Webinar on India's GHG Emissions: Trends & Indicators (along with GHGPI partners)
- Round-table on Karnataka Urban Observatory

### COMMITTEES

- Confederation of Indian Industry - Karnataka Power Taskforce
- Bureau of Indian Standards
- Federation of Indian Chambers of Commerce and Industry
- Shakti Foundation and Indian School of Business
- Karnataka Electricity Regulatory Commission

### EVENTS

- Workshop on UDAY Scheme: Implementation Strategies and the way forward
- Training Workshop on Economics of Electricity Markets
- Workshop following the release of our report on Benefit Cost Analysis of Emission Standards for Coal-based Power Plants in India



# IMPACT STORY



SNEHA

## No Child's Play!



## ABOUT SNEHA

Solutions for Nutrition and Effective Health Access (SNEHA), our multi-sectoral solution for better management of health and nutrition of children and new mothers, was piloted in Yelahanka, Bengaluru. Launched across 34 anganwadis in partnership with the Government of Karnataka (GoK), the project covered over 3,000 children and 530 mothers.



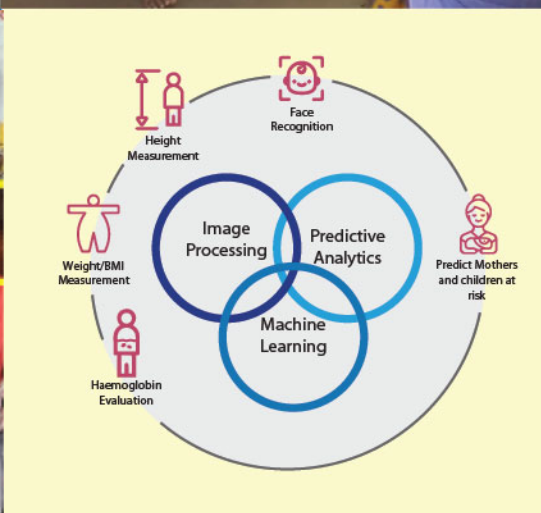
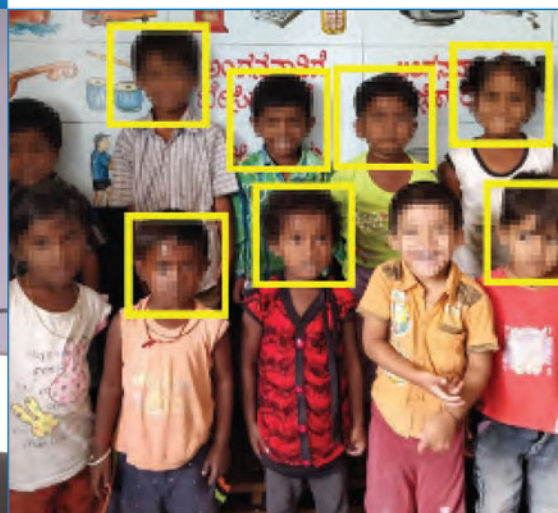
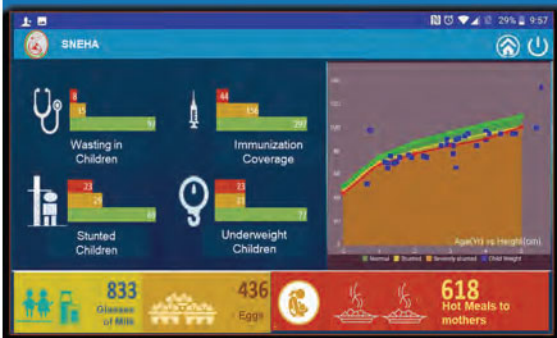
## AIM

In addition to tackling malnutrition, SNEHA aims to bring about the digital transformation of anganwadis, making the tracking of height and weight of children seamless. A spurt in height measurement of children by 60 per cent, and weight recording by 20 per cent has been noticed in the anganwadis, primarily due to ease of use, timely alerts and reminders, which are part of the solution.



