Schweizerische Eidgenossensch
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

**Swiss Agency for Development and Cooperation SDC**

# Net-Zero Climate Resilient City Action Plan

# Tiruchirappalli

## July 2024

south pole

ICLEI Local Governments for Sustainability SOUTH ASIA

econcept Research / Consulting / Evaluation

NIUA National Institute of Urban Affairs

# FOREWORD

As the Mayor of Tiruchirappalli, I am privileged to introduce the Net-zero Climate Resilient City Action Plan, which showcases Trichy's bold climate roadmap. This ambitious initiative underscores our commitment to a sustainable future and positions our city as a leader in climate action. In line with the goals set by the state of Tamil Nadu to achieve net zero well before 2070, we strive not only to meet but exceed our target of reducing carbon emissions. The current plan aims to reduce the emissions by over 95% by 2070.

Our approach is inclusive, leveraging the collective strength of our community, local businesses, and governmental bodies. By fostering green practices and supporting technological innovations in sustainability, we aim to catalyse economic growth while addressing environmental challenges. The roadmap in this plan is not just a pathway to resilience but also an open invitation for all citizens to join us in shaping a legacy of sustainability for generations to come. Together, let's embrace this journey toward a cleaner, greener Tiruchirappalli.

Our government is committed to reducing the impact of climate change by providing funds to cities across the state to reduce their emissions.

This plan reflects a crucial turning point in our city's history. We will closely monitor our progress and adapt our approaches to ensure maximum effectiveness as we implement these strategies. Our commitment extends beyond environmental stewardship; it is about ensuring a high quality of life for all our residents.

The development of this Net-zero CRCAP was made possible with significant support from the Swiss Agency for Development and Cooperation (SDC) and the implementing partners ICLEI South Asia, eConcept, and South Pole. We are deeply grateful for their contribution to this vital climate roadmap document.

Let us move forward with resolve and optimism, knowing that our actions today will pave the way for a sustainable and prosperous future. I wish Tiruchirappalli City Corporation the best wishes in this bold and decisive climate journey.

*Mayor*
*M Anbazhagan, M.A.*

# PREFACE

As we confront the pressing challenge of climate change, the Tiruchirappalli City Corporation is honoured to present our Net-zero Climate Resilient City Action Plan. This document is a blueprint for a sustainable future, reflecting our commitment to environmental responsibility and the well-being of our citizens.

Outlined within are our ambitious targets, which include a 95.16% reduction in carbon emissions by 2070. These goals are not just our aspirations, but they are in direct alignment with the Nationally Determined Contributions (NDC) goals set forth by the Government of India, and also the goal of the Government of Tamil Nadu to achieve net-zero emissions well before 2070. This ensures that our city-level climate actions are not isolated, but are part of a larger, coordinated effort at the state and national level.

Our plan also emphasises economic growth through environmental leadership. We aim to empower local businesses by promoting green practices, stimulating innovation in sustainable technology, and generating employment in the rapidly expanding green sector. Further, we are committed to improving our city's infrastructure to better adapt to the varied impacts of climate change, including extreme weather events like extreme rainfall and heat stress.

The development of this Net-zero CRCAP was made possible with the significant support from Swiss Agency for Development and Cooperation (SDC) and the implementing partners ICLEI South Asia, eConcept, and South Pole. We are deeply grateful for their contribution to this vital climate roadmap document.

We would like to express our sincere thanks to the support given by other public sector stakeholders including the Public Works Department, Highways Department, Finance Department, Trichy Collectorate and Transport Department.

TCC places great importance on our community's involvement. This plan is not only a call to action but an invitation to every citizen, business, and community group to participate actively in our city's transformation. Together, we will forge a sustainable legacy for future generations.

We are happy and committed to scale climate action and also inspire other ULBs in the state in their climate journeys

*Thiru. V. Saravanan, I.A.S.,*
*Commissioner*

# FOREWORD

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

**Embassy of Switzerland**
**Swiss Cooperation Office in India**

**Foreword**

It is with immense pride and admiration that I extend my heartfelt congratulations to the Tiruchirappalli City Corporation (TCC) for its work in advancing climate resilience through the creation of the Net-Zero Climate Resilient City Action Plan 2070 (Net-zero CRCAP) for Tiruchirappalli City. This visionary plan, developed with the support of the Capacity Building for Low-Carbon and Climate Resilient Cities in India (CapaCITIES) Project, funded by the Swiss Agency for Development and Cooperation (SDC), represents a bold and proactive step in addressing the global challenges of climate change and urbanization. Tiruchirappalli, a rapidly growing urban center and vibrant economic hub, stands as an example of how cities can not only meet the demands of development but also contribute significantly to global climate goals. By leading the way with its Net-zero CRCAP 2070, Tiruchirappalli is showcasing an exemplary commitment to sustainability, setting a high bar for others to follow. Since its inception in 2016 and expansion in 2019, the CapaCITIES Project has played a pivotal role in integrating climate action into the urban planning landscape across India. It empowers cities like Tiruchirappalli to enhance their resilience while reducing greenhouse gas emissions. By focusing on key areas such as renewable energy, water management, and waste management, this project has enabled partner cities to create a sustainable urban future.

India's commitment to achieving net-zero emissions by 2070, as announced at COP26, reflects a nationwide determination to lead in global climate action. The Government of Tamil Nadu has indicated that it will achieve net-zero well before 2070. Tiruchirappalli's alignment with this vision, complemented by Tamil Nadu's State Action Plan on Climate Change, underscores its proactive and ambitious role in contributing to regional, national and global climate targets. Through its leadership and initiative, Tiruchirappalli is making a powerful statement about the role of cities in combating climate change.

The Net-zero CRCAP for Tiruchirappalli stands as a testament to the city's dedication to sustainability. Developed through rigorous scientific assessments and broad stakeholder collaboration, this plan serves as a reference for other cities aiming to achieve net-zero emissions while ensuring inclusive growth and resilient municipal services. As Tiruchirappalli moves forward with the implementation of this plan, its ongoing commitment to innovation and adaptation will ensure that it remains a dynamic leader in the fight against climate change. This remarkable achievement is a milestone in Tiruchirappalli's inspiring journey toward a greener and more resilient future. It reflects the foresight and dedication of the Tiruchirappalli City Corporation and its leadership in setting ambitious targets for a more sustainable world. I applaud TCC and the CapaCITIES Project for their vision and tireless efforts, and I am confident that this will create a lasting positive impact for generations to come.

Philippe Sas
Head of International Cooperation and Counsellor

Swiss Cooperation Office in India
Philippe Sas
Embassy of Switzerland
Nyaya Marg, Chanakyapuri, New Delhi - 110021
Phone: +91 11 4995.9500
Philippe.sas@eda.admin.ch
www.eda.admin.ch/newdelhi

# MESSAGE

As cities around the world confront the realities of climate change, the importance of decisive action to protect communities, economies, and ecosystems has never been clearer. With its rich history and vibrant community, Tiruchirappalli is emerging as a leader in the transition to a netzero carbon future, while enhancing its resilience to the growing impacts of climate change.

At ICLEI South Asia, we are happy to have supported Tiruchirappalli on this transformative journey through the CapaCITIES Phase II project, funded by the Swiss Agency for Development and Cooperation. Our focus has been to provide technical assistance and strategic guidance, ensuring that the city is fully equipped with the tools and knowledge to address its unique challenges, while aligning with India's NDC commitments, Tamil Nadu's State Action Plan on Climate Change and the Sustainable Development Goals (SDGs).

This action plan is the result of extensive collaboration, research, and consultations involving a wide array of stakeholders. Local government leaders, urban planners, technical experts, and community representatives have all contributed to crafting a vision for a more sustainable, resilient, and prosperous Tiruchirappalli. We also extend our heartfelt thanks to the Government of Tamil Nadu officials for their leadership and grand vision for climate action, which has been instrumental in driving forward these critical initiatives. The plan charts a course to achieve netzero emissions and integrates key strategies to build resilience against climate-related risks such as floods, extreme heat, and droughts.

We express our deepest gratitude to the Tiruchirappalli City Corporation, local stakeholders, and our dedicated team at ICLEI South Asia for their unwavering commitment and hard work. It is our hope that this document will inspire other cities, especially non-metropolitan ones, to embark on their own paths toward sustainability and climate resilience.

Through shared commitment, innovation, and collaboration, we can build cities that are not only climate-friendly but also more liveable, inclusive, and thriving. The journey ahead may be challenging, but the future we envision is well within reach.

*Emani B.V Kumar*
*Executive Director, ICLEI South Asia*
*Deputy Secretary General, ICLEI Global*

**திருச்சிராப்பள்ளி மாநகராட்சி மாமன்ற தீர்மானம் எண்.487 நாள்.24.07.2024 ன் உண்மை நகல்**

தமிழ்நாடு அரசும் உலக வங்கியும் இணைந்து மேற்கொள்ளும், தமிழ்நாடு பருவநிலைக்கு அனுகூலமான நகர்ப்புற மேம்பாட்டுத் திட்டத்தின் (TNCRUDP – Tamil Nadu Climate Resilient Urban Development Program) கீழ் உரிய பணிகளை மேற்கொள்ள திருச்சிராப்பள்ளி நகரம் தேர்ந்தெடுக்கப்பட்டுள்ளது. இத்திட்டத்தின் கீழ் ஊக்கத் தொகை பெறுவதற்கு, திருச்சிராப்பள்ளி நகர எல்லைக்குள், "சமுதாயத்தின் அனைத்து பிரிவுகளையும் உள்ளடக்கிய பருவ நிலையினை சீராக்கும் திட்டம்" தயாரிக்கப்பட வேண்டும்.

மேலும், ஸ்விஸ் நாட்டினைச் சேர்ந்த ஒரு முகமை மூலம், ICLEI தெற்கு ஆசியா உதவியுடன் ஏற்கனவே CapaCITIES என்ற திட்டம் மூலமாக திருச்சிராப்பள்ளி மாநகராட்சியில் வரைவு "அனைத்து பிரிவுகளையும் உள்ளடக்கிய பருவநிலையினை சீராக்கும் திட்டம்" மற்றும் "பருவநிலைக்கு அனுகூலமான நகர்ப்புற மேம்பாட்டுத் திட்டம்" (CCAP/CRCAP) தயாரிக்கப்பட்டுள்ளது. இத்திட்டங்களை தயாரிப்பதற்கு தேவையான தொழில்நுட்ப உதவி, ஒன்றிய அரசின் நகர்ப்புற மேம்பாட்டு அமைச்சகம் மூலம் ICLEI தெற்கு ஆசியா மற்றும் நகராட்சி நிர்வாக இயக்குநரகத்தில் வழங்கப்பட்டது. ICLEI தெற்கு ஆசியா என்கிற அமைப்பு தமிழ்நாட்டில் நகராட்சி நிர்வாக இயக்குரகத்தின் அனுமதி பெற்று அவ்வலுவலகத்திலிருந்து செயல்பட்டு வருகிறது.

திருச்சிராப்பள்ளி நகரில் பருவநிலை மாற்றத்தினால் ஏற்படும் அனைத்து சவால்களையும் கடந்து செல்வதற்கும், அனைத்து பிரிவுகளையும் ஒருங்கிணைத்து, நகரின் நீட்டித்த வளர்ச்சிக்கும், பருவநிலை மாற்றத்தால் ஏற்படும் மாற்றங்களை சமாளிப்பதற்கும் "அனைத்து பிரிவுகளையும் உள்ளடக்கிய பருவநிலையினை சீராக்கும் திட்டம்" மற்றும் "பருவநிலைக்கு அனுகூலமான நகர்ப்புற மேம்பாட்டுத் திட்டம்" ஒரு முக்கிய திட்டமாக செயல்படும். நீட்டித்த, அனுகூலமான, அனைத்து அம்சங்களையும் உள்ளடக்கிய நகரமாக திருச்சிராப்பள்ளி நகரத்தினை மாற்றும் பொருட்டு, உள்ளாட்சி சேவைகள், வீட்டு வசதி, எரிசக்தி, குடிநீர், திடக்கழிவு மேலாண்மை, சுகாதாரம், போக்குவரத்து மற்றும் பொருளாதார மேம்பாட்டு பணிகளில் மேற்கொள்ளப்படும் அனைத்து முதலீடுகள், கொள்கைகள் மற்றும் நடவடிக்கைகளை ஒருங்கிணைத்து, திருச்சிராப்பள்ளி நகரத்தினை நீட்டித்த, அனுகூலமான, அனைத்து அம்சங்களையும் உள்ளடக்கிய நகரமாக மாற்றுவதே இத்திட்டத்தின் நோக்கமாகும். நகரத்தின் அனைத்து பிரிவுகளையும் ஒருங்கிணைத்து முழுமையான அணுகுமுறையுடன் நகரத்தினை மேம்படுத்துவதையே இத்திட்டங்களின் முக்கிய குறிக்கோளாகும்.

"அனைத்து பிரிவுகளையும் உள்ளடக்கிய பருவநிலையினை சீராக்கும் திட்டம்" மற்றும் "பருவநிலைக்கு அனுகூலமான நகர்ப்புற மேம்பாட்டுத் திட்டம்" கீழ்க்கண்ட முக்கிய அம்சங்களை கொண்டுள்ளது.

- நகரத்தின் குடிநீர், கழிவு நீர் மேலாண்மை, மழைநீர் வடிகால் மேலாண்மை, போக்குவரத்து, திடக்கழிவு மேலாண்மை, அவசர கால சேவைகள், காற்றின் தரம் மற்றும் பசுமை வளர்ச்சிக்கு அடிப்படை தரவுகள் வழங்கப்படும்.

- நகரில் 2030, 2050 மற்றும் 2070ம் ஆண்டுகளில் பருவநிலை மாற்றத்தால் ஏற்படவிருக்கும் மாற்றங்களை சமாளித்தல்.
- பருவநிலை ஆபத்து மற்றும் அதனால் ஏற்படவிருக்கும் பாதிப்புகளை ஆய்வு செய்தல்.
- 2021–2022ம் ஆண்டினை அடிப்படையாக கொண்டு 2070 ஆண்டு வரை பசுமையின்மையால் ஏற்படும் ஆபத்தான வாயுக்களை மேலாண்மை செய்தல்.
- காற்றுமாசினை போக்குவதற்கான மாற்று பாதை அமைத்தல் (சாதாரண முறை, நடவடிக்கையுடன் கூடிய முறை மற்றும் முழுமையான மாசற்ற முறை).
- 2070க்குள் முழுமையான மாசற்ற முறையை உருவாக்குதல்.

பருவநிலை மாற்ற நடவடிக்கை திட்டம் ஒன்றிய அரசு மற்றும் தமிழக அரசின் கொள்கைகளுக்கேற்ப 2070ம் ஆண்டிற்குள் மாசற்ற நிலையினை அடைந்திட நகரத்தின் முக்கிய நபர்களுடன் கலந்தாலோசித்தல், முக்கிய தரவுகளின் அடிப்படையில் முடிவெடுத்தல் மற்றும் நீட்டித்த மற்றும் எதையும் தாங்கவல்ல நிலையினை அடைவதற்கான அனைத்து அம்சங்களை கொண்டதாகும். இதற்கென நகரத்தின் அனைத்து முக்கியத் துறைகள், அரசுத் துறைகள், தனியார் துறைகள், லாபம் மற்றும் லாபநோக்கமற்ற அடிப்படையில் செயல்படும் அனைத்து நிறுவனங்கள், அனைத்து சமூகங்களது ஆலோசனை பெறப்படும். இதன் மூலம் பெறப்படும் தரவுகளை கொண்டு நகரத்திற்கு தேவையான முக்கியமான பணிகளை அடையாளம் காணுதல், அப்பணிகளின் முன்னேற்றத்தினை கண்காணித்தல் மற்றும் தேவைக்கேற்ப யுக்திகளை மாற்றி பணிகள் மேற்கொள்ளப்படும். கூடுதலாக, புதுமையான தொழில்நுட்பங்களை செயல்படுத்துவதை ஊக்கப்படுத்துதல், ஆற்றலை உயர்த்துதல், மாசினை கட்டுப்படுத்துதல் மற்றும் அனைத்து மக்களுடைய நகர்ப்புற வாழ்க்கை தரத்தினை உயர்த்துதல், குறிப்பாக சமூகத்தின் விளிம்பில் உள்ள மக்களின் வாழ்க்கை தரத்தினை உயர்த்துவது போன்ற திட்டங்கள் செயல்படுத்தப்படும்.

(**இப்பொருளின் ஆங்கில வடிவம்** : Tiruchirappalli City has been chosen as one of the cities under the Tamil Nadu Climate Resilient Urban Development Program (TNCRUDP), which is jointly funded by the Government of Tamil Nadu and the World Bank. One of the Disbursement Linked Incentives (DLI) under TNCRUDP is the development of a Cross-Sectoral Climate Action Plan (CCAP) for the administrative boundary of Tiruchirappalli City Corporation.

Tiruchirappalli City Corporation (TCC) has developed the CCAP/Climate Resilient City Action Plan (CRCAP), in collaboration with ICLEI South Asia under the CapaCITIES project funded by the Swiss Agency for Development and Cooperation. This technical assistance was provided to TCC under the Memorandum of Understanding that ICLEI South Asia has with Director of Municipal Administration and Tiruchirappalli City Corporation. ICLEI South Asia has been functioning in the office of Director of Municipal Administration office after getting appropriate permission

In Tiruchirappalli, the CCAP/CRCAP serves as a strategic blueprint to address urban challenges through an integrated approach across various sectors and stands as a testimony to the commitment of Tiruchirappalli City Corporation toward sustainable urban development and climate action. This comprehensive plan aims to create a sustainable, resilient, and inclusive city by aligning policies, investments, and actions in Municipal services, Housing, Energy, Water, Waste water, Solid waste management, Health, Transportation, and Economic development. The plan seeks to generate synergies and promote a holistic approach to urban development by considering the interconnections between these sectors.

The CCAP/CRCAP includes the following key sections:

- Baseline for the various urban systems like Water, Waste water, Storm water management, Transport, Solid waste management, Emergency services air quality & Urban greens.
- Gap in the various urban systems in the various horizon years of 2030, 2050 & 2070.
- Climate Risk & Vulnerability Assessment.
- The GHG inventory for the base year of (2021-22) and projected years till 2070.
- Alternate emissions pathways (including Business-as-Usual, Progressive Action & Net-Zero Scenario Pathway.
- Plans and strategies to achieve net-zero by 2070.

Aligned with the Government of India's and the Government of Tamil Nadu's NDC target of achieving net-zero emissions by 2070, Tiruchirappalli's Climate Action Plan emphasises stakeholder engagement, data-driven decision-making, and a focus on sustainability and resilience. Involving various stakeholders—including government agencies, the private sector, non-profits, and the community—ensures diverse perspectives and comprehensive solutions. The plan leverages data and analytics to identify priorities, monitor progress, and adjust strategies accordingly. Additionally, it encourages innovative technologies and practices to enhance efficiency, reduce emissions, and improve the quality of urban life, while ensuring that all residents, particularly marginalized and vulnerable groups, benefit from urban development and services.)

**அலுவலகக் குறிப்பு :**

1. இத்திட்டத்தில் பங்கேற்று, ஊக்கத் தொகையினை உலக வங்கியிடமிருந்து பெற்று பருவநிலை மாற்றத்தால் ஏற்படும் சவால்களை நேரிடுவதற்கு தேவையான பணிகளை மேற்கொள்ள அனுமதி அளிக்கலாம்.
2. இதற்குரிய அனைத்து ஆவணங்களிலும் கையொப்பமிட ஆணையருக்கு அதிகாரம் அளிக்கலாம்.

**இ1/14844/2019(மையம்)**

**தீர்மானம் :-**

**அலுவலக குறிப்பினை ஏற்று அனுமதி அளிக்கப்பட்டது.**

**(ஒம்).மு. அன்பழகன்,**
**மாண்புமிகு மேயர்,**
**திருச்சிராப்பள்ளி மாநகராட்சி.**

**/உண்மை நகல்/**

**ஆணையருக்காக,**
**திருச்சிராப்பள்ளி மாநகராட்சி.**

24/7/2024

# CONTENTS

## Annexures

# LIST OF TABLES

# LIST OF FIGURES

# ABBREVIATION

| | |
|---|---|
| **ADIP** | Aerospace and Defence Industrial Policy |
| **AQMS** | Air Quality Monitoring Stations |
| **AMRUT** | Atal Mission for Rejuvenation and Urban Transformation |
| **Avg Temp** | Average Temperature |
| **BOV** | Battery Operated Vehicle |
| **BEE** | BUREAU OF ENERGY EFFICIENCY |
| **BRT** | Bus Rapid Transit |
| **CPCB** | Central Pollution Control Board |
| **CRCAP** | Climate Resilient City Action Plan |
| **CRVA** | Climate Risk and Vulnerability Assessment |
| **CVA** | Climate Vulnerability Assessment |
| **CPHEEO** | Central Public Health and Environmental Engineering Organisation |
| **CRA** | Commissioner of Revenue Administration |
| **CMA** | Commissionerate of Municipal Administration |
| **CAGR** | Compounded Annual Growth Rate |
| **CMP** | Comprehensive Mobility Plan |
| **CNG** | Compressed Natural Gas |
| **C&D** | Construction and Demolition |
| **DoECC** | Department of Environment and Climate Change |
| **DMA** | Directorate of Municipal Administration |
| **DTCP** | Directorate of Town and Country Planning |
| **DDMP** | District Disaster Management Plan |
| **ESEAP Scheme** | EESL's Super-Efficient AC Program |
| **ECS** | Equivalent Car Spaces |
| **FMP** | Freight Management Policy |
| **GIS** | Geographical Information System |
| **GPC** | Global Protocol for Community |

| | |
|---|---|
| **GHG** | GreenHouse Gas |
| **GGE** | Greenhouse Gas Emissions |
| **ICLEI** | ICLEI South Asia |
| **IMD** | Indian Meteorological Department |
| **ICCC** | Integrated Command and Control Centre |
| **IWMUST** | Integrated Waste Management and Urban Services Tamil Nadu |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **kWp** | KiloWatt Hour Peak |
| **KfW** | Kreditanstalt für Wiederaufbau |
| **LST** | Land Surface Temperature |
| **LULC** | Landuse Land Cover |
| **LNA** | Local Natural Assets |
| **MP** | Master Plan |
| **MaxTemp** | Maximum Temperature |
| **Million Cubic Meter** | MCM |
| **MTC** | Metropolitan Transport Corporation |
| **MCC** | Micro Composting Centers |
| **MLD** | Million Liters per Day |
| **MWh** | MillionWatt Hour Peak |
| **MimTemp** | Minimum Air Temperature |
| **MoHUA** | Ministry of Housing and Urban Affairs |
| **NAAQS** | National Ambient Air Quality Standards |
| **NCAP** | National Clean Air Programme |
| **NEMMP** | National Electric Mobility Mission Plan |
| **NMSH** | National Mission on Sustainable Habitat |
| **NWM** | National Water Mission |
| **NDC** | Nationally Determined Contribution |
| **NOC** | No Objection Certificate |
| **NMT** | Non-Motorized Transport |
| **OTT** | Observed Temperature Trend |

| | |
|---|---|
| **OCC** | Onsite Composting Center |
| **OHTs** | Over Head Tanks |
| **PM10** | Particulate Matter |
| **UJJWALA** | Pradhan Mantri Ujjwala Yojana (PMUY) |
| **RCPs** | Representative Concentration Pathways |
| **RRC** | Resource Recovery Center |
| **STP** | Sewage Treatment Plant |
| **SLDs** | Shared Learning Dialogues |
| **SUP** | Single Use Plastic |
| **SCM** | Smart Cities Mission |
| **SEZ** | Special Economic Zones |
| **SETC** | State Express Transport Corporation |
| **SBM** | Swachh Bharat Mission |
| **TNCCM** | Tamil Nadu Climate Change Mission |
| **TNDIC** | Tamil Nadu Defence Industrial Corridor |
| **TANGEDCO** | Tamil Nadu Energy Distribution Company |
| **TNGM** | Tamil Nadu Green Mission |
| **TNIDB** | Tamil Nadu Industrial Development Board |
| **TNIFMC** | Tamil Nadu Infrastructure Fund Management Corporation |
| **TNSAPCC** | Tamil Nadu State Action Plan on Climate Change |
| **TNSTC** | Tamil Nadu State Transport Corporation |
| **TNWM** | Tamil Nadu Wetlands Mission |
| **TNWE** | Tamil Nadu Wind Energy Roadmap |
| **TCC** | Tiruchirappalli City Corporation |
| **TP** | Town Panchayats |
| **UGSS** | Under Ground Sewerage Schemes |
| **ULB** | Urban Local Body |

# EXECUTIVE SUMMARY

# EXECUTIVE SUMMARY

## Introduction

Climate change is an urgent global challenge that is accelerated by human activities such as the burning of fossil fuels and industrial processes, leading to a significant increase in greenhouse gasses like carbon dioxide. This increase has resulted in a greenhouse effect, causing global warming with far-reaching consequences on the environment and all its inhabitants. The situation necessitates ambitious global action to mitigate the effects of climate change.

Over 2,300 jurisdictions worldwide have declared a 'climate emergency,' recognising the situation's urgency. The Paris Agreement, a pivotal global framework, seeks to limit global temperature rise to 2°C below pre-industrial levels. As a signatory to the Paris Agreement, India announced its commitment to achieve 'Net-zero emissions by 2070' at the 26th Conference of Parties (COP-26) in Glasgow in 2021 in response to the need for accelerated climate action at a global scale. In the near term, as part of its climate commitment under the Paris Agreement, India's updated Nationally Determined Contribution (NDC) aims to reduce the emission intensity of the country's Gross Domestic Product (GDP) by 45% by 2030 from 2005 levels. This updated commitment builds on the initial NDC submitted in 2015, which set a target to reduce the emission intensity of GDP by 33% to 35% by 2030 from 2005 levels. At COP26, India introduced Mission LiFE (Lifestyle for Environment) and Panchamrit (five nectar elements) as a global movement advocating for environmentally conscious lifestyles that encourage positive behavioural changes through individual and community actions.

"As a signatory to the Paris Agreement, India announced its commitment to achieve 'Net-zero emissions by 2070' at the 26th Conference of Parties (COP-26) in Glasgow in 2021 in response to the need for accelerated climate action at a global scale.

India, faces its own set of challenges such as rising temperatures, increased frequency of heatwaves, disrupted monsoon patterns, and rising sea levels, has taken significant steps towards addressing climate change. These include enhancing commitments under the Nationally Determined Contribution (NDC) at COP-26, aiming for net-zero emissions by 2070, and implementing various national missions and urban development strategies to reduce its environmental impact.

Tamil Nadu and its cities like Tiruchirappalli (Trichy) have been proactive in implementing policy initiatives and projects for sustainable development and environmental conservation. Tamil Nadu's actions include boosting solar energy capacity, wind energy production, innovative water management practices, and establishing the Tamil Nadu Green Climate Company to manage three missions (Tamil Nadu Climate Change Mission, Tamil Nadu Green Mission & Tamil Nadu Wetland Mission).

Trichy has focused on both mitigation and adaptation actions, such as restoring water bodies, improving waste management, investing in renewable energy, and planning sustainable urban mobility solutions like a Bus Rapid Transit system. These efforts aim to reduce the city's carbon footprint and enhance resilience to climate impacts.

Trichy City Corporation's Climate Action Plan outlines a vision for transitioning Trichy towards a net-zero emissions future, emphasising resilience against climate change and fostering an equitable, sustainable urban environment. This plan is aligned with Tamil Nadu's State Action Plan on Climate Change, the Paris Agreement, and Sustainable Development Goals, targeting net-zero emissions by 2070 through climate-resilient urban planning and sustainable practices. Trichy has adopted a comprehensive Net-zero ClimateResilientCities Action Planning Methodology for its Climate Action Plan, which includes vulnerability assessments, stakeholder engagement, and capacity building, setting a benchmark for urban climate action in Tamil Nadu. This collective approach underscores the critical role of local governments and communities in combating climate change through technology, policy innovation, and environmental stewardship.

An aerial view of the Sri Ranganathaswamy Temple, a renowned Vishnu temple, reveals its majestic presence on the island of Srirangam. Nestled amidst the Cauvery River, this island is a peaceful oasis just a short distance from the bustling city of Tiruchirappalli.

## Methodology

The Trichy City Corporation (TCC) has strategically adopted the ICLEI SA's "Net-zero ClimateResilientCities Action Planning Methodology," aligned with the Government of India's goal to achieve net-zero emissions by 2070. This methodology has a structured 9-step process distributed across three key phases: **Analyse, Act, and Accelerate.** Each phase has steps designed to embed climate resilience into urban development, ranging from initial research and analysis to the practical implementation of strategies and the expansion of climate actions.

Trichy's adoption of this methodology demonstrates a committed effort towards understanding local climate vulnerabilities, setting actionable goals, and initiating tangible climate resilience measures. The "Analyse" phase involves gaining support, researching local climate issues, and establishing baselines for action. The "Act" phase transitions into the implementation of the CRCAP, with a focus on practical actions and monitoring progress. The final "Accelerate" phase seeks to sustain and grow climate actions through collaboration, revision of plans, and securing investments for further initiatives.

The progress of Trichy through these steps reflects an active commitment by TCC to respond to climate challenges, starting with leadership commitment and the establishment of a dedicated climate core team. This foundation supports a detailed assessment of local vulnerabilities and the development of a targeted action plan prioritising resilience measures. Trichy's approach includes a blend of mitigation and adaptation strategies, assessing their impact and feasibility to ensure effective integration into the CRCAP. The plan aligns with national goals and international frameworks, aiming to reduce greenhouse gas emissions and enhance urban climate resilience.

As Trichy advances through the methodology's steps, it emphasises detailing and financing priority climate actions, implementing and monitoring project outcomes, and collaboration across governance levels. The city's efforts in reporting achievements through platforms like ICLEI-CDP and others, highlight its role as a model for urban climate resilience. Through this methodology, Trichy not only aims to safeguard its urban environment against climate change impacts but also sets a benchmark for sustainable urban development and climate action planning.

## City Profile

Tiruchirappalli, often called Trichy, is a city of both historical and modern significance located in the Indian state of Tamil Nadu. Nestled along the Cauvery River, it stands as the state's fourth-largest city by area and the fifth in terms of population, housing over 1.08 million residents as of 2021. The city's landscape is marked by a mix of ancient temples, such as the Rock Fort Temple and Sri Ranganathaswamy Temple, alongside a thriving industrial sector, contributing to its economic significance. Trichy's flat terrain, divided by the flow of the Cauvery River, comprises various zones, including the southern Cantonment, northern temples, and a bustling central bazaar, surrounded by natural and urban beauty that enhances its appeal to both residents and visitors.

Trichy is known for its excellent connectivity, within the state and also with other parts of India. The Trichy International Airport connects it to several international destinations, while its status as the divisional headquarters of Southern Railways ensures extensive rail links throughout Tamil Nadu and to other major Indian cities. The city's comprehensive road network, featuring national and state highways, reinforces its strategic importance, providing seamless connectivity to various urban and rural areas. This connectivity supports Trichy's role as a central node in transportation, significantly impacting its economic and social development.

Demographically, Trichy has witnessed significant growth over the years, with a population that's projected to nearly double by 2070. Despite a surge in urbanisation and migration in the early 2000s, the pace has moderated due to rising real estate costs and improved accessibility to the city's outskirts.

Efforts to address slum populations through effective resettlement and the provision of essential infrastructure have decreased slum dwelling percentages, reflecting the city's commitment to improving living conditions for the vulnerable and also have an inclusive urban landscape. The city corporation provides several services, from infrastructure development to public health and urban planning, supported by a budget that increasingly allocates funds towards projects focused on sustainability and adaptation to climate challenges.

Trichy's economic landscape is characterised by a robust engineering and fabrication sector, with notable contributions from Bharat Heavy Electricals Limited (BHEL) and other key industries, establishing it as an industrial nucleus within Tamil Nadu. Additionally, its designation as a node in the Tamil Nadu Defence Industrial Corridor (TNDIC)[1] underscores its strategic importance in national defence and aerospace sectors.

Urban planning and land use in Trichy are geared towards accommodating its growing population and economic activities, with a revised master plan extending its area to 804.55 sq.km and focusing on sustainable urban expansion. The city's climate, marked by a tropical wet and dry pattern, poses challenges and opportunities in terms of managing seasonal rainfall and high temperatures. Trichy has been identified as a non-attainment city for PM10 and is currently working on a series of actions proposed as part of the action plan under the National Clean Air Programme (NCAP), underscoring its efforts towards creating a healthier and more sustainable urban environment.

# Urban System Gap Analysis

The Urban System Gap Analysis for Tiruchirappalli (Trichy) assesses the various urban systems of the city and also highlights the gaps and opportunities that this presents over the horizon periods up to 2070. This analysis spans various critical urban systems, including water supply, waste management, transportation, urban greenery, and disaster management, detailing the current state, projected demands, and gaps that need addressing to ensure sustainable development and improve residents' quality of life.

### Water Supply System

Trichy's water supply, heavily reliant on the supply wells that recharge from Cauvery and Coleroon rivers, faces sustainability challenges, particularly during low river flow periods. Despite a designed capacity for water pumping at 203 MLD, actual pumping is about 134.77 MLD. The water supply is managed through a partial SCADA system for remote management. The city has challenges in NRW losses due to transmission and distribution of up to 31%, inadequate groundwater recharge systems, and a lack of a comprehensive groundwater management policy.

### Waste Management System

Trichy produces approximately 470 metric tonnes of municipal solid waste daily, with a high waste collection efficiency of nearly 90%. However, the city grapples with waste processing and disposal challenges, including low utilisation of micro composting centres, reliance on unscientific dumping sites leading to potential environmental hazards, and an ageing fleet of waste collection vehicles. The need for enhanced source segregation, scientific landfill management, and improved enforcement against single-use plastics are identified as critical areas for improvement.

### Transportation

Trichy's transportation network, marked by congestion and an outdated road infrastructure, must be equipped to handle current and future demands. The city's bus fleet needs to be improved for its population, and pedestrian infrastructure needs significant expansion. Proposals include - increasing the bus fleet, incorporating electric buses, developing additional roads and footpaths, and establishing a comprehensive parking policy to manage congestion effectively.

### Urban Green and Biodiversity

Despite having a green cover of 10.6 sq.m / person which exceeds WHO's recommendations of 9sq.m / person, Trichy's higher temperature ranges suggest a need to enhance its green spaces further to combat heat stress. The absence of a City Biodiversity Action Plan indicates an opportunity for more organised efforts to increase biodiversity and green cover through strategic planning and interdepartmental collaboration.

### Disaster Management and Emergency System

Trichy's vulnerability to natural disasters, including cyclones and floods, highlights the necessity of a city-level disaster management plan, establishing an early flood warning system, and expanding the Integrated Command & Control Centre coverage. Such measures are crucial for improving resilience, ensuring preparedness, and facilitating effective response and recovery in the face of natural calamities.

The Urban System Gap Analysis reveals that while Trichy has made commendable progress in urban management and infrastructure development, significant gaps remain across several key areas. Addressing these challenges through targeted investments, policy reforms, and strategic planning is essential for Trichy to fulfil its vision of sustainable urban development and improved liveability for its rapidly growing population.

## GHG Inventory

> "For the baseline year of 2021-22, the total GHG emissions in Trichy stood at **1,425,761** $tCO_2e$, with a per capita emission of **1.32** **$tCO_2e$**.

The greenhouse gas (GHG) emissions inventory for Tiruchirappalli, spanning from 2017-18 to 2021-22, adheres to the Global Protocol for Community-Scale GHG Emissions (GPC). This inventory, focusing on both community-level and local government emissions, reveals an intricate picture of the city's contribution to climate change through its energy consumption in various sectors, waste management, and municipal operations. For the baseline year of 2021-22, the total GHG emissions stood at 1,425,761 tCO2e, with a per capita emission of 1.32 tCO2e, indicating a city on the move towards identifying and implementing strategies for carbon footprint reduction.