## METHODOLOGY

Developed after extensive research and consultation with experts and senior officials, SNEHA uses the advanced technology of image recognition for evidence-based data entry.



# IMPACT STORY



Intersectionality-Informed Gender  
Mainstreaming Framework

## The Clean-up Act

CONCLAVE ON  
MAINSTREAMING  
RESPONSIVE SANITATION



## PROJECT BRIEF

We worked with the Government of Andhra Pradesh to mainstream gender and inclusiveness into sanitation planning and implementation in the towns of Anantapur, Kowur and Narsapur. The collaborative project on Intersectionality-Informed Gender Integration in Sanitation was supported by the Bill and Melinda Gates Foundation.



## HOW IT WORKS

As part of the project, social mobilisation platforms were set up at neighbourhood and city levels in the three towns to empower communities. The platforms took up sanitation-related issues with municipal authorities. These insights informed municipal authorities to frame effective policies to improve access to sanitation, keeping in mind the different needs of vulnerable groups.



## OUTREACH

Watch our documentary, 'Cleaning Up the Act' (<https://youtu.be/WXx1G4txed8>), to learn more about the impact of the project.





# CLIMATE & ENERGY POLICY



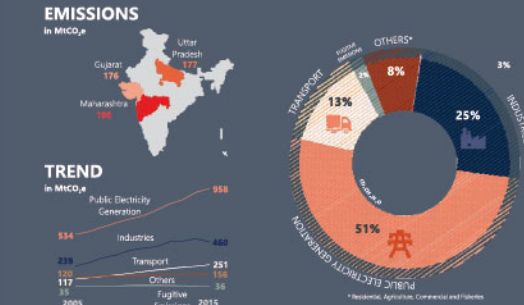
Our modelling study on Long-Term Strategy of Low-Carbon Growth for MoEFCC will inform India's future commitments to the United Nations Framework Convention on Climate Change.

- CSTEP is analysing mid-century scenarios for India under Long-Term Strategy of Low-Carbon Growth project for the Ministry of Environment, Forest and Climate Change (MoEFCC).

- We developed a Computable General Equilibrium model for India to analyse the impact of macroeconomic policy changes on energy consumption and emission pathways.

## GHG Emission Estimates in India | 2015 ENERGY

**74%** Gross Emissions **1862** MtCO<sub>2</sub>e **78%** Net Emissions



- CSTEP completed Phase 1 of a multi-year engagement to evaluate Energy and Emission Implications for Desired Quality of Life. The project uses system dynamics modelling to account for interlinkages between SDGs and energy-demand sectors.

- We completed Phase 2 and initiated Phase 3 of GHG Platform India, a civil society initiative to understand emission estimates at the national and state levels.

## TEAM



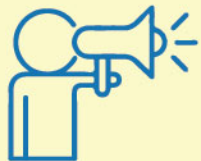
CSTEP was a technical reviewer of India's Second Biennial Update Report to the UN. Several of our recommendations are being implemented.

Our time-series sectoral GHG emission estimates helped states design policy interventions for the highest emitting sectors. Further, we are working with the Government of MP for GHG mitigation strategies for the energy sector, which will inform the revision of SAPCC.

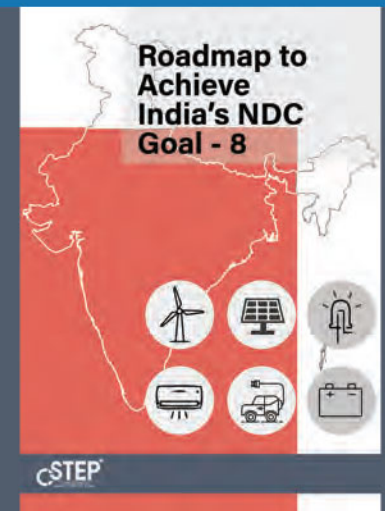


## Watch out for

- Report on Long-Term Strategy for Low-Carbon Growth on India's Mid-Century Emission Pathways for MoEFCC.
- Roadmap for Implementation of India's NDC Goal 8 for MoEFCC.
- MP's SAPCC 2.0 - Energy Sector Low-Carbon Strategies.