The analysis segregates emissions into community-level and local government operations, highlighting significant sectors like residential buildings, commercial establishments, manufacturing, transport, and waste management. The community-level emissions, which encompass the broader scope of urban activities including residential, commercial, institutional, transport, solid waste, and domestic wastewater, dominate the city's GHG profile. This approach allows for a comprehensive understanding of emissions sources and paves the way for targeted interventions.

Transport and residential buildings are sectors accounting for substantial portions of energy use and associated GHG emissions. The transport sector, in particular, has shown a marked increase in emissions, emphasising the need for sustainable urban mobility solutions. Waste management also contributes significantly to the city's GHG emissions, with solid waste and domestic wastewater being notable contributors.

Local government operations, which include municipal buildings, street lighting, water supply, wastewater treatment, the municipal vehicle fleet, and waste management facilities, form a subset of the community-level profile. This distinction helps in pinpointing specific areas where the municipal corporation can take direct action to reduce emissions, demonstrating leadership and commitment to climate action.

The GHG emissions inventory employs various methodologies for estimating emissions across different sectors, utilizing the Harmonised Emission Analysis Tool Plus (HEAT+) for accuracy. This tool not only facilitates the calculation of GHG emissions but also aids in forecasting growth, evaluating policy impacts, and developing action plans for emissions reduction. The reliance on sector-specific emission factors and the inclusion of a range of GHGs such as CO2, CH4, and N2O, reflect a methodical approach to capturing the city's climate impact.

Despite the detailed analysis, the inventory identifies areas of concern and opportunities for improvement. For instance, the increasing trend in GHG emissions from certain sectors like transport underscores the urgency for enhancing public transport systems, promoting non-motorised transport, and adopting cleaner fuels. Additionally, the significant role of waste in contributing to GHG emissions calls for more effective waste management practices, including increased recycling, composting, and the adoption of waste-to-energy technologies.

This GHG inventory serves as a crucial step for Tiruchirappalli in its journey towards sustainability, providing a clear picture of the current emissions landscape and laying the groundwork for targeted climate action. It underscores the importance of continuous monitoring, reporting, and verification (MRV) of GHG emissions to track progress, refine strategies, and ensure the city moves towards its carbon neutrality goals effectively.

# Scenario Planning

The Scenario Planning for Tiruchirappalli's Climate Resilient City Action Plan (CRCAP) illustrates a methodological approach to mapping out future GHG emissions pathways and establishing strategic emission reduction targets. Through three distinct scenarios—BAU Projection, Progressive Action Scenario, and Net Zero Pathway — the plan lays out a roadmap for Trichy to achieve net-zero emissions by 2070, aligning with India's NDC commitment and global climate goals.

The **Business-as-Usual (BAU)** Projection is a baseline, forecasting GHG emissions if current practices continue. This scenario underscores the need for transformative actions to mitigate emissions and highlights the urgency of sustainable practices and policies.

The **Progressive Action Scenario** builds on BAU but incorporates increased climate actions, aligning with national and state policies, programs, and missions. This scenario aims for higher emission reductions than BAU by implementing realistic and achievable climate actions based on local conditions, resources, and financial commitments. It reflects Trichy's commitment to climate action, recognising the city's role in aligning with national policy and its bold climate vision.

The **Net Zero Pathway** sets the most ambitious target for net-zero emissions by 2070. This pathway goes beyond existing policies' goals by setting even more ambitious targets, requiring substantial financial investment and collaborative efforts from municipal, state, and national governments and the private sector.

The CRCAP uses the Net Zero GHG Emissions Tool, developed by ICLEI South Asia, for emissions modelling and scenario analysis. This tool facilitates the planning of effective strategies to reduce emissions, incorporating local data and allowing for city-level customisations. The analysis considers sector-specific dynamics, population growth, economic development, and urbanisation rates to forecast future emissions under different scenarios.

**Key findings from the scenario planning include:**

- The BAU scenario significantly increases emissions, highlighting the need for urgent climate action.
- The Progressive Action Scenario substantially reduces GHG emissions by 57.75% compared to BAU by 2070.
- The Net Zero Pathway, while ambitious, outlines the comprehensive climate actions necessary for Trichy to achieve net-zero emissions by 2070. It reduces the emissions by 87.4% compared to BAU. It emphasizes the importance of substantial financial investment, policy support, and collaborative efforts.

The scenario planning in Trichy's CRCAP underscores the critical need for targeted climate actions to reduce GHG emissions and achieve a sustainable, resilient, and net-zero future. It highlights the role of strategic planning, policy alignment, and the importance of collective efforts in addressing the challenges of climate change.

# Goals & Strategies for Climate Resilience

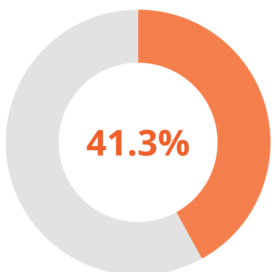
This comprehensive exploration into Tiruchirappalli's strategies and goals for climate resilience and sustainability showcases a detailed blueprint to transform the city into a climate-resilient, net-zero emission urban centre by 2070. The Climate Resilient City Action Plan (CRCAP) underscores a multi-sectoral approach, focusing on the built environment and energy, transport, water and wastewater management, stormwater management, solid waste, urban greening and biodiversity, and air quality. Each sector outlines ambitious goals and strategies supported by current status assessments, identified opportunities and gaps, ongoing initiatives, and potential climate resilience impacts.

## Tiruchirappalli's Vision for a Net-Zero Climate Resilient Future:

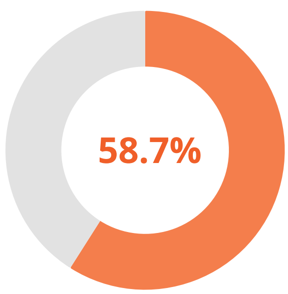
Trichy is embarking on a visionary course toward environmental sustainability, aiming for net-zero emissions by 2070, committing to significant reductions in greenhouse gasses, strengthening urban resilience, and focusing on integrating sustainable practices across all development sectors to achieve a transformative climate future.

### Results & Highlights

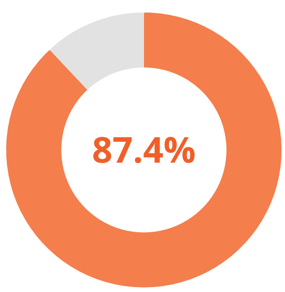
The Net Zero Pathway aims to reduce the emissions in the horizon years compared to BAU by:




2030: Net zero GHG emissions are 41.3% lower than BAU




2050: Net zero GHG emissions are 58.7% lower than BAU




2070: Net zero GHG emissions are 87.4% lower than BAU

## Adaptation Goals

To reduce the impact of heat stress and urban flooding on urban infrastructure and citizens, particularly vulnerable communities, by enhancing their capacities, build climate resilient infrastructure and respond successfully to climate change.

## Key Highlights:

- **Built Environment & Energy:** Trichy aims to transition to a heat-resilient city powered by sustainable energy. Strategies include promoting green building concepts, energy-efficient appliances, and renewable energy adoption. Significant reductions in GHG emissions are anticipated across timelines leading to 2070. These will build on the existing progress made on green buildings in the city.

- **Transport:** The city plans to foster clean, zero-emission mobility by shifting motorised trips to non-motorized and public transport, ensuring all vehicles are electric and powered by renewables by 2070.

- **Water and Wastewater:** Goals include enhancing water resilience through 100% wastewater treatment and reuse, with strategies focusing on energy-efficient and renewable energy facilities and reducing non-revenue water levels. TCC aims to achieve 15% NRW by 2024-25.

- **Stormwater:** Trichy adopts comprehensive stormwater management and natural-based solutions to minimise run off and urban flooding and achieve 100% coverage as per CPHEEO norms.

- **Solid Waste:** The city aims to become a zero-waste city by 2030, with strategies for 100% segregated waste collection and scientific waste processing, treatment, and disposal.

- **Urban Greening and Biodiversity:** Trichy emphasises urban greening and biodiversity conservation to improve climate resilience. It aims to maintain its per capita green cover of 10.6 sq.m and aims to double the green cover in wards where extreme heat is observed. TCC aims to increase carbon sinks through urban greening and develop microhabitats for local biodiversity management.

- **Air Quality:** The goal is to enhance liveability by achieving the National Clean Air Program Targets especially PM10, with strategies to reduce vehicular air pollution, manage construction activities and debris, and reduce air pollution from industrial activities.

By leveraging data-driven decision-making, engaging a wide range of stakeholders, and prioritising evidence-based strategies, Trichy is well-positioned to confront and overcome the multifaceted challenges of climate change. The plan not only targets GHG emission reductions and adaptation measures but also has

# Way Forward

To advance Tiruchirappalli's ambitious goal of achieving net-zero emissions by 2070, a series of structured actions under various key areas are proposed. These actions aim to enhance governance, increase community engagement, streamline data management, secure financing, and ensure effective monitoring and reporting. Here's a structured approach to achieving these objectives:

### Governance, Vision & Policy

- **Enhance the Climate Core Committee (CCC):**
  TCC will allocate a dedicated budget for CCC to implement cross-cutting climate projects, focusing on policy, research, stakeholder liaison, and awareness campaigns.

- **Establish a Climate Change Department:**
  TCC will aim at creating a dedicated department within TCC to centralize all climate action efforts and ensure alignment with the CRCAP.

- **Form a High-Powered Steering Committee:**
  TCC will include representatives from various city and state departments, emphasising collaboration with the state finance department for aligned goals and funding.

- **Create a Climate Action Council**
  TCC will assemble a group of thematic experts to provide advisory support on evolving technologies and strategies.

- **Develop a Climate Volunteers Pool:**
  TCC will mobilise community experts to support climate initiatives, leveraging their expertise in disaster management, climate modelling, and assessments.

### Climate Awareness & Community Engagement

- **Implement Climate Education Programs:**
  TCC will work to integrate climate change modules into school and college curriculums in collaboration with educational departments.

- **Set up Climate Information Centres:**
  TCC will establish centres for knowledge exchange and dissemination of climate change information and best practices.

- **Facilitate Community-Led Initiatives:**
  TCC will support and resource community initiatives aimed at contributing to the net-zero goal, such as community gardens and clean-up drives.

### Data Collection & Management

- **Develop a Climate Data Policy:**
  TCC will revise existing data policies to include climate data collection standards, managing protocols, and dissemination guidelines.

- **Invest in Data Infrastructure:**
  TCC will leverage ICCC capabilities for climate data processing and invest in GIS systems, data analysts, and staff upskilling.

### Climate Financing

- **Create a Dedicated Climate Fund:**
  TCC will plan to establish a fund sourced from city budgets, grants, and contributions for sustained financing of climate actions.

- **Leverage Public-Private Partnerships:**
  TCC will encourage private investment in clean energy and climate action projects through incentives like tax breaks.

### Capacity Building & Procurement

- **Update Schedule of Rates (SoR):**
  Incorporate climate-friendly components and materials to facilitate green projects and mainstream Nature-based Solutions (NbS).

- **Conduct Training Programs:**
  Provide regular training for city officials on climate science, impact assessment, and response strategies.

- **Hire Climate Experts:**
  Onboard specialists across thematic areas for leading climate initiatives.

### Monitoring & Reporting

- **Establish Institutional Frameworks:**
  Designate specific roles within the Climate Core Team for tracking progress, compiling reports, and conducting reviews.

- **Implement Accountability Measures:**
  Regularly audit climate data and ensure transparency by making progress accessible on public platforms.

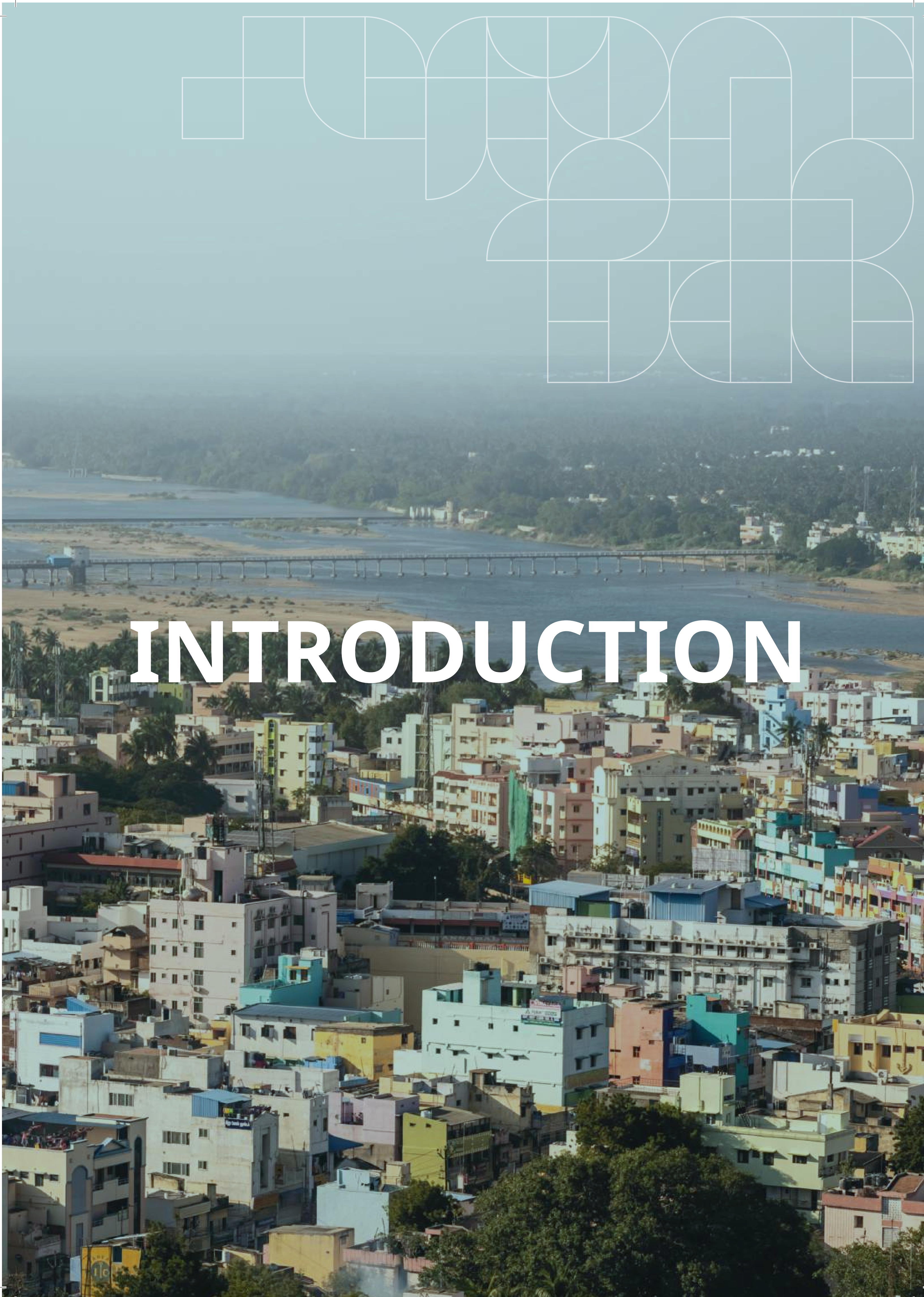
- **Set Reporting Frequencies:**
  Define consistent intervals for reporting progress to stakeholders.

By implementing these actions, Trichy aims not only to meet its net-zero emissions goal but also to enhance its resilience against climate change, promote sustainable development, and improve the quality of life for its residents. These structured actions represent a holistic approach to climate action, emphasizing governance, community participation, technological leverage, financial innovation, and continuous learning and adaptation.


City View of Trichy.

# 01

# INTRODUCTION



01

# INTRODUCTION

## 1.1 Background

### 1.1 Climate Change – A Global Challenge that Requires Ambitious Action

Climate change represents a critical global challenge that demands immediate action. It stems mainly from anthropogenic activities, such as the combustion of fossil fuels and various industrial processes, which emit significant amounts of greenhouse gasses, including carbon dioxide ($CO^2$). The global average temperature has risen by approximately 1.2° Celsius[1] since the late 19th century, exacerbating weather extremes and impacting ecosystems worldwide. Concurrently, sea levels have increased by about 20 centimetres since 1900, due to melting caused by warmer seawater, threatening coastal communities and habitats. The rapid climate changes are accelerating species depletion and are linked to a sixth mass extinction event[2], with studies indicating that up to 1 million species[3] are at risk of extinction in the coming decades. Since the pre-industrial era, the Arctic has lost over 75% of its summer sea ice volume[4], reflecting a dramatic change in the Earth's climate system. The atmospheric concentration of $CO^2$ has also exceeded 419.3 parts per million (ppm)[5] by 2023[6], intensifying the greenhouse effect and contributing to global warming. These profound and wide-ranging consequences highlight the pressing need to address climate change.

*Wide angle shot of white smoke coming out of the nuclear plants*

[1]Global Temperature Rise. Accessed April 2024.
[2]Sixth mass Extinction Event. Accessed April 2024.
[3]Species Extinction Study. Accessed April 2024.
[4]Arctic Summer Ice Volume. Accessed April 2024.
[5]Atmospheric $CO^2$ level. Accessed April 2024.
[6]The increase between 2022 and 2023 was 2.8 ppm—the 12th year in a row where the amount of carbon dioxide in the atmosphere increased by more than 2 ppm.

### 1.1.1 India's Climate Change Challenges

**India, like many nations, faces significant challenges due to climate change:**

#### Temperature Rise

Over the past century, India has seen a notable increase in average temperatures, rising by approximately 0.7°C. This trend, reported by the Indian Meteorological Department (IMD), has accelerated in recent decades, resulting in various climate-related extremities across the country. This trend is detailed in Chapter 04.

#### Monsoon Patterns

India's vital monsoon, crucial for agriculture and freshwater supply, faces mounting pressures from climate change. Shifting temperature patterns are already disrupting rainfall timing, intensity, and distribution, amplifying the damage caused to the vulnerable communities that are reliant on monsoon rains.

#### Heatwaves

The frequency and intensity of heatwaves in India have surged by almost 5-10 times between 2020-22[7], posing significant risks to human health, energy resources, and water availability. According to research published by the University of Cambridge and published in Plos Climate Journal[8], 90%[9] Indians have suffered due to heat waves caused by climate change in 2022.