## How we influenced Policy?

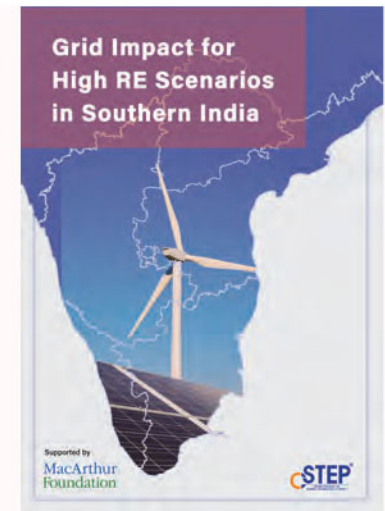


# POWER



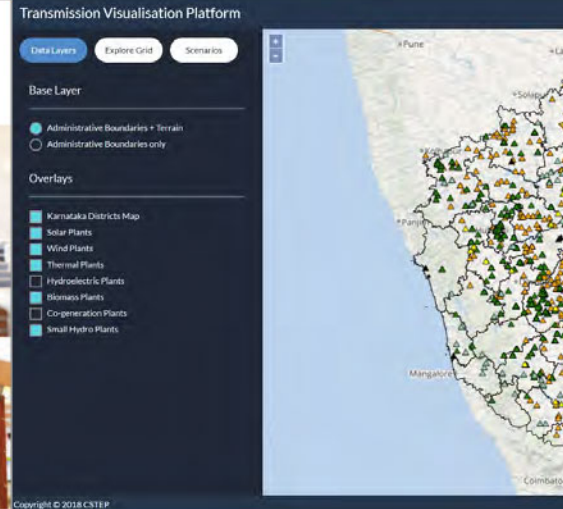
Our study estimates there will be excess power of the order of around 23 GW and 51 GW for 2022 and 2030 respectively under peak of solar-plus-wind scenario, with the possible implication of a need to shut down thermal plants for the duration of the RE surge.

Analysed the transmission network of southern India to study the impact of high levels of renewables on the grid for the years 2022 to 2030.

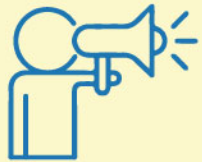


Initiated work with the Government of Bihar to develop an integrated power sector roadmap and vision for the state.

# TEAM



Conducted field-level surveys in Mysore and Bengaluru to study challenges of metering, maintenance, and energy accounting practices at the distribution level.



## How we influenced Policy?

Provided recommendations to the Karnataka Power Transmission Corporation Limited and Energy Planning Department to strengthen the state's transmission network, and help it absorb planned renewable capacity additions in the coming years.



## Watch out for

Commercial Accountability Framework for Distribution Utilities, which would improve the financial health of DISCOMs.