#### Sea Level Rise

With a vast coastline over 7,500 kilometres, India confronts escalating risks from rising sea levels. As per data from National Centre for Coastal Research (NCCR)[10] India has witnessed an average rise of 3.3 mm/year in the recent decades (1993-2015) in the Indian Ocean.

[7]Heatwaves Information by the Ministry of Earth Sciences laid in Rajya Sabha. Accessed March 2024.
[8]Plos Climate Journal. Accessed April 2024.
[9]Killer heatwaves endanger India's development (cam.ac.uk). Accessed April 2024.
[10]Sea Level Rise State laid in Rajya Sabha based on MoES. Accessed March 2024

## 1.2 Global Response to Climate Change

Global momentum in addressing climate change has surged, with more than 2300 jurisdictions and local governments declaring a 'climate emergency,[11]' highlighting the pressing need for action. At the heart of these efforts lie pivotal treaties & frameworks such as the Paris Agreement[12], the 2030 Agenda for Sustainable Development[13], and UN-Habitat's 2016 New Urban Agenda. The Paris Agreement stands as a beacon for international cooperation, aiming to cap global temperature rise well below 2°C above pre-industrial levels, with a fervent ambition to limit it to 1.5°C. Complementing this vision, the 2030 Agenda outlines 17 Sustainable Development Goals (SDGs), encompassing crucial facets like clean energy, sustainable cities, climate action, clean water, health, and social equity. Furthermore, the New Urban Agenda places cities at the forefront, advocating for inclusive, resilient, and thriving urban spaces. These frameworks underscore the indispensable role of local governments and cities in shaping a sustainable future. Additionally, the IPCC 2018 Special Report on Global Warming of 1.5°C[14] reiterates the imperative of urban areas in driving ambitious climate action to safeguard our planet's future.

### 1.2.1 India's Commitment and Climate Actions

India announced its commitment to achieve 'Net-zero emissions by 2070' at the 26th Conference of Parties (COP-26) in Glasgow in 2021 in response to the need for accelerated climate action at a global scale. In the near term, as part of its climate commitment under the Paris Agreement, India's updated Nationally Determined Contribution (NDC) aims to reduce the emission intensity of the country's Gross Domestic Product (GDP) by 45% by 2030 from 2005 levels. This updated commitment builds on the initial NDC submitted in 2015, which set a target to reduce the emission intensity of GDP by 33% to 35% by 2030 from 2005 levels. At COP26, India introduced Mission LiFE (Lifestyle for Environment) and Panchamrit (five nectar elements) as a global movement advocating for environmentally conscious lifestyles that encourage positive behavioural changes through individual and community actions.

"This updated commitment builds on the initial NDC submitted in 2015, which set a target to reduce the emission intensity of GDP by 33% to 35% by 2030 from 2005 levels.

India's approach to combating climate change is comprehensive, incorporating strategic urban development projects with innovative environmental policies. Central to its urban development strategy are initiatives like the Smart Cities Mission, AMRUT (Atal Mission for Rejuvenation and Urban Transformation), and Swachh Bharat Mission-Urban[15], each targeting urban regeneration and sustainability.

In addition, India has launched seven pivotal missions under the National Action Plan on Climate Change (NAPCC) to further its environmental goals. The National Solar Mission aims to expand India's solar energy capacity, significantly reducing the country's dependence on fossil fuels. The National Mission for Enhanced Energy Efficiency seeks to improve energy efficiency across various sectors, while the National Mission on Sustainable Habitat (NMSH) focuses on promoting energy-efficient buildings and urban planning. The NMSH 2.0 emphasises incorporating sustainable practices into urban planning to reduce greenhouse gas emissions and increase resilience to climate change. NMSH 2.0 lists out enabling climate actions, which are intended to address the overarching framework to facilitate the adoption and implementation of the sector-wise climate action strategies mentioned above. These include strategies for urban governance, capacity building, data, technology, and innovation for

[11] Climate Emergency Declaration. Accessed Feb 2024

[12] The Paris Agreement 2016.. Accessed Feb 2024

[13] The 2030 Agenda for Sustainable Development. Accessed Feb 2024

[14] IPCC 2018 Special Report on Global Warming. Accessed Feb 2024

[15] Note: Several of these missions & programs are coming to an end in 2024. However, there are several consultations that are in progress to extend these schemes or replace them with other schemes that will have most of these program elements.

the mission. Support is provided in the form of funding and technical support via the various missions and schemes under NMSH 2.0.

The National Water Mission is designed to optimise water usage and ensure sustainable water resource management. The National Electric Mobility Mission Plan encourages a shift towards electric vehicles to reduce emissions from the transportation sector. Lastly, the Green India Mission aims at afforestation and enhancing the country's green cover. The ClimateSMART Cities Assessment Framework (CSCAF)[16] (subsequently absorbed into the Urban Outcomes Framework) was initiated by the Ministry of Housing and Urban Affairs (MoHUA) in 2020. It enables Indian cities to track and assess their climate actions, offering a strategic and parametric approach to tackle climate change in urban planning.

These initiatives collectively illustrate India's nuanced and proactive approach to achieving sustainability and resilience, reflecting a deep commitment to addressing climate change through a blend of technology, policy innovation, and environmental stewardship.

### 1.2.2 Tamil Nadu's Climate Journey & Actions

The Tamil Nadu government has long been at the forefront of pioneering policy initiatives and projects aimed at sustainable development and environmental conservation. Among its notable endeavours are implementing the Tamil Nadu Solar Energy Policy, aiming to boost solar energy capacity in the state significantly, and establishing wind farms, making Tamil Nadu one of India's leaders in wind energy production. Furthermore, the state's innovative water management practices, including rejuvenating water bodies under the "Kudimaramathu" scheme and the comprehensive rainwater harvesting program, have set effective water resource management benchmarks. Building on this legacy of environmental stewardship, the Tamil Nadu government has taken a significant leap forward by

*Solar panel on blue sky background, Alternative energy concept,Clean energy,Green energy*

[16]CSCAF 3.0 Website. Accessed Nov 2023

[17]TNGCC Website. Accessed Dec 2023

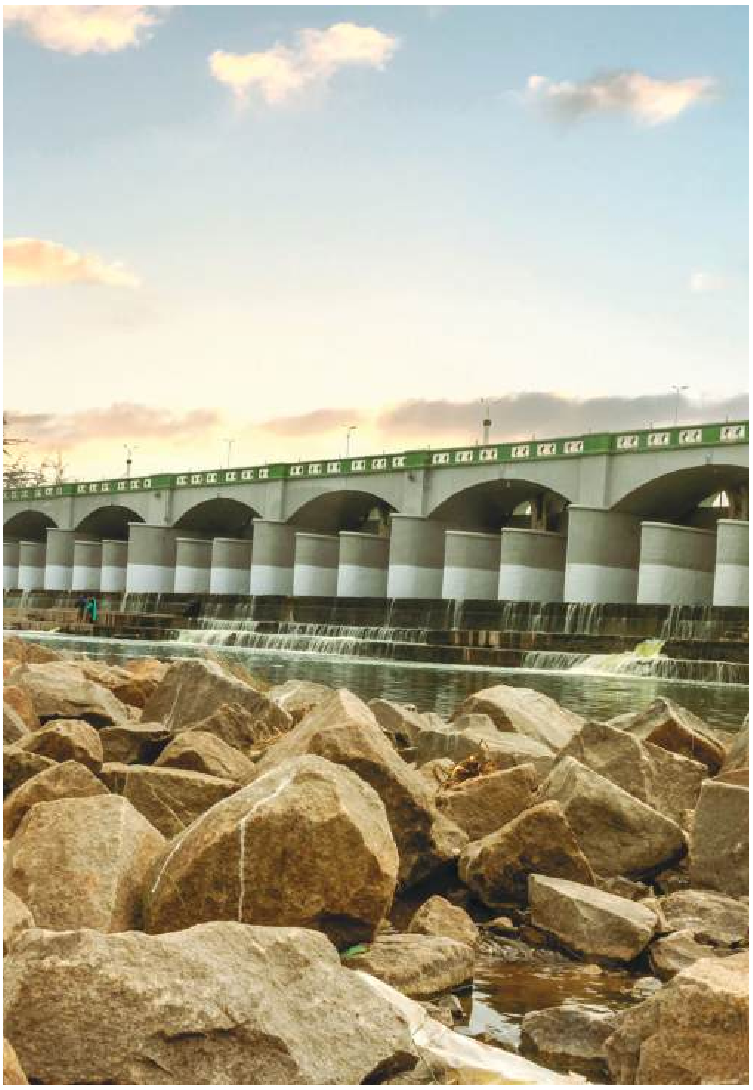
establishing a Special Purpose Vehicle (SPV) named the Tamil Nadu Green Climate Company (TNGCC)[17]. This initiative is designed to manage and implement three critical natural conservation missions professionally: Tamil Nadu Climate Change, Tamil Nadu Green, and Tamil Nadu Wetlands, each tailored to address various aspects of environmental conservation and climate change mitigation.

**Tamil Nadu Climate Change Mission[18]** - aims to spearhead climate change adaptation and mitigation efforts across the state. With an allocation of INR 500 crore, this mission focuses on implementing comprehensive strategies to reduce greenhouse gas emissions, enhance green manufacturing, and promote the adoption of eco-friendly technologies. **Tamil Nadu Green Mission[19]** - is dedicated to increasing the state's forest and tree cover from 23.27% to 33% by the year 2030-2031. **Tamil Nadu Wetlands Mission[20]** - focuses on the ecological restoration of wetlands, identifying and mapping 100 wetlands for restoration over five years at a cost of INR 150 crore. This mission aims to restore the ecological balance of these vital ecosystems, with a particular emphasis on enhancing livelihood options for local communities. Additionally, the mission includes initiatives such as the plantation of mangroves and seagrass as part of coastal wetlands management, signaling a comprehensive approach to wetland conservation.

Tamil Nadu is also drafting the State Action Plan for Climate Change (SAPCC). The Net-zero CRCAP dovetails into the SAPCC that is currently being revised and will be submitted to the Ministry of Environment, Forest and Climate Change of India (MoEFCC).

### 1.2.3 Tiruchirappalli's Climate Journey

Tiruchirappalli City Corporation (TCC) has taken bold steps in both mitigation and adaptation actions (A detailed list of Mitigation & Adaptation Action by TCC in 2024-25 is mentioned in Annexure A - Table A1). By restoring water bodies and enhancing the capacity of Thepakulam, Chettikulam, Thamarai and Keel Panjapur water bodies spread across the city, TCC is improving adaptation and also improving its resilience to water scarcity and ensuring a sustainable water supply for its residents. The city has allocated INR 5 million per ward (in 2023-24) for all 65 wards to improve micro-drainage. The laying of underground drainage systems in areas like Ariyammangalam and Thiruvarambur is further improving the city's infrastructure to cope with potential flooding and sanitation challenges, thereby reducing health risks associated with poor water management. The city is also building a 100 MLD sewage treatment plant (STP) in Panjapur with high energy efficiency. This will reduce emissions from the wastewater sector in the city that is currently untreated in most cases.



*Kallannai dam*

[17]TNGCC Website. Accessed Dec 2023

[18]Tamil Nadu Climate Change Mission Website. Accessed Feb 2023.

[19]Tamil Nadu Green Mission Website - Accessed Feb 2024

[20]Tamil Nadu Wetland Mission Website. Accessed Feb 2024.

> Installing a 9.60 MWp solar power plant in Panjappur and converting 41,615 street lights to LED technology are concrete steps towards decreasing the city's carbon footprint.

On the mitigation front, Trichy's significant investment in renewable energy and energy efficiency directly contributes to reducing greenhouse gas emissions. Installing a 9.60 MWp solar power plant in Panjappur and converting 41,615 street lights to LED technology are concrete steps towards decreasing the city's carbon footprint. The city has also installed roof-top solar in 206 buildings totalling 831 kWp.

Furthermore, the city's solid waste management improvements, including Bio-Mining of 2,58,263 tonne legacy waste in Ariyamangalam dump yard and the deployment of 100 Battery Operated Vehicles (BOVs) for waste collection, reflect mitigation and adaptation actions. By efficiently managing waste, Tiruchirappalli city has reduced methane emissions from waste decomposition, a potent greenhouse gas, while also adapting its waste management system to minimise pollution and enhance public health.

Tiruchirappalli has taken steps towards sustainable urban mobility by planning the development of a 24 km - Bus Rapid Transit (BRT) system[21] and an additional 68 km for Mass Transit in Trichy[22]. While still in the planning and proposal stage, this project aims to provide an efficient, reliable, and eco-friendly public transportation option, reducing reliance on private vehicles and thus lowering traffic congestion and vehicle emissions.

These comprehensive actions undertaken by Tiruchirappalli demonstrate a proactive approach in addressing climate change through both mitigation of its causes and adaptation to its impacts, setting a commendable example for urban climate resilience.

## 1.3 Trichy's Climate Vision

Tiruchirappalli City Corporation's Climate Action Plan charts a strategic path towards a net-zero future, emphasising resilience against climate change while having an equitable and sustainable urban environment. The Net-Zero CRCAP aims to transition Trichy into a city with net-zero emissions, addressing urgent challenges such as urban heat and flooding. This builds on the various projects and schemes already mentioned in the Tiruchirappalli District 2030 Vision Plan[23].

The Net-zero Climate Resilient City Action Plan for Tiruchirappalli delineates the comprehensive climate actions necessary to progress towards achieving net zero greenhouse gas emissions by 2070, aligning with the Government of India's commitment to a net zero future. This ambitious pathway aligns with and aims to surpass the goals and targets set by various national and Tamil Nadu state policies, missions, and programs dedicated to climate change mitigation.

Integrating blue-green infrastructure is central to TCC's approach, thereby enhancing the city's resilience and promoting the well-being of its residents. The plan underscores the importance of sustainable urban development, focusing on clean air, energy-efficient buildings, and renewable energy sources, aiming to minimise environmental impact and foster a circular economy.

Trichy's Net-zero Climate Resilient City Action Plan (Net-Zero CRCAP) aligns with Tamil Nadu's State Action Plan on Climate Change (SAPCC) and global initiatives like the Paris Agreement and Sustainable Development Goals (SDGs). It sets a benchmark in TN's journey towards net-zero emissions. The plan significantly reduces greenhouse gas emissions and enhances urban climate resilience, aiming for net-zero emissions by 2070. It promotes climate-resilient urban planning and infrastructure development, emphasising the necessity of sustainable practices across all urban development sectors.

[21] Corporation draws up long-term plan for BRTS - The Hindu. Accessed Dec 2023.

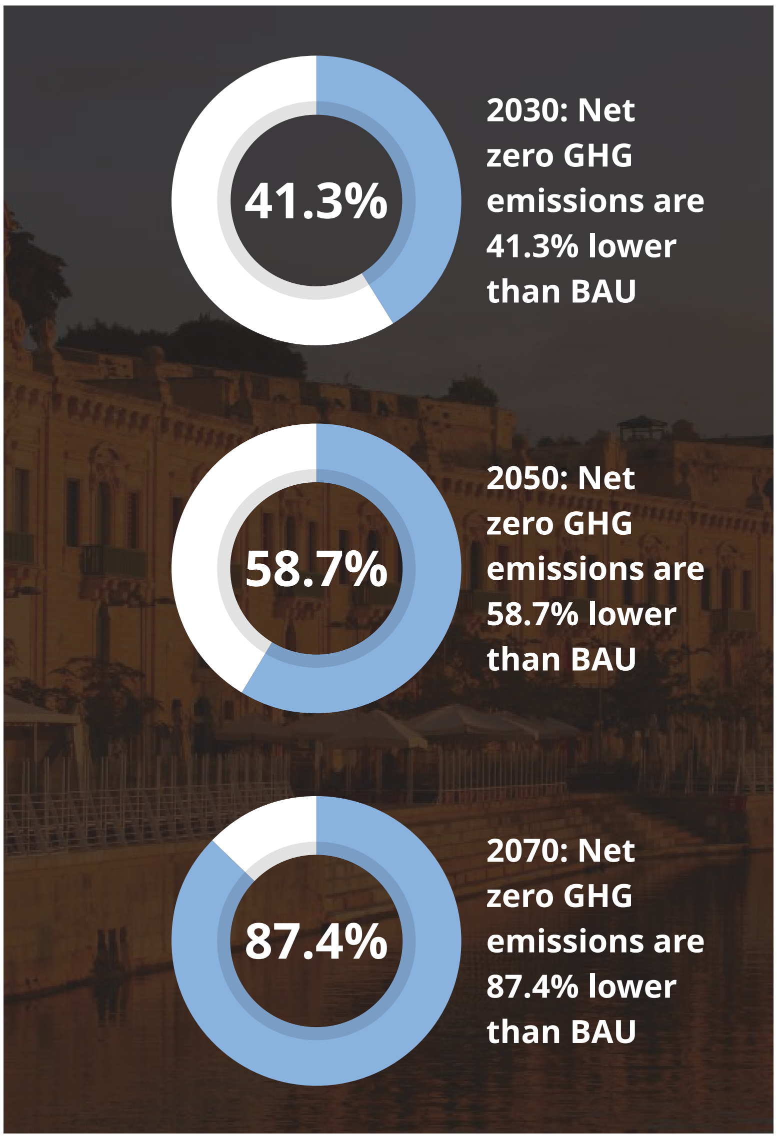
[22] Comprehensive Mobility Plan for Tiruchirappalli Local Planning Area. Accessed Nov 2023.

[23] Tiruchirappalli District 2030 Vision Plan. Accessed Feb 2024.

**Tiruchirappalli's Vision for a Net-Zero Climate Resilient Future:** Trichy is embarking on a visionary course toward environmental sustainability, aiming for net-zero emissions by 2070, committing to significant reductions in greenhouse gasses, strengthening urban resilience, and focusing on integrating sustainable practices across all development sectors to achieve a transformative climate future.

**Mitigation Targets**

The Net Zero Pathway aims to reduce the emissions in the horizon years compared to BAU by:




**Adaptation Goals**

To reduce the impact of heat stress and urban flooding on urban infrastructure and citizens, particularly vulnerable communities, by enhancing their capacities, build climate resilient infrastructure and respond successfully to climate change.

## 1.4 Net-zero Climate Resilient Cities Action Planning Methodology

TCC has adopted the "Net-zero ClimateResilientCities Action Planning Methodology (Net-zero CRC Action Planning Methodology)," a comprehensive 9-step process to build the city's adaptive capacity to climate change and mitigate emissions (detailed in Chapter 02).

The Net-zero Climate Resilient City Action Plan for Tiruchirappalli is developed based on insights from the Simplified ClimateResilientCITIES Plan, which helped TCC rapidly & efficiently assess its greenhouse gas (GHG) emissions, the state of its urban systems (Basket of Solutions), and recommend broader actions across these systems to address gaps in urban systems and initiate its climate journey.

This process includes rigorous vulnerability assessments, capacity building, and stakeholder engagement, ensuring a well-rounded and practical approach to climate action. Trichy's Climate Action Plan aims to enhance local resilience and sustainability by drawing on global best practices and expert insights. The emissions trajectory is aligned to GoI's 2070 net-neutrality commitment in COP 26[24].

The detailed methodology adopted has been described along with the milestones achieved by TCC in Chapter 02.

**This CRCAP sets a benchmark for urban local bodies within Tamil Nadu by being one of the first Urban Local Body (ULB) in TN in the 1-2 million population category to create a Net-zero Climate Resilient City Action Plan aligned to the Government of Tamil Nadu's goal of achieving net-zero before 2070.**

[24]India's NDC Commitment Press Release. Accessed Feb 2024.

*The factory releases a lot of smoke and smog into the sky*


02


# NET-ZERO CLIMATERESILIENTCITIES ACTION PLANNING METHODOLOGY & TRICHY'S PROGRESS

02

# NET-ZERO CLIMATE RESILIENT CITIES ACTION PLANNING METHODOLOGY & TRICHY'S PROGRESS

## 2.1 A Robust CRCAP Methodology based on Global Best Practices

TCC has adopted the ICLEI SA's "Net-zero ClimateResilientCities Action Planning Methodology (Net-zero CRC Action Planning Methodology)" in developing its Net-zero Climate Resilient City Action Plan, targeting net-zero emissions (aligned to GoI) by 2070 and also Government of Tamil Nadu's goal of achieving net-zero emissions well before 2070. This methodology offers a step-by-step guide for crafting plans that effectively combine climate change adaptation and mitigation, emphasising their interlinkages in achieving a sustainable and resilient future.

### 2.1.1 Methodology

The various steps of the "Net-zero ClimateResilientCities Action Planning Methodology (Net-zero CRC Action Planning Methodology)" are illustrated in figure 2.1.

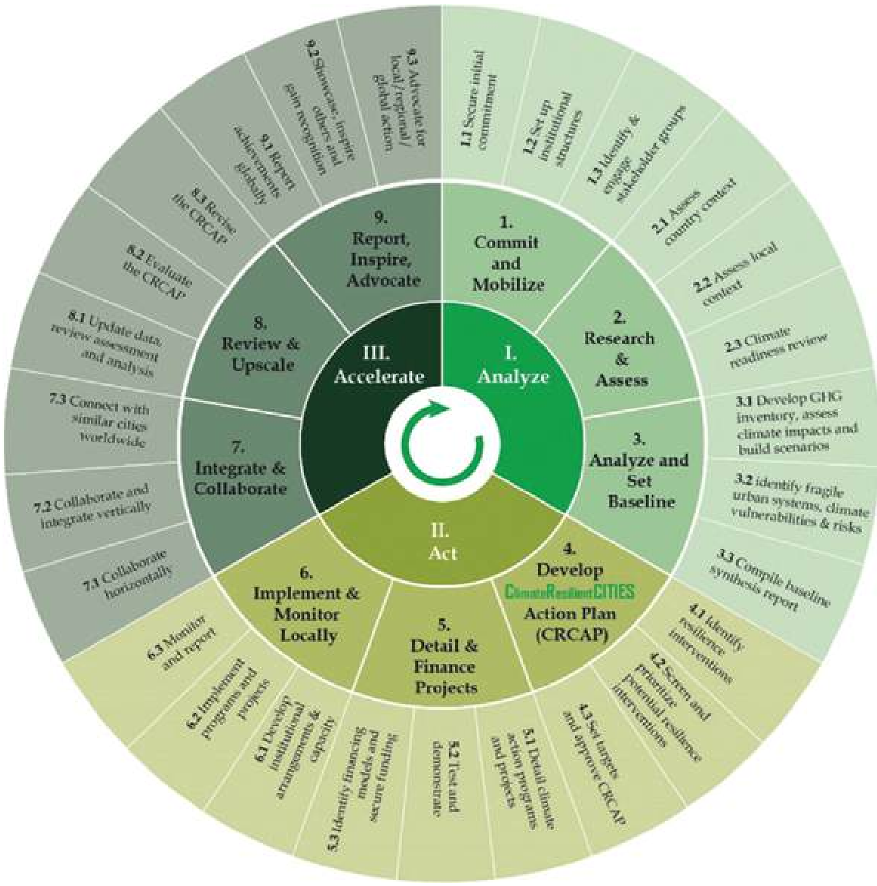



*Figure 2.1: Net Zero Climate-Resilient Cities Methodology*

The methodology is structured around a nine-step process, divided across three phases: Analyse, Act, and Accelerate, focusing on embedding climate resilience into urban development strategies.

## Analyse

The initial "Analyse" phase covers the first four steps, which involve gaining local government support, research, data analysis to establish baselines, and formulating an initial action plan. This phase sets the foundation by developing a deep understanding of local climate issues and preparing for effective action.

## Act

In the "Act" phase, steps five through six are dedicated to the practical execution of the Net-zero Climate Resilient City Action Plan. This includes the actual implementation of strategies, monitoring of progress, and overseeing the application of plans. These actions translate strategic plans into concrete measures, emphasizing a proactive and adaptive approach to building climate resilience.

## Accelerate

The concluding "Accelerate" phase, comprising steps seven to nine, focuses on sustaining and expanding the reach of climate actions. It involves collaboration with various governance levels, enhancing and possibly revising the Net-zero CRCAP to widen its scope, and reporting achievements to secure recognition and investment for scaling up initiatives.

This approach underscores the necessity for long-term sustainability and continuous improvement, as evidenced by the comprehensive "Climate Resilient City Action Plan – Towards a Net Zero Future" developed for Trichy, showcasing a committed and strategic approach to achieving climate resilience and sustainability.

## 2.2 Tiruchirapalli's Progress in Methodology

**The progress of TCC on the various steps of the methodology is indicated below:**

### Step 1: Commitment and Mobilization

**1.1 Secure Initial Commitment:** Trichy formalised its commitment to climate resilience by signing an MoU[1] with ICLEI-South Asia for the CapaCITIES project,that assisted in the development of this Net-zero CRCAP (Annexure B - Figure A1).

**1.2 Set up institutional structures:** Supported by the CapaCITIES project, Trichy set up a Climate Core Team[2] of nine officials led by the Commissioner to integrate climate action into its development strategy. The team meets at least once every quarter (Annexure B - Figure A2).

**1.3 Identify and engage stakeholder groups:** TCC formed a stakeholder committee[3] with 24 officials from key government departments to include input from CSOs, academia, and the private sector in various consultations (Annexure B—Figure A3).

### Step 2: Research and Assess

**2.1 Assess country context, 2.2 Assess local context, 2.3 Climate readiness review:** An extensive evaluation of Trichy's socioeconomic factors, demography, connectivity, land use, air quality, municipal budget and transport system was done to create a City Profile. This baselines the current ground conditions in the city. This is detailed in Chapter 3.

### Step 3: Analyse and Set a Baseline

#### 3.1 Develop GHG inventory, assess climate impacts and build scenarios

**a. Collecting Baseline Data in Trichy City:**

- Data on fuel, waste, transport, and electricity were collected with the Trichy City Corporation (TCC) and other external agencies, ensuring thorough coverage and addressing data gaps through further inquiries.
- Engagements with local stakeholders helped identify key energy usage and carbon emitters, with detailed analysis of all collected data to establish a comprehensive baseline.

**b. Developing GHG Emissions Inventory for Trichy City:**

- GPC-GHG emissions inventory from 2017-18 to 2022-23 was created. The baseline GHG inventory for this Net-zero CRCP is 2021-22. It was created using the Harmonized Emissions Analysis Tool plus (HEAT+) by GPC protocols.
- The comprehensive BASIC inventory included emissions from both community-wide activities and specific municipal operations. This will help benchmark the emissions reductions of all the mitigation actions in this net-zero CRCAP and also subsequent planned revisions. (Detailed in Chapter 6.)

**c. GHG Emissions Projection and Scenario Planning for Trichy City:**

- Energy consumption and GHG emissions projections were assessed for the short term (2030), medium term (2050), and long term (2070) to facilitate strategic planning for future years.
- Projections for municipal service energy consumption were based on population forecasts and existing/ future city planning initiatives.

[1]MoU Document - (Annexure B - Figure A1)

[2]Climate Core Committee - (Annexure B - Figure A2)

[3]Stakeholder Committee - (Annexure B—Figure A3)

- GHG emissions forecasting across sectors utilized ICLEI South Asia's Net Zero GHG Emissions Tool, considering socio-economic developments/factors.
- Specific GHG emissions reduction targets and priority mitigation strategies were identified for two scenarios: 'Progressive Action' and 'Net Zero Pathway,' aligning with ambitions and climate action objectives.

The Scenario planning aims to demonstrate how emission levels will change over the horizon years in different scenarios and intends to help identify an evidence-base for the levels of ambition and climate actions to achieve net zero goals. (Detailed in Chapter 7.)

- **BAU Projection:** This scenario illustrates GHG emissions levels under current climate action trajectories, assuming no additional reduction efforts beyond existing measures.
- **Progressive Action Scenario:** Reflecting increased levels of climate action at the city-scale compared to the BAU projection, this scenario considers national and state government policies and local conditions.
- **Net Zero Pathway:** Aligned with the Government of India's commitment to achieve net zero emissions by 2070, this scenario outlines the ambitious efforts required for Trichy City to transition towards meeting net-zero GHG emission targets. It incorporates and builds upon national and state government goals and targets.

### 3.2 Identify Fragile Urban Systems, Climate Vulnerabilities & Risks:

- A gap analysis for all the urban systems such as water, wastewater, stormwater, solid waste, transport, urban greenery, and emergency services against climate risks like urban flooding and high temperatures was conducted. (Detailed in Chapter 5.)
- Based on the historical climatic data like rainfall and temperature from IMD, the future trends are estimated. Based on this the vulnerability of the urban system is assessed.
- Identified vulnerable areas and populations within each urban system are identified. This will assist in planning targeted interventions at a later stage.
- The adaptive capacities of urban systems are determined with input from stakeholders.
- The risk assessments are conducted based on likelihood and impact, pinpointing specific climate risks across Trichy's wards to guide mitigation efforts.

### 3.3 Compile Baseline Synthesis Report:

Based on all the above information, a baseline report is created for the city.

## Step 4: Develop Net-zero Climate Resilient City Action Plan

The methodology and the strategies & actions for the climate action plan have been detailed in chapter 8 & 9.

- **4.1 Identify resilience intervention:** TCC has identified mitigation and adaptation measures, with considerations for their potential impacts, financial aspects, and implementation strategies.
- **4.2 Screen and prioritize potential resilience intervention:** Through a rigorous evaluation process, Trichy prioritized resilience measures for integration into the Net-zero CRCAP, assessing their feasibility and potential impact. Considerations like budget, scale, impact, duration, alignment with other policies and projects of state and national government have influenced the selection of these projects.
- **4.3 Set targets and approve CRCAP:** The Net-zero CRCAP is aligned to the goals and commitments of Government of India as part of its NDC for net-zero target by 2070 also Government of Tamil Nadu which has aimed to achieve net-zero well before 2070.

**The various steps undertaken so far by TCC in developing the Net-zero CRCAP is illustrated in figure 2.1.**

## Net-zero CRC Action Planning Methodology

### Step 1:Commitment and Mobilize

1.1 Secure initial commitment

1.2 Set up institutional structures

1.3 Identify & engage stakeholder groups

### Step 2: Research and Assess

2.1 Assess country context

2.2 Assess local context

2.3 Climate readiness review

### Step 3: Analyse and Set a Baseline

3.1 Develop GHG inventory, assess climate impacts and build scenarios

3.2 Identify Fragile Urban Systems, Vulnerabilities & Risks

3.3 Compile baseline systhesis report

### Step 4: Develop Net-zero Climate Resilient City Action Plan

4.1 Identify resilience intervention

4.2 Screen and prioritize potential resilience intervention

4.3 Set targets and approve CRCAP

### Next Steps

5. Detail & Finance Projects
6. Implement & monitor locally
7. Integrate and Collaborate
8. Review & Upscale
9. Report, Inspire, Advocate

TCC has so far completed till step 4 and the subsequent steps will be undertaken after further discussion with stakeholders.

**Towards Implementing the Climate Resilient City Action Plan - Towards a Net Zero Future:**

Having prepared this climate action plan, TCC is preparing to implement it. Guidance provided in the methodology will help TCC implement, monitor, scale-up, review and report on projects and actions identified in the CRCAP (steps 5 to 9 of the methodology). A gist of these steps is given below:

### Step 5: Detail & Finance Projects

- **5.1 Detail Climate Action programs and projects:** Establish timelines and identify financial models and funding sources for priority climate initiatives.
- **5.2 Test and demonstrate:** Develop and test pilot projects using innovative approaches to evaluate intervention effectiveness.
- **5.3 Identify financing model and secure funding:** Explore a variety of funding sources, including municipal budgets, grants, and private investments.

### Step 6: Implement & Monitor Locally

- **6.1 Develop institutional arrangements & capacity:** Build capacity and enhance the capabilities of city government staff.
- **6.2 Implement programs and projects:** Execute approved projects following established timelines and milestones.
- **6.3 Monitor and report:** Set up a comprehensive Monitoring and Evaluation (M&E) system, incorporating Measure, Report, Verify (MRV) processes to track progress and impacts.

## Step 7: Integrate and Collaborate

- **7.1 Collaborate horizontally:** Strengthen project sustainability and impact through collaboration with local and subnational governments.
- **7.2 Collaborate and integrate vertically:** Engage with higher levels of government to support policy frameworks and funding mechanisms.
- **7.3 Connect with similar cities worldwide:** Utilise global network memberships to exchange experiences and learn from other cities' climate efforts.

## Step 8: Review and Upscale

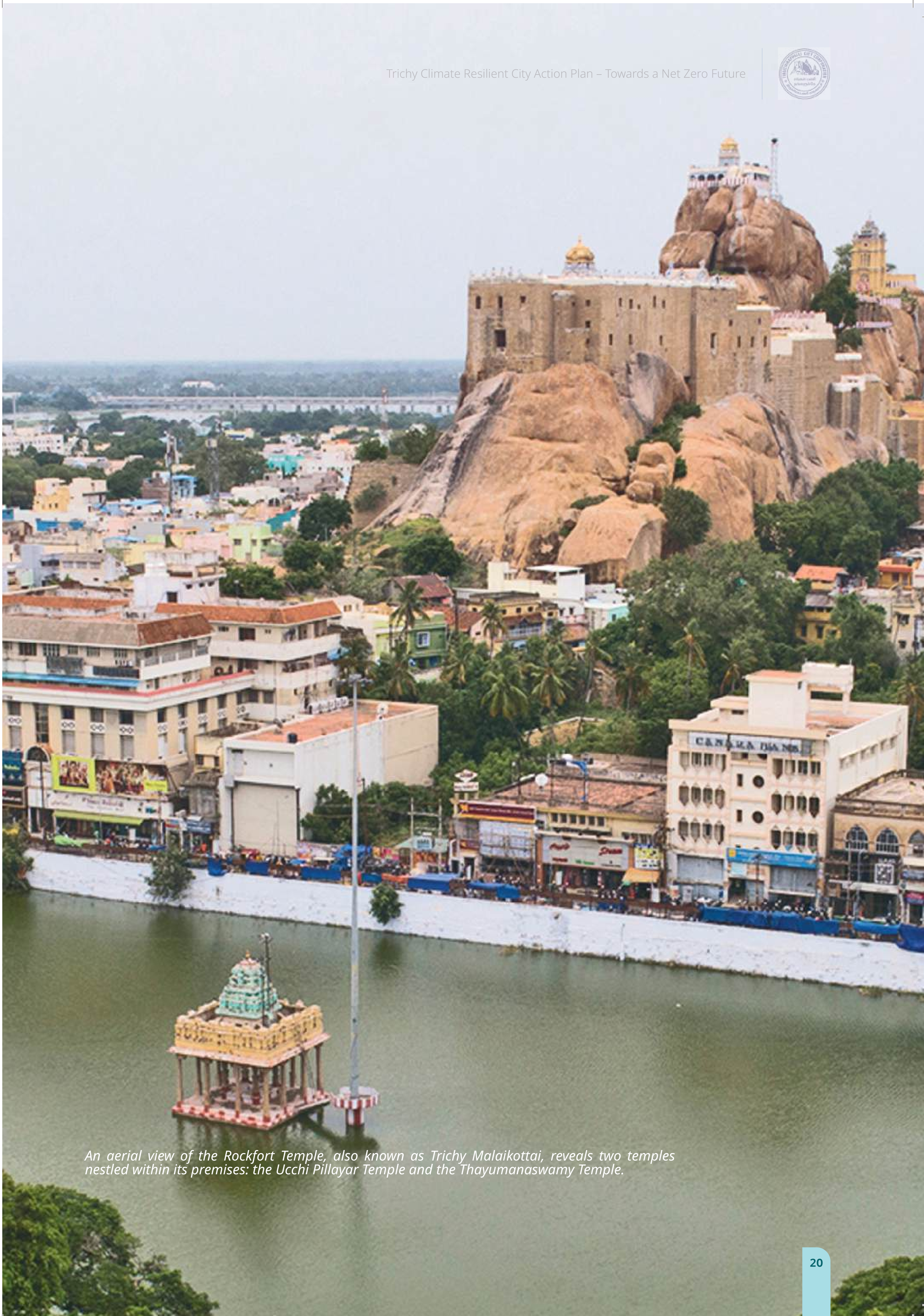
- **8.1 Update data, review assessment and analysis:** Regularly review baseline data and GHG emissions inventories to adjust climate strategies.
- **8.2 Evaluate the CRCAP:** Periodically review the CRCAP's implementation to identify new priorities and opportunities.
- **8.3 Revise the CRCAP:** Periodically update the plan to reflect new climate challenges, priorities, and technological advancements.