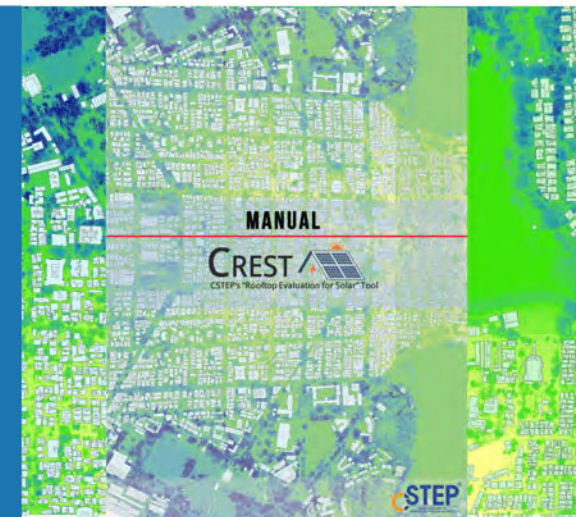


## RE & EE



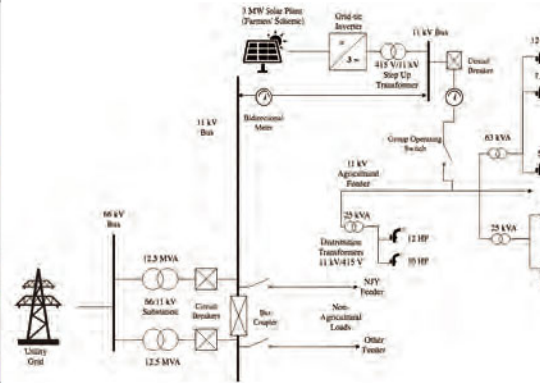
Based on a multi-criteria analysis, CREST will help DISCOMs identify the most suitable rooftops for installing solar PV.

Launched CREST, a Light Detection and Ranging (LiDAR)-based web tool for RTPV potential assessment, in Bengaluru. The tool enables BESCOM and its consumers to achieve 1 GW target in a sustainable manner.

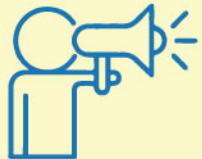


## TEAM

Conducted a feasibility study for using solar power for dedicated agricultural feeders in Karnataka. Our assessment showed that if 2-5 MW solar plants are directly connected to the feeders, then 2.9 GW can be installed with the existing infrastructure, leading to annual savings of INR 2,500 crores for GoK.



Designed floating solar-plus-battery systems for Lakshadweep islands to reduce the dependency on diesel. Besides obvious environmental benefits, it also brings down the cost of energy generation.



## How we influenced Policy?

- Results from our RTPV tool CREST, developed using aerial LiDAR, have convinced BESCOM to revise their RTPV target to 1GW for 2021-22.

- Our engagement with SECI for designing RE-based systems for Lakshadweep and Dadra & Nagar Haveli allows CSTEP to contribute to India's efforts at mitigating climate change. Currently, 100% RE-based electrification with pumped-hydro storage is being designed for Dadra & Nagar Haveli.



## Watch out for

Innovative, aerial imagery-based RTPV potential assessment and deployment in Bihar, Odisha and Manipur.

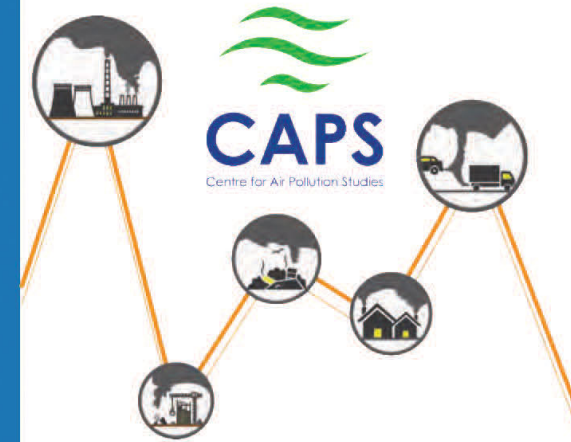


# AIR POLLUTION



Mobile monitoring of exposure-level particulate matter north of Bengaluru revealed alarming concentration of PM2.5 and Black Carbon around Peenya.

The Centre for Air Pollution Studies (CAPS) is building an emission inventory and conducting source apportionment study for Bengaluru. This will aid in identifying major polluting sources and sectoral contribution, and help provide policy advice for mitigating air pollution.



CSTEP, along with Urban Emissions, published a research paper projecting the increase in emission load and deterioration in air quality of Bengaluru by the year 2030.