## Step 9: Report, Inspire, Advocate

- **9.1 Report achievements globally:** Report climate action achievements on national and global platforms, using tools like CDP for self-assessment and improvement.
- **9.2 Showcase, inspire others and gain recognition:** Engage in awards and recognition programs to secure support and explore partnerships, highlighting successes like the Tamil Nadu Urban Livability Framework ranking.
- **9.3 Advocate for local/global/regional action:** Promote Trichy's climate leadership on various platforms to advocate for comprehensive climate action worldwide.

**The Climate Core Committee will lead steps 5-9.**

The 'Methodology' chapter gives in detail the process adopted by TCC to create the Net-zero CRCAP. The next chapter (3), assesses Trichy's socioeconomic factors, demography, connectivity, land use, air quality, municipal budget and transport system. This gives an overall characteristic of the city's conditions.



*An aerial view of the Rockfort Temple, also known as Trichy Malaikottai, reveals two temples nestled within its premises: the Ucchi Pillayar Temple and the Thayumanaswamy Temple.*

# 03

# TIRUCHIRAPPALLI CITY PROFILE

03

# TIRUCHIRAPPALLI CITY PROFILE

## 3.1 Introduction

Situated along the Cauvery River, Tiruchirappalli, commonly known as Trichy, is Tamil Nadu's fourth-largest city by area (167.23 sq. km) and ranks fifth in population, with over 1.08 million residents as of 2021[1]. Initially established as a municipality on July 8, 1866, Tiruchirappalli was made a corporation on June 1, 1994, incorporating adjacent areas to accommodate its expansion.

Trichy is renowned for its temples and monuments, including the Rock Fort Temple and Sri Ranganathaswamy Temple, making it a key destination for travellers. The city also hosts major industries and suppliers, further establishing its economic significance.

Trichy's geography is marked by a flat terrain that is 78 meters above sea level, with the urban agglomeration covering 804.5 sq. km. The Cauvery River's flow divides the city into the southern Cantonment, the northern temples, and the central bazaar. The Cantonment hosts government and hospitality services, while the temples and the Rock Fort, surrounded by a bustling market, define the city's cultural and commercial centres. Hills like Golden Rock add to the city's diverse topography, with reserve forests along the Cauvery showcasing its natural beauty.

The Tiruchirappalli City Corporation encompasses the areas of Trichy, Srirangam, Golden Rock municipalities, 5 Town Panchayats, and 6 village panchayats, totalling 65 wards in 5 administrative zones over 167.23 sq. km. Given significant urban growth and expansion, a new comprehensive revised master plan has been notified for the period 2021-2041[2]. The area of the Master Plan has been increased from the existing 281.14 sq. km. to 804.55 sq. km. The boundaries of the existing TCCn, Lalgudi, and Thuvakudi municipalities, four Town Panchayats and 103 villages have been included in the Master Plan.

> "Trichy's geography is marked by a flat terrain that is 78 meters above sea level, with the urban agglomeration covering 804.5 sq. km. The Cauvery River's flow divides the city into the southern Cantonment, the northern temples, and the central bazaar.

[1]Note: The population of Trichy in the last Census in 2011 was 915,569

[2]Trichy Master Plan 2021-2041. Accessed Nov 2023.

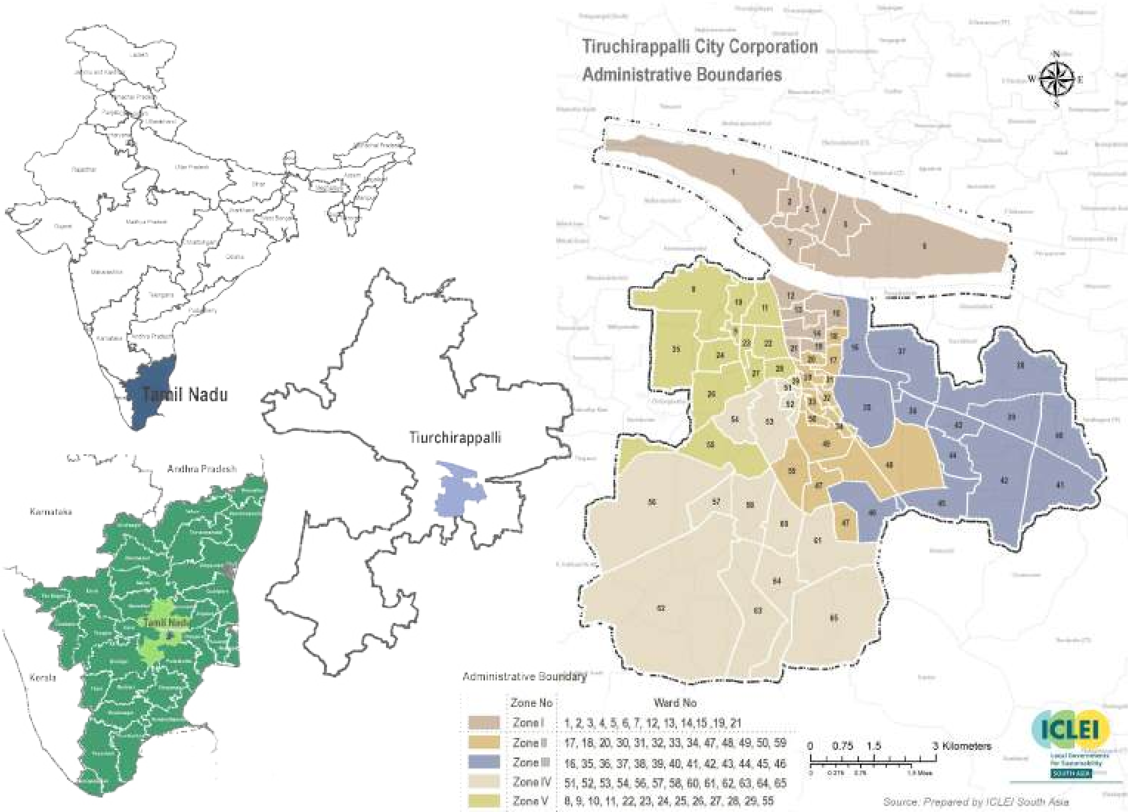



*Figure 3.1: Location map of Tiruchirappalli and ward map of TCC area.*
*Source: Tiruchirappalli City Corporation*

## 3.2 Connectivity

Tiruchirappalli is known for its excellent connectivity and is a crucial hub for transportation for intra state journeys within Tamil Nadu. It also is well-linked by air, rail, and road networks.

**Air Connectivity:** Tiruchirappalli International Airport[3] offers daily non-stop flights to several international destinations, including Singapore, Malaysia, the UAE, and Sri Lanka. Furthermore, major domestic airlines provide regular services to key Indian cities such as Delhi, Chennai, Bangalore, and Kochi, highlighting its importance as an aerial gateway.

**Rail Connectivity:** As the divisional headquarters of Southern Railways, Trichy has extensive rail links to other parts of India. It is well-connected to various cities in Tamil Nadu like Chennai, Kanyakumari, Madurai, Thanjavur, Rameshwaram, and Coimbatore, as well as major metropolitan areas across India, including Delhi, Kolkata, and Mumbai, ensuring robust rail connectivity.

**Road Connectivity:** Tiruchirappalli has an extensive and intricate road network, comprising five national highways, seven state highways, and a multitude of roads connecting to the rest of the district. The city's strategic placement is further underscored by its direct routes to the Chennai port via NH45 and to the Thoothukudi port, significantly enhancing the flow of both passengers and cargo. A map of the road network in Tiruchirappalli is listed in Annexure C - Figure C1.

This robust infrastructure positions Trichy as an intra-state transportation hub, ensuring seamless connectivity to major cities and tourist destinations such as Chennai, Coimbatore, Madurai, Ooty, Thanjavur, and Rameshwaram.

[3]Trichy International Airport Website. Accessed Dec 2023.

## 3.3 Demography

As of 2011 Census, TCC administrative area had a population of 0.92 million[4], with 0.45 million males and 0.46 females. The Tamil Nadu state government estimated the 2021 population of Tiruchirappalli[5] at 1.08 million[6]. Projections suggest a significant growth to approximately 1.86 million by 2070[7]. The population density was about 6,465 persons per sq.km in 2021.

Over the decades, growth rates were recorded at 11.45% for 1991-2001, 22.75% for 2001-2011, and 18.06% for 2011-2021. The city experienced a surge in migration and urbanisation between 2001-2011, attributed to affordable real estate for the working class and traders. However, migration has slowed post-2021 due to increased real estate costs and improved access to areas beyond the city limits. The number of households in TCC administrative areas (65 wards) is about 0.29 million households[8].

Area (2021)

**167.23**
sq.km

Population (2021)

**10,08,234**[6]
49.43% males
50.57% females
(census 2011)

Population Density (2021)

**6,465**
person per sq.km (increased from 5,474 person per sq.km in 2011)

Households (2021)

**283,040**
with average household size of 3.82)

Slum Population (2021)

**10,224**
(2,556 households in 262 notified slum areas)

### 3.3.1 Slum Population

In 2001, the number of people living in slums was about 0.16 million (21.24% of population). This reduced to 0.11 million (10.6%) across 262 slums by 2021. This reduction is attributed to the effective resettlement and housing strategies implemented by the Tamil Nadu Urban Habitat Development Board, focusing on providing essential infrastructure such as water, sewerage, and sanitation in these areas and also moving several sites outside the ULB limits. A map depicting all the notified and non-notified slums in the TCC boundary area is presented in Annexure C - Figure C2.

[4] Trichy City Corporation Population. Accessed Nov 2024.
[5] TCC Administrative Boundary
[6] Government of Tamil Nadu GO 152 for Population - Accessed July 2023.
[7] Note: A table of the historical population of TCC is presented in Annexure C - Table C1.
[8] Note: Current household size is 3.82

# 3.4 TCC Organization Structure & Municipal Budget

## 3.4.1 TCC Organization Structure

The corporation consists of Executive and Political Wings, with the former led by the Municipal Commissioner, who oversees the day-to-day administrative functions, project implementation, and service delivery, and the latter consisting of the elected council, headed by a mayor. The council has 65 councillors, each representing one of the city's wards (1-65).

The Executive wing is headed by the Commissioner, who serves as the chief executive authority and head of administration. He is supported by a team comprising the City Engineer, City Health Officer, Assistant Commissioners (for each of the 5 zones), and the departments of Personnel, Revenue, and Accounts, ensuring comprehensive oversight of city operations.

### Departmental Leadership & Functions:

- **Engineering Department:** Headed by the City Engineer, this department is responsible for the maintenance and development of infrastructure, including roads, water supply, drainage, sewerage systems, and street lighting.
- **Public Health Department:** Headed by the City Health Officer, this department focuses on solid waste management, registration of births and deaths, vaccinations, disease prevention, and the operation of public healthcare facilities.
- **Town Planning Department:** Headed by the Executive Engineer, this department focuses on issuing building licenses, implementing development plans, managing urban planning and building regulations, and overseeing land acquisition for the corporation. Assistant Commissioners in respective zones handle plan approvals and building permissions, contributing to urban development and revenue generation strategies.
- **Revenue and Accounts Department:** Headed by the Assistant Commissioner (Accounts and Revenue), this department manages financial aspects, including the maintenance of Revenue/Capital and Water Supply/Drainage Funds, ensuring the financial health and accountability of the corporation.

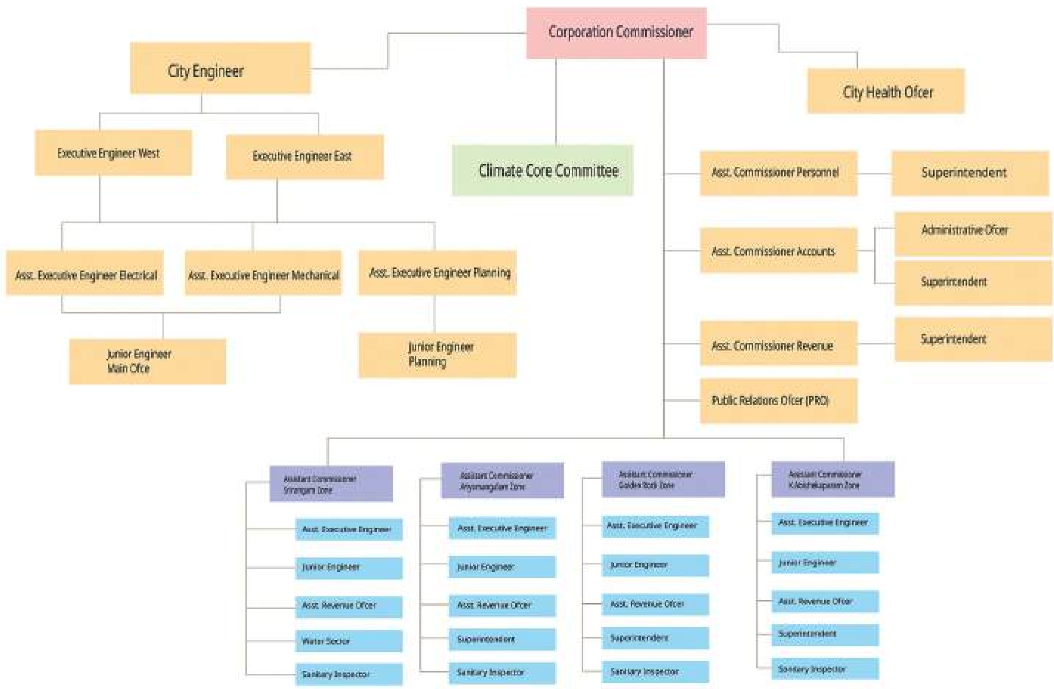



*Figure 3.2: Organization Structure of TCC.*

### 3.4.2 Municipal Budget

The budget of TCC has been increasing at the average rate of 14.83% every year for the last 4 years[9]. The budget trend of TCC is indicated in Figure 3. As in most years, the 2022-23 budget of TCC was a surplus budget.

*Table 3.1: Outlay, Budget & Expenditure of TCC over the last 5 years. (Only revised budget numbers are considered)*

| S. No. | Year | Outlay (in million INR) | Expenditure Budget (in million INR) | Climate Budget in % |
|---|---|---|---|---|
| 1 | 2018-19 | 4946.29 | 4856.04 | Not estimated |
| 2 | 2019-20 | 7679.48 | 8158.39 | |
| 3 | 2020-21 | 13354.70 | 13350.44 | |
| 4 | 2021-22 | 13122.65 | 13113.81 | |
| 5 | 2022-23 | 21401.15 | 21391.90 | |
| 6 | 2023-24 | 10267.00 | 10259.52 | 38.26 |

> Based on the analysis of the audited annual budget for the year 2022-23 it is estimated that 39.2% of the budget was utilised for projects on mitigation and adaptation. Detailed analysis table is presented in Annexure A - Table A1.

## 3.5 Economic Activities

Trichy has evolved into a significant engineering and fabrication hub in Tamil Nadu, especially with the establishment of Bharat Heavy Electricals Limited (BHEL) in 1963. This major power sector manufacturer has spurred the growth of numerous ancillary units, employing approximately 120,000 individuals in the surrounding industrial belt. The presence of other key industries such as Ordnance Factories (including HAPP and the Small Arms project), Golden Rock Locomotive Workshop, sugar and paper mills, and Dalmia Cement further cements Trichy's role as an industrial nucleus in the state.

[9] TCC Budget for Previous 5 Years. Accessed Feb 2024

Trichy is recognised as a crucial node in the proposed Tamil Nadu Defence Industrial Corridor (TNDIC), a project announced by the Government of India in 2019 under the "Aerospace and Defence Industrial Policy (ADIP)."

Beyond heavy industry, Trichy hosts flour mills and distilleries as significant contributors to its industrial landscape, with notable industrial activities extending to Thuvakudi, Thiruverumbur, and Mathur areas. The city also serves as a vibrant regional centre for commerce, with significant commercial activities focused in the inner-city areas around Main Guard Gate and Gandhi Market and the Rockfort Market area, known for specialised items like artificial diamonds and silverware.

Trichy is a notable tourist destination in Tamil Nadu, renowned for its historical significance and religious sites. The city experiences its peak tourist season from October to February, during which the weather is most conducive for exploring its rich cultural heritage. Notably, the winter months are ideal for visiting due to the pleasant weather, drawing a considerable number of tourists who come to see landmarks like the Rock Fort Temple and the Ranganathaswamy Temple in Srirangam, which is one of the largest temple complexes in India was honoured with the UNESCO Asia Pacific Award of Merit in 2017. This award was given in recognition of the temple's outstanding efforts in conserving cultural heritage, specifically for a significant renovation project that restored the temple's historic grandeur while preserving its architectural integrity using traditional materials and techniques.

## 3.6 Land Use

Trichy's residential areas have higher densities in historical cores areas of the city and lower densities in peripheral areas of the ULB. Key dense areas include the Fort, Puthur, Woraiyur, Tennur, and Bheema Nagar in the western zone, with newer developments like Thillainagar, Ramalinganagar, Sengulam, Kajamalai, and Ponmalai in the eastern and southern zones, indicating the city's ongoing expansion and the need for updated urban planning.

To better understand the trend of urbanisation within the ULB area a Land Use & Land Cover classification of Trichy was done by analysing Sentinel 2A data over 3 years of 2019, 2021 and 2023. (The detailed procedure is attached in Annexure C - Note 1). An improvised[10] methodology of the USGS 9-step classification was used to classify land into the land uses of built-up area, crop, road, tree, bare ground and water bodies. The LULC maps are available in Annexure C - Figure C3, C4, C5). The latest land-use land cover classification is indicated in figure 3.3.