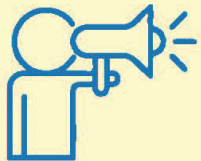
## TEAM



## COMPREHENSIVE CLEAN AIR ACTION PLAN FOR CITY OF PATNA



CAPS has initiated studies towards developing Clean Air Action Plans for Patna, Gaya and Muzaffarpur in Bihar.



### How we influenced Policy?

Our recommendations, as part of the Patna Clean Air Action Plan (PCAAP) study, have been approved by the Bihar State Pollution Control Board (BSPCB), with some departments having already initiated control measures suggested by us.

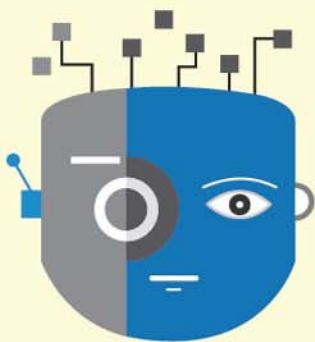


### Watch out for

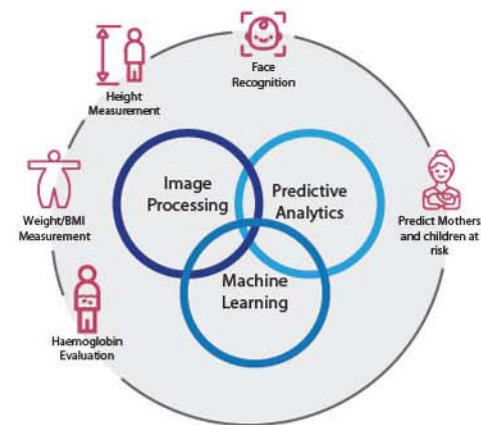
Taking the Clean Air Action Plan to other states of India.



## AI & DIGITAL LAB



Launch of our multi-sectoral solution SNEHA for detecting and tackling malnutrition and growth-related health problems in children and new mothers in Yelahanka across 34 anganwadi centers.



To avoid duplication and inconsistencies, a common family survey was designed for the Department of Women and Child Development and the Department of Health and Family Welfare.

## TEAM



SNEHA was successfully integrated with RCH system, the main application for Health department, to ensure that critical data about child and mother health is kept consistent.



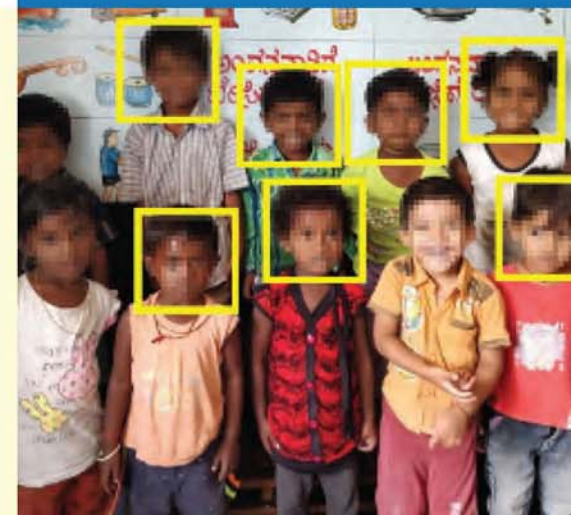
### How we influenced Policy?

We facilitated agreement between multiple departments for consistent data on family, mother and child health. The Departments of Women and Child Development and Health and Family Welfare have agreed on a unique ID for women and children (RCH ID), and single family survey.

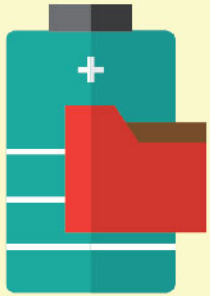


### Watch out for

Integration of the AI-based height tracking and attendance monitoring at anganwadis.



# MATERIALS & STORAGE



Our renewable energy technology-based solutions have been the catalyst for the socio-economic transformation of Kudagaon, a remote village in Odisha.

Our implementation plan for electrification of public bus service in Bengaluru focussed on:

- (a) identification of suitable BMTC routes for installing Electric Vehicle Supply Equipment,
- (b) a GIS-based integrated planning and visualisation tool for EV fleet operation,
- (c) a cost-benefit framework for e-bus variants, and
- (d) generating consumer awareness.

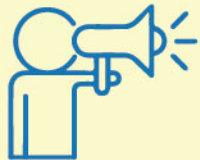


## TEAM



CSTEP also provided recommendations on significant (up to 50%) e-bus deployment by 2022 and 100% e-bus deployment by 2030 in Bengaluru, which is in line with GoI's all-electric plans for public transportation by 2030.

- Conducted a techno-economic feasibility assessment for indigenisation of lithium-ion battery manufacturing.
- CSTEP analysed solar PV micro-grid for its potential as a promising solution for electrifying rural homes and villages.



### How we influenced policy?

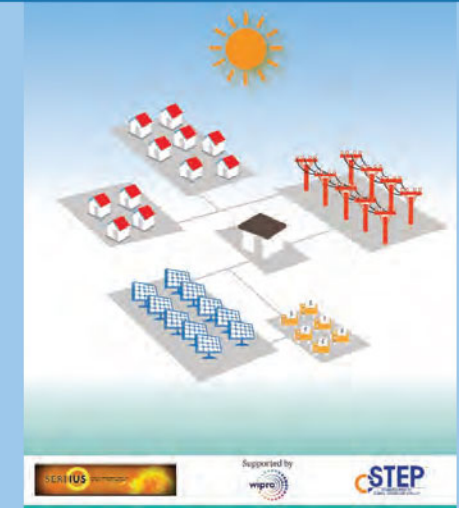
CSTEP contributed to Karnataka state EV and storage policy and technical draft of the tender for the first fleet of electric buses for Bangalore Metropolitan Transport Corporation (BMTC).

CSTEP is a member of NITI Aayog's expert committee for rare earth materials, which is preparing a roadmap for indigenisation of rare earth-based components.



### Watch out for

Feasibility assessment of opportunity charging, trolleybus systems, and battery swapping for electric buses in Bengaluru.



# URBAN DEVELOPMENT



The Urban Observatory helps visualise data to monitor changes in the urban landscape over a period of time, while facilitating data-driven decision-making for urban planning.

CSTEP developed a proof-of-concept Urban Observatory platform for Karnataka, the first of its kind in India for a state government.

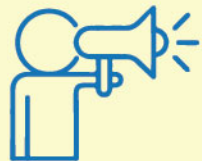


## TEAM



- As part of our engagement with the Government of Karnataka, CSTEP developed a list of sustainable urban planning strategies for cities in Karnataka, with specific focus on water, sanitation and transportation.

- We are working with the Government of Andhra Pradesh to mainstream gender and inclusiveness into sanitation planning and implementation. Successful pilots have been demonstrated in three towns of the state.



## How we influenced Policy?

- Our Urban Observatory platform for Karnataka has generated interest in the MoHUA in shaping policies for Data Smart Cities under the Smart Cities Mission. We have directly contributed towards shaping the policy, which can help cities make evidence-based decisions on critical urban challenges.

- CSTEP is also supporting Municipal Administration and Urban Development Department, Andhra Pradesh, in integrating gender into the current State Sanitation Strategy.



## Watch out for

Our engagement with the Government of Karnataka in building an Urban Observatory for the state.