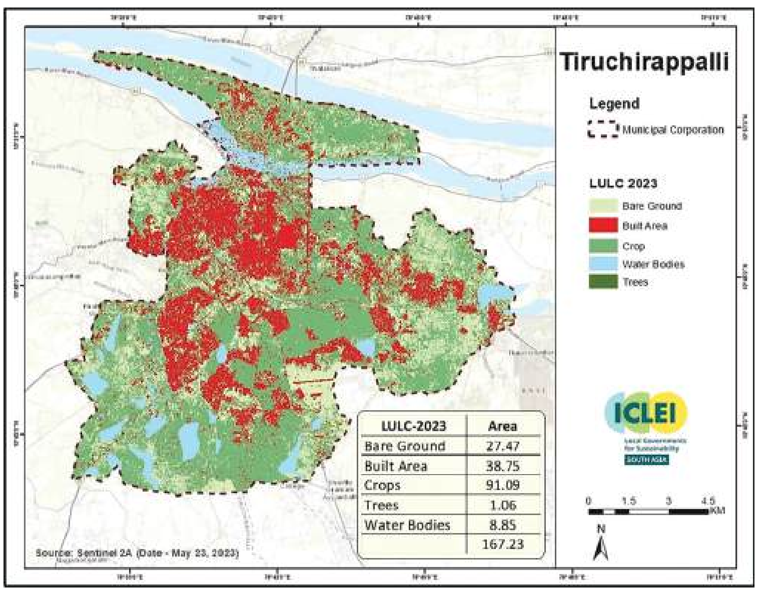



*Figure 3.3: LULC Map of Trichy 2023*

[10]Note: The improvised methodology refers to predefined layers like road network, tree cover, and water body layers subtracted from the classification. This also increases classification accuracy.

**Observations in Land Use Change**

Based on the assessment of LULC in Trichy for the years 2019, 2021 and 2023 as given in table 3.2, the following key observations are made:

- The built-up area in Trichy has increased by 1.19% between the years 2019 and 2023 which is an increase of 1.99 sq. km. The increased built-up area typically has reduced permeability of the surface and causes increased run-off and thereby flooding.
- The area under cropland and bare ground is coming down over the years. This indicates the reclassification of these land uses into residential and commercial lands (built-up)
- The area of water bodies remains unchanged throughout the analysis.
- The dense tree cover in the city has remained constant at 0.63% over the years.

*Table 3.2: Land use change across 2019, 2021, & 2023*

| S. No. | Land Use | 2019 | | 2021 | | 2023 | |
|---|---|---|---|---|---|---|---|
| | | Area (sq.km) | % of total area | Area (sq.km) | % of total area | Area (sq.km) | % of total area |
| 1 | **Built Area** | 36.76 | 21.98 | 37.98 | 22.71 | 38.75 | 23.17 |
| 2 | **Crop Land**[11] | 92.50 | 55.32 | 90.98 | 54.40 | 91.09 | 54.47 |
| 3 | **Tree** | 1.06 | 0.63 | 1.06 | 0.63 | 1.06 | 0.63 |
| 4 | **Bare Ground** | 28.05 | 16.78 | 28.35 | 16.95 | 27.47 | 16.43 |
| 5 | **Water Bodies** | 8.85 | 5.29 | 8.85 | 5.29 | 8.85 | 5.29 |
| | **Total Area** | **167.23** | | **167.23** | | **167.23** | |

> **"Trichy's residential areas have higher densities in historical cores areas of the city and lower densities in peripheral areas of the ULB.**

[11] Crop land includes unorganized shrublands, grasslands and grazing ground.

Based on GIS analysis the increase in the built-up is observed more in the south-west area of the city in the regions of K-Kallikudi and Panjapur located in wards 56 & 62 as indicated in figure 3.4.

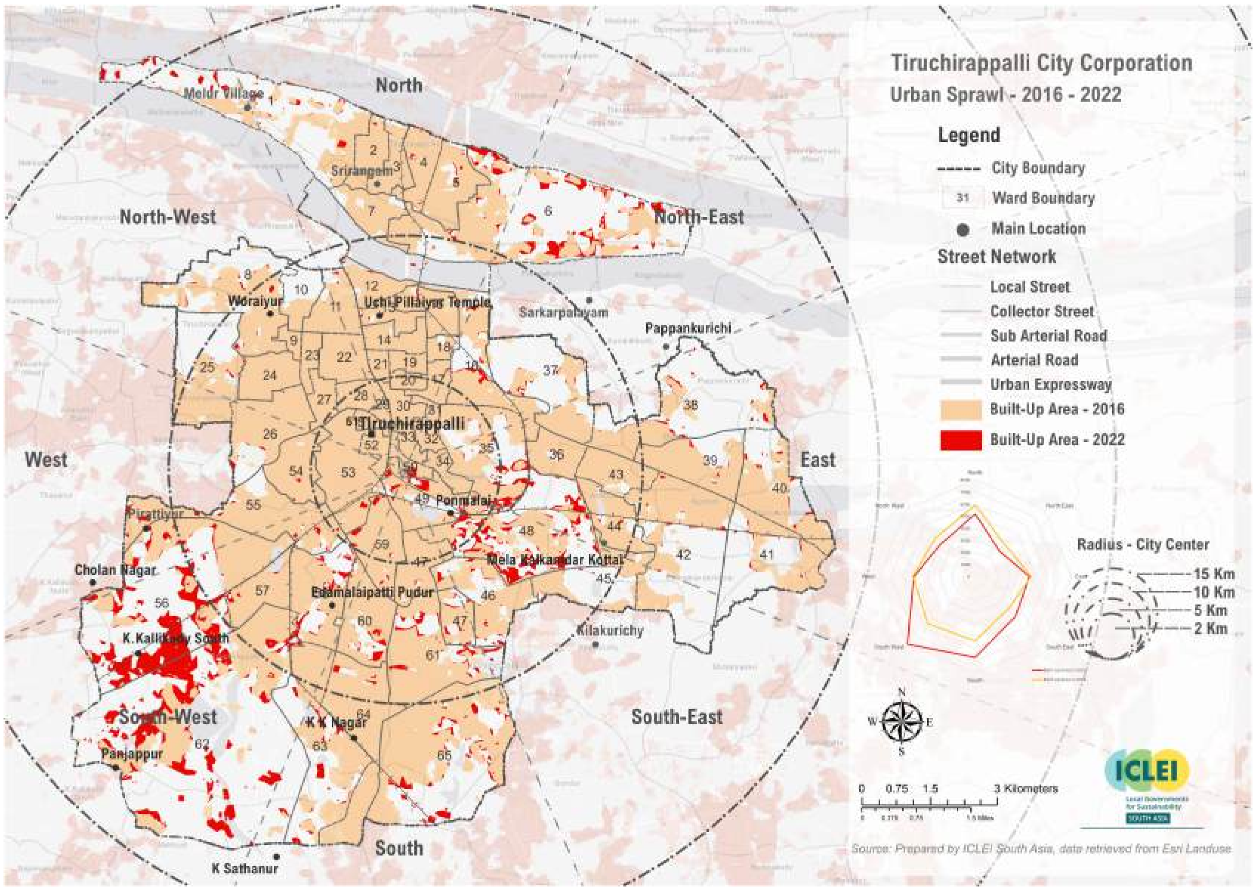



*Figure 3.4: Increase in Built-up area from 2016-2022*

## 3.7 Soil

The urban region Srirangam, situated north of the River Cauvery, lies on a fertile alluvial plain with a subtle west-to-east slope. This terrain is marked by distinct crystalline rock formations, notably the Trichy Rockfort and Golden Rock. The alluvial soil here is highly conducive to groundwater absorption, benefiting from its proximity to the river. This area is known for its excellent infiltration rates and natural recharge capabilities, drawing from river water, rainfall, and other hydrogeological attributes.

## 3.8 Climate

Trichy experiences a tropical wet and dry climate characterised by high temperatures and seasonal rainfall. The climate in Trichy varies throughout the year, with distinct wet and dry seasons.

**Temperature & Precipitation:** Based on the data available from IMD for the Tiruchirappalli region between 1981 - 2023, the hottest month is May, where temperatures can reach an average high of around 42.25°C (109.85°F), making it exceptionally warm. Conversely, the coldest month is December, with more moderate temperatures averaging around 24.8°C (76.6°F). Precipitation levels vary significantly over the year, with February being the driest month, receiving as little as 12 mm (0.5 inches) of rainfall. On the other hand, November is the wettest month, seeing up to 182 mm (7.2 inches) of rain, indicating a marked peak in rainfall during this time.

The wet season extends for about 3.6 months, from late August to early December, with a higher chance of rainfall during this period, particularly in October, which averages 12.8 days of rain. The drier season lasts for the remaining 8.4 months.

**Humidity & Sunshine[12]:** Based on the data available from IMD for the Tiruchirappalli region between 1981 - 2023, throughout the year, humidity and sunshine hours vary. June is noted for having the maximum daily sunshine hours, averaging about 11.01 hours per day. The weather patterns show a gradual increase in cloud cover from clearer conditions in January (53% clearer) to cloudier conditions by June (93% cloudier) before slightly decreasing towards the end of the year.

**Winds:** Due to Trichy's geographic location in southern India, the annual wind patterns show significant variation across different seasons. During the northeast monsoon season, from October to December, winds predominantly blow from the northeast, bringing heavy rainfall to the region. These winds can often be strong, averaging between 10 and 15 knots[13].

Conversely, in the southwest monsoon period, which spans from June to September, the winds generally shift to come from the southwest. This season also sees considerable wind activity, with speeds commonly ranging from 12 to 18 knots, contributing to the region's rainfall. A more detailed climate profile of Trichy is given in Chapter 5.

*Sand banks in Cauvery River*

[12]Difference between sunset and sunrise time.
[13]The knot (/nɒt/) is a unit of speed equal to one nautical mile per hour, exactly 1.852 km/h

## 3.9 Air Quality

Tiruchirappalli operates five manual Ambient Air Quality Monitoring Stations (AQMS) under the Central Pollution Control Board (CPCB). Recognised as a PM10 nonattainment city, it has developed an action plan as per CPCB directive for the National Clean Air Programme (NCAP).

Data from 2016 to 2023 indicate that the city's annual average PM10 concentration exceeded the National Ambient Air Quality Standards (NAAQS) limit of 60 µg/m^3 by almost 50% in three of those years, while PM2.5, NOx, and $SO_2$ levels remained within acceptable limits. Furthermore, during years with PM10 breaches, about 70% of days had PM10 levels above the CPCB threshold. Areas with consistently high PM10 levels have been marked as critical zones needing focused pollution control measures.

Based on the observed concentration, Tiruchirappalli falls under 'Moderate to Poor' in all the five stations. A source apportionment study was conducted in Tiruchirappalli by IIT Madras with the following findings:

- Source apportionment study reveals that the main contribution of PM10 is from the mineral dust containing silica due to the re-suspension of dust present in roads
- Presence of water-soluble organic matter and elemental carbon in all the stations indicate the that the main source of pollution is combustion of vehicles fuel and biomass
- The following are the outcome of the source contribution derived from receptor modelling for each station.
  - **Factor 1**: Vehicular Emission/Biomass Combustion, (53%)
  - **Factor 2**: Soil dust/Road Paved Dust (35%)
  - **Factor 3**: Industries/other source (12%)

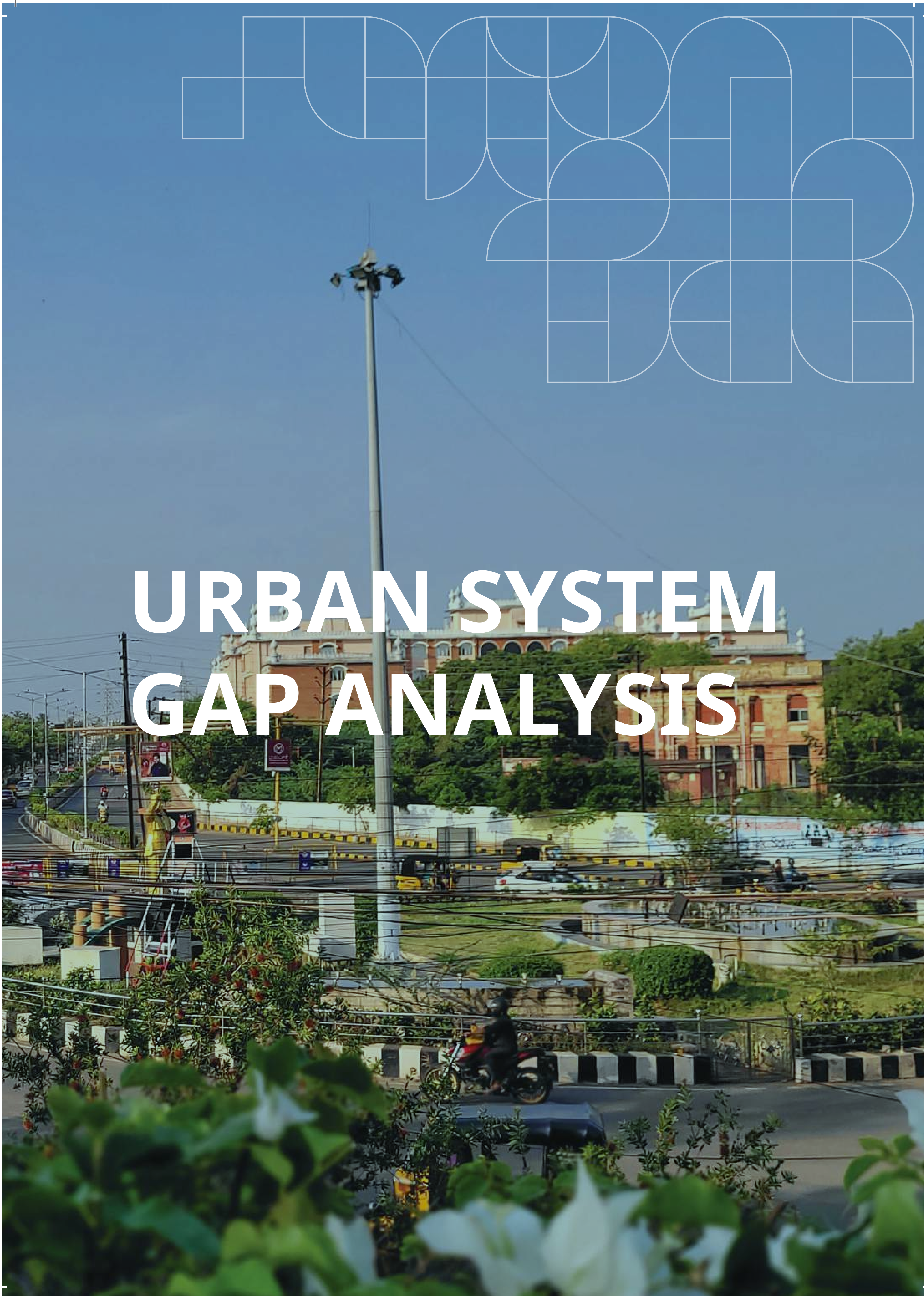
To reduce $PM^{10}$ TCC has undertaken several activities as part of its action plan under NCAP. These activities are cross-cutting across several line departments and agencies and the private sector. Some of these activities are as follows:

- Enhance urban transport by expanding CNG stations, electrifying public transport, and promoting e-rickshaws.
- Implement traffic improvements by reducing congestion, enforcing emission standards, and constructing bypasses to divert traffic from Tiruchirappalli.
- Manage environmental health by eliminating brick kilns near Tiruchirappalli, regulating construction waste management, and preventing open burning.
- Increase public awareness by engaging schools in educational programs about the health impacts of pollution and vehicle emissions.

The action plan does not quantify the outcome of these actions. Hence it is challenging to assess the gap. However, Trichy should consider accelerating these actions and also create an Air Quality Action Plan cell having stakeholders from other departments under the leadership of the Commissioner to monitor the progress on a monthly basis.

**The next chapter discusses the gap in the various urban systems like water supply, wastewater, solid waste, transport, urban green and biodiversity, and services like disaster management and emergency systems in the TCC administrative area. The chapter also indicates the gap and issues impacting these urban systems.**

# 04


URBAN SYSTEM
GAP ANALYSIS

04

# URBAN SYSTEM GAP ANALYSIS

## 4.1 Introduction

Tiruchirappalli is poised for significant urban expansion, signalling a heightened demand for municipal services and infrastructure. The city's population has surged from 0.75 million in 2001 to 1.08 million in 2021. Future projections, based on the UN World Urbanization Prospect[1] (based on Shared Socio-economic Pathways[2] method), forecast Tiruchirapalli's population to increase to 1.32 million by 2030, 1.63 million by 2050, and 1.86 million by 2070-effectively doubling the current count. This anticipated population growth will significantly pressure the city's environmental resources and urban systems.

The various urban systems of Tiruchirapalli like Water supply, wastewater, solid waste, transport, urban green and biodiversity, and services like disaster management and emergency systems that are already undergoing significant stress will have to cope up with significant additional infrastructure demand and this will only be exacerbated by the impact of climate change. The subsequent sections indicate the existing status and the gap in the various urban systems in Tiruchirapalli.

**The responsibility for managing water supply within the TCC administrative area is with the Engineering Department. TWAD manages the water till the pumping stage at the supply wells.**

## 4.2 Water Supply System

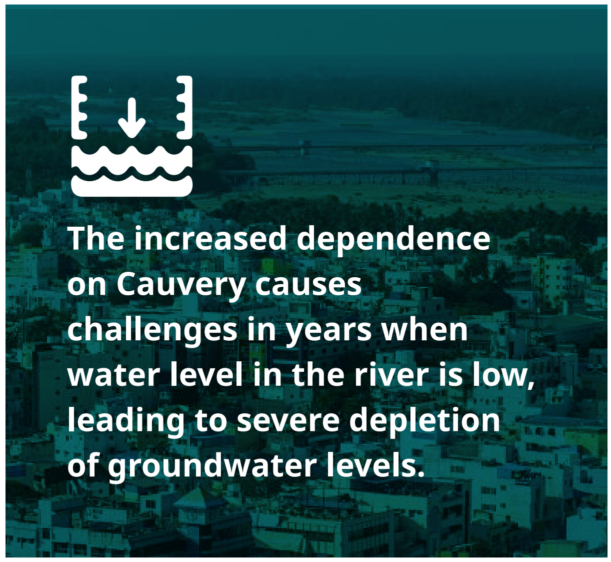
River Cauvery & Coleroon are the major source of water supply in Tiruchirappalli City Corporation administrative area. 98% of water is pumped from supply wells[3] that are recharged/fed by these rivers. At present, 132 MLD of water is pumped from 10 pumping stations managed between PWD & TWAD[4] (listed in Table 4.1). Subsequently, it undergoes chlorination before distribution.