# TRANSPORT



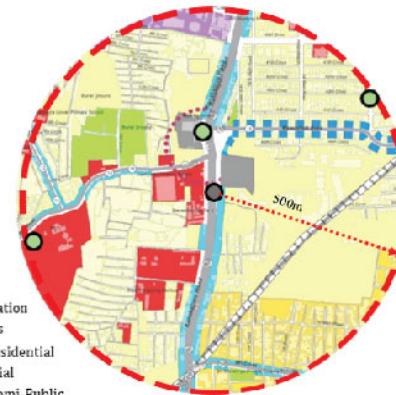
Our study on infrastructure integration serves as a guideline for the design of future Metro stations, with an emphasis on multimodal transport.

Engaged with stakeholders in Government of Karnataka such as Bangalore Metropolitan Transport Corporation (BMTc) and Bangalore Metro Rail Corporation Limited (BMRCL) for multimodal transport system planning and integration studies for Bengaluru.

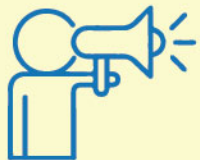


# TEAM

Working with app-based shared mobility shareholders (cab aggregators and government officials at the Centre and states) to identify key policy issues through exploratory research across India.



Engaged as experts with the Government of Karnataka to develop a strategic transportation plan. This will help stakeholders in Bengaluru in developing frameworks to aid in better land use and multimodal transport integration.



## How we influenced Policy?

Our research findings helped BMTc make informed decisions on feasible routes for operation of new AC bus services; rescheduling and rerouting of impacted routes along metro corridors to improve operational efficiency; and plan for feeder bus routes and transfer stops connecting metro stations.



## Watch out for

Extended engagement with various stakeholders from the industry, government and civil society, regarding multimodal transport planning, integration and shared mobility.





## We thank our funders:

*OAK Foundation, Bill & Melinda Gates Foundation, MacArthur Foundation, CIFF, GoodEnergies Foundation, UNDEF, UNDP, Government of Karnataka, MoEFCC, 2050 Pathways Platform, European Commission, Bloomberg Philanthropies, Hewlett Foundation, SED Fund, SHAKTI Sustainable Energy Foundation, IDRC, and European Climate Foundation.*

# STATISTICS

2018-2019

ANNUAL BUDGET  
INR 23 Crore



TOTAL NUMBER  
OF EMPLOYEES



117

MALE



70

FEMALE



47

NEWSPAPER  
ARTICLES  
PUBLISHED



18

REPORTS  
PUBLISHED



19

EVENTS/  
WORKSHOPS



05

COMMITTEES



24

# REPORTS

**Benefit Cost Analysis of Emission Standards for Coal-based Thermal Power Plants in India**

Transition to All-Electric Public Transportation: Energy Resource Assessment

Sustainable Urban Planning Strategies for Cities in Karnataka

**Roadmap for Achieving India's NDC Pledge**

**Feasibility of New Routes for High-End AC Buses**

Compilation of Input-Output Table and Social Accounting Matrix for India

Energy Auditing: Case Study of Karnataka

## POLICY BRIEFS

### PUBLICATIONS 2018-2019

**Techno-Economic Analysis of Stand-alone Solar PV and Battery-based Micro-grids in Karnataka**

Impact of Cab Aggregators on Vayu Vajra Service

Impact of Metro on Bus Ridership

**Integration of BMTC and BMRCL**

**Karnataka's Energy Mix: Computational Model for Energy Planning**

**Indigenisation of Lithium-ion battery manufacturing: A Techno-Economic Feasibility Assessment**

Implementation Plan for Electrification of Public Bus Transport in Bengaluru

Methanol as an Alternative Fuel for India

**Financial Implications of Emission Standards for Coal Power Plants**

## WORKING SERIES

**Exploring the Potential of BMTC Land Resources**

Techno-Economic Assessment of a Low-Temperature Solar Organic Rankine Cycle System

Effect of Module Reliability on Techno-Economics of a Utility Scale Solar Photovoltaic Plant in India

**Exploring the Potential of BMTC Land Resources**

**Dedicated Feeders for IPs Using Solar-Based Generation**



The Center for Study of Science, Technology  
& Policy

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