Currently 132.00 MLD[5] being pumped from ten pumping stations. This water is then distributed through two intermediate sumps and 137 Over Head Tanks (OHTs) located within the Corporation limits.

[1] UN World Urbanization Prospects 2018. Accessed Sep 2023.
[2] Shared Socio-Economic Pathways Poster. Accessed Feb 2024.
[3] The recharge wells are situated in the banks of River Cauvery & Coleroon.
[4] 7 managed by WRD and 3 by TWAD.
[5] 203 MLD is design capacity

These OHTs collectively have an installed capacity of 66.58 million litres[6] . Additionally, 2.77 MLD of water is sourced from 1662 hand pumps, and 98 bore wells equipped with power pumps[7] . The total water supplied to the city is about 134.77 MLD per day. There is minimal dependence on private borewells.

The entire water supply scheme is overseen and managed by a Supervisory Control and Data Acquisition (SCADA) system. This system is installed at 97 (out of 137) OHTs, pumping stations, and intermediate sumps, allowing for real-time monitoring of the water supply system from the Integrated Command and Control Center (ICCC) located in the Corporation's Main office.



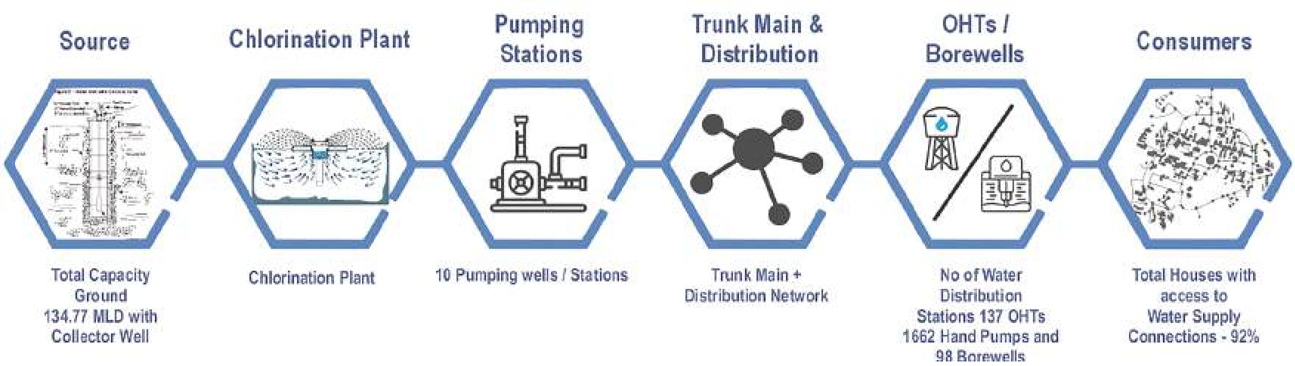




*Table 4.1: Headworks and Schemes for Water Supply in Trichy*

*Source: Trichy City Corporation*

| S .No | Water Supply Source Points | Output (Quantity in MLD) | Source |
|---|---|---|---|
| 1 | Main Pumping Stations | 14 | River Cauvery |
| 2 | Turbine Pumping Station | 12 | River Cauvery |
| 3 | Collector Well Periyar Nagar Pumping Stations | 25 | River Cauvery |
| 4 | Pirattiyur Pumping Stations (TWAD) | 4 | River Cauvery |
| 5 | Common sump Pumping Station | 38.33 | River Coleroon |
| 6 | Collector Well III Pumping Station | 18 | River Coleroon |
| 7 | Alavanthar Padithurai Pumping Station | 12 | River Coleroon |
| 8 | Thiruverumbur Pumping Station (TWAD) | 4.62 | River Coleroon |
| 9 | Ayyalamman Padithurai Pumping Station (TWAD) | 3.5 | River Cauvery |
| 10 | Puthiapuram Pumping Station | 0.55 | River Cauvery |

[6]Note: These OHTs are filled upto twice a day and HHs in some regions are served directly from the intermediate sumps.
[7]Belonging to TCC

Piped water supply is available/accessible to ~92% of the households. As on 2021-22, the total number of households with access to piped water supply was about 261954[8] .

### Tanker Supply

In areas in the periphery of the city and newly added areas like ward 61-65, where access to piped water infrastructure is limited or non-existent, the municipal corporation steps in to provide water via tanker trucks. This service ensures that all residents, including those living in both authorized and unauthorized slums, receive water. The combination of piped water and tanker deliveries, supplemented by non-potable[9] groundwater from bore wells, open wells, and hand pumps, is vital. This groundwater, primarily used for non-drinking purposes, is crucial in peripheral and slum areas. Moreover, private water tankers supplement the municipal supply, offering potable and non-potable water to meet the varied needs of commercial, institutional, and residential sectors throughout the city.

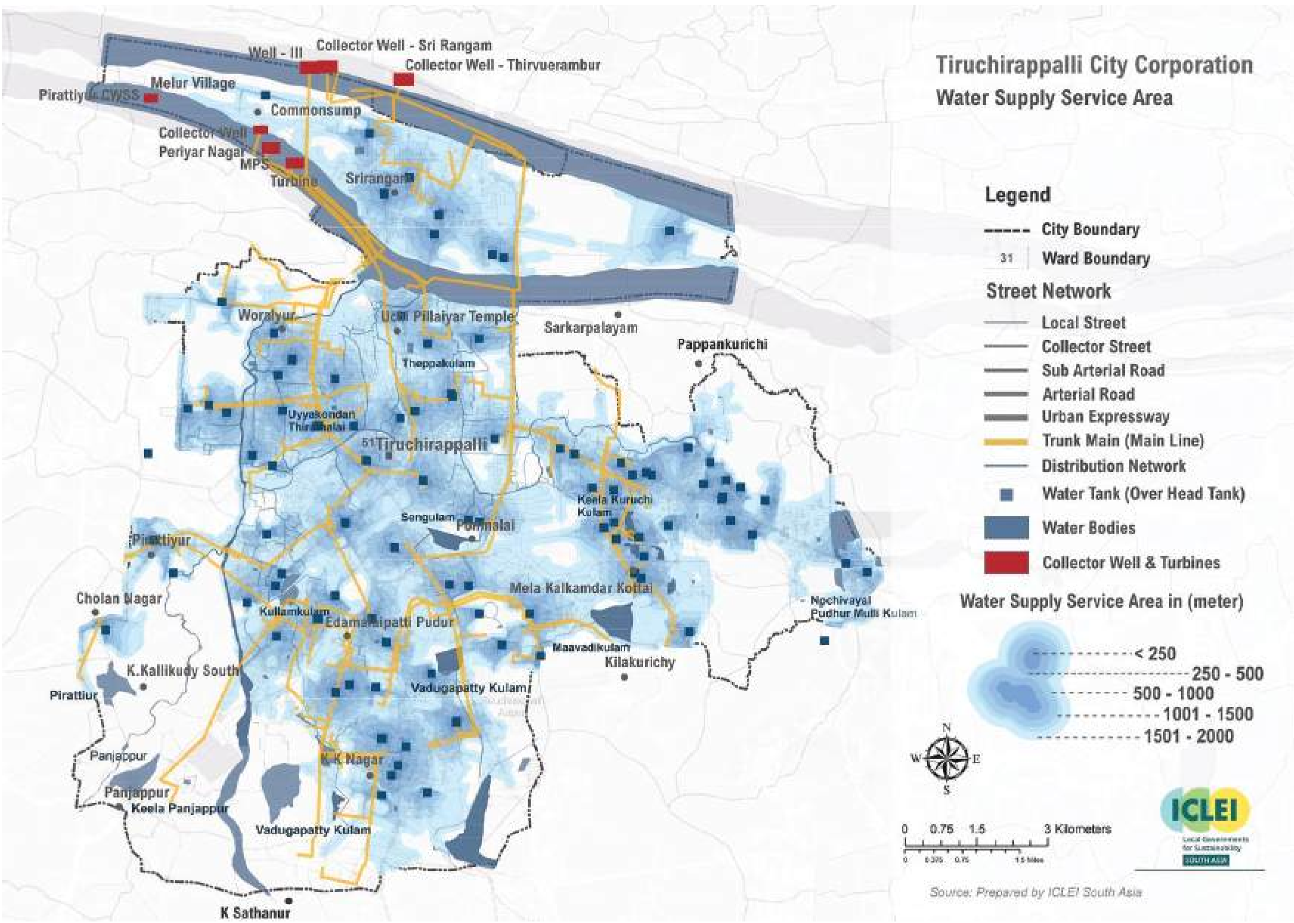



*Figure 4.1: Water Supply Service Area in Trichy*

*Source: Trichy City Corporation*

Note: Only SCADA connected OHTs are mapped

[8]Note: Single House Piped Connections: 128736, Huts & Slums: 45998, Multi-Kitchen Apartments: 87220.

[9]Note: Used for non drinking purposes like toilets, washing etc.

### 4.2.1 Status of Ground Water

Tiruchirappalli City's groundwater levels fluctuate seasonally, dropping to 14 meters (avg) pre-monsoon and potentially recovering post-monsoon. Long-term trends show declining levels due to inadequate rainfall and high extraction for urban needs. Both pre & post-monsoon GL levels have been dropping over the years (GL levels from 2013-2021 are detailed in Annexure D - Table D1 & Figure D3). The Central Ground Water Board classifies Tiruchirappalli as semi-critical, with groundwater usage at 79% of the 725.60 Million Cubic Meter (MCM) available[10] resources.

### 4.2.2 Water Treatment

The water drawn from the supply wells surpass the quality prescribed by CPCB & IS[11], hence water is directly chlorinated and supplied directly.

**The service level improvement plan developed under the 15th Finance Commission has targeted to achieve water supplied level from 124.29lpcd in 2020-21 to 135 lpcd by 2024-25.**

### 4.2.3 Distribution Network

The city's water distribution network spans pumping mains of 263.8 km and distribution mains of 1069.4 km.

### 4.2.4 Service Level Benchmark

*Table 4.2: Service Level Benchmark*
*Source: Trichy City Corporation*

| S .No | Performance Indicator | TCC Levels | Benchmark | Gap/Comments/ Remark |
|---|---|---|---|---|
| 1 | Coverage of water supply | 100% (92% is piped supply and rest i via public pipes, lorries) | 100% | 8% in piped network |
| 2 | Per capita water supply (lpcd) | 124.29 | 150 | 25.71 lpcd |
| 3 | Extent of NRW | upto 31% | 15% | 16% |
| 4 | Continuity of water supply | 10-15 min - 12 hours [12] | 24 hours | upto 23 hours 45 minutes |
| 5 | Efficiency in redressal of customer complaints | 84% | 80% | Above benchmark |
| 6 | Efficiency in the collection of water supply-related charges | 5% improvement YoY which is currently 55% (2021-22) | 90% | 35% |

[10]Note: A significant part of the drawdown is near the supply wells
[11]Water Quality Samples & Standards. Accessed Mar 2024.
[12]Note: In locations where OHTs are available upto 12 hours of supply is observed but in some places water pressure is high only for 10-15 minutes and such locations in spite of having piped supply depend on public pipes.

### 4.2.5 Issues & Gaps

- The current status mentioned in SLB indicated in section 4.2.4 indicates that the supply side needs augmentation to achieve target supply capacity.
- Water loss stands at 10% in transmission and 21% in distribution, necessitating leak detection and NRW surveys to enhance efficiency.
- Even though water meters are provided, tariffs in some areas are collected on a flat rate basis.
- The city's reliance on groundwater for 134.77 MLD of its water supply, without effective recharge systems, has led to a significant depletion, highlighting urgent sustainability challenges.
- Water supply varies by area, with 3.5 hours daily on average, extending up to 12 hours near OHTs and as little as 10-15 minutes in remote areas[13]. This is significantly lower than the guidelines issued by CPHEEO & MouHA.
- Policy challenges include the absence of a statewide Ground Water Act to oversee groundwater resources. The Tamil Nadu Groundwater (Development and Management) Act, 2003 does not apply to wells sunk before 2003 and also the enforcement and monitoring mechanism of the said act must be strengthened to check compliance.
- The Tiruchirappalli City Corporation (TCC) encounters challenges in supplying water from the Cauvery River during periods of low flow. The water table near the supply wells declines to 15 meters due to extensive water extraction from multiple schemes tapping the same source.
- Extraction units should be metered and monitored regularly with respect to the availability of ground water and monsoon conditions.
- The city administration delivers 132 MLD of water sourced from rivers[14], and an additional 2.77 via borewells targeting an average supply of 124 liters per capita per day (lpcd)[15]. However, the actual supply received at the consumer end is 92.4 lpcd (Currently, residents of wards 1 to 60 receive 102 liters per capita per day (lpcd), while those in the newly added areas (wards 61-65) receive 70 lpcd.).

**As per MoUHA guidelines[16] cities with 1 million+ population should ensure a supply of 150 lpcd (At NRW of 15%).**

**The current supply of 134.77 MLD per day translates to about 124 lpcd. However to meet the standards set by CPHEEO (of 150 lpcd) the supply should have been 162.6 MLD[17]. This demand is likely to rise to 198 MLD by 2030, 245 MLD by 2050 & 279 MLD by 2070[18] , assuming an NRW of 10% in 2070.**

**Given the reliance of the local water supply on supply wells drawing from the Cauvery and Coleroon rivers, the Trichy City Corporation (TCC) faces significant risks during periods of insufficient rainfall. A failed monsoon can drastically reduce river flows, stressing these vital water resources. To mitigate potential water shortages and enhance the resilience of the water supply system, TCC must develop a comprehensive water-resilient strategy. This strategy should include utilising existing water bodies more efficiently and increasing storage capacity.**

[13] Areas away from OHT's or pumping stations.
[14] Note: Water sourced from Supply wells in the banks of the river
[15] Non-Revenue Water (NRW), which was reported at 31% in 2020-21, is excluded.
[16] MoUHA Guidelines for 24/7 Water Supply. Accessed Feb 2024.
[17] Assuming an NRW of 15% instead of current 31% to achieve 150 lpcd supply/capita
[18] ICLEI South Asia estimates for service level demand projections which are based on future population growth. Population growth has been forecasted by adapting UNFCCC's Shared Socio-economic Pathways methodology to suit the Indian cities' urbanisation context.

### 4.2.6 Proposed Projects

TCC has proposed several projects that would improve its water supply and improve urban livability. Some of these projects and actions are:

1. Proposed 24/7 Water Supply distribution under TNCRUDP - it also gives an opportunity to reduce NRW as 'leak detection arrest' is expected to be a precursor activity. This also reduces the dependence on transport emission from lorries. The proposed water supply will also give an opportunity to migrate the pumping motors to be more energy efficient motors. It also enhances water resilience.
2. KfW funded 'Combined Water Supply Scheme' for augmentation of supply in the newly added areas at INR 21.6 million under annuity model paid to TWAD Board with an overall budget of INR 637 million. This will help increase the per capita water supply to above 135 lpcd and also provide energy efficient pumps.
3. Construction of Master Balance Reservoirs at the cost of INR 500 million under capital funding - This intervention will ensure stability in supply across the leaner months.

## 4.3 Wastewater Management System

**The responsibility for managing waste water treatment within the TCC administrative area is with the Engineering Department of TCC.**

Approximately 66.54% of households in the city, equating to 0.19 out of 0.28 million households, are connected to STP via open drains. However, the current system is being migrated to an Underground Sewerage Scheme (UGSS) which is expected to be functional by 2025-26. This system is designed for collecting, conveying, and treating domestic wastewater. In the fiscal year 2021-22, Tiruchirappalli's total domestic wastewater generation was about 74.39 MLD.

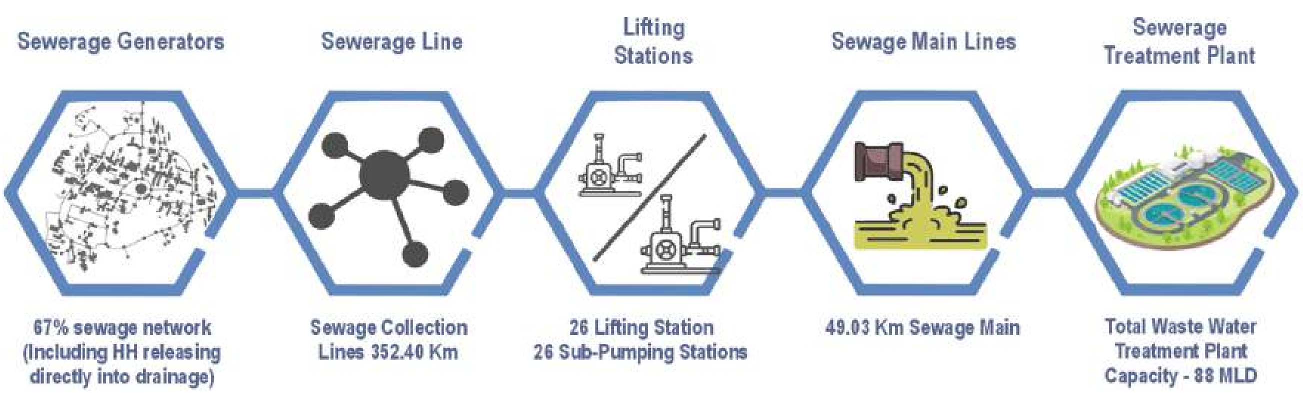



*Figure 4.2: Wastewater Treatment Cycle*
*Source: Trichy City Corporation*

### 4.3.1 Sewage Network

The city's sewerage infrastructure encompasses a network of 352.40 km of sewer lines and 49.03 km of sewer mains. This is collected and pumped to the STP at Panjappur using 26 lifting stations and 26 sub-pumping stations scattered throughout the city. This network facilitates wastewater transportation from connected households and establishments to various collection sumps. From there, the wastewater is pumped to the Sewage Treatment Plant (STP) for processing and treatment.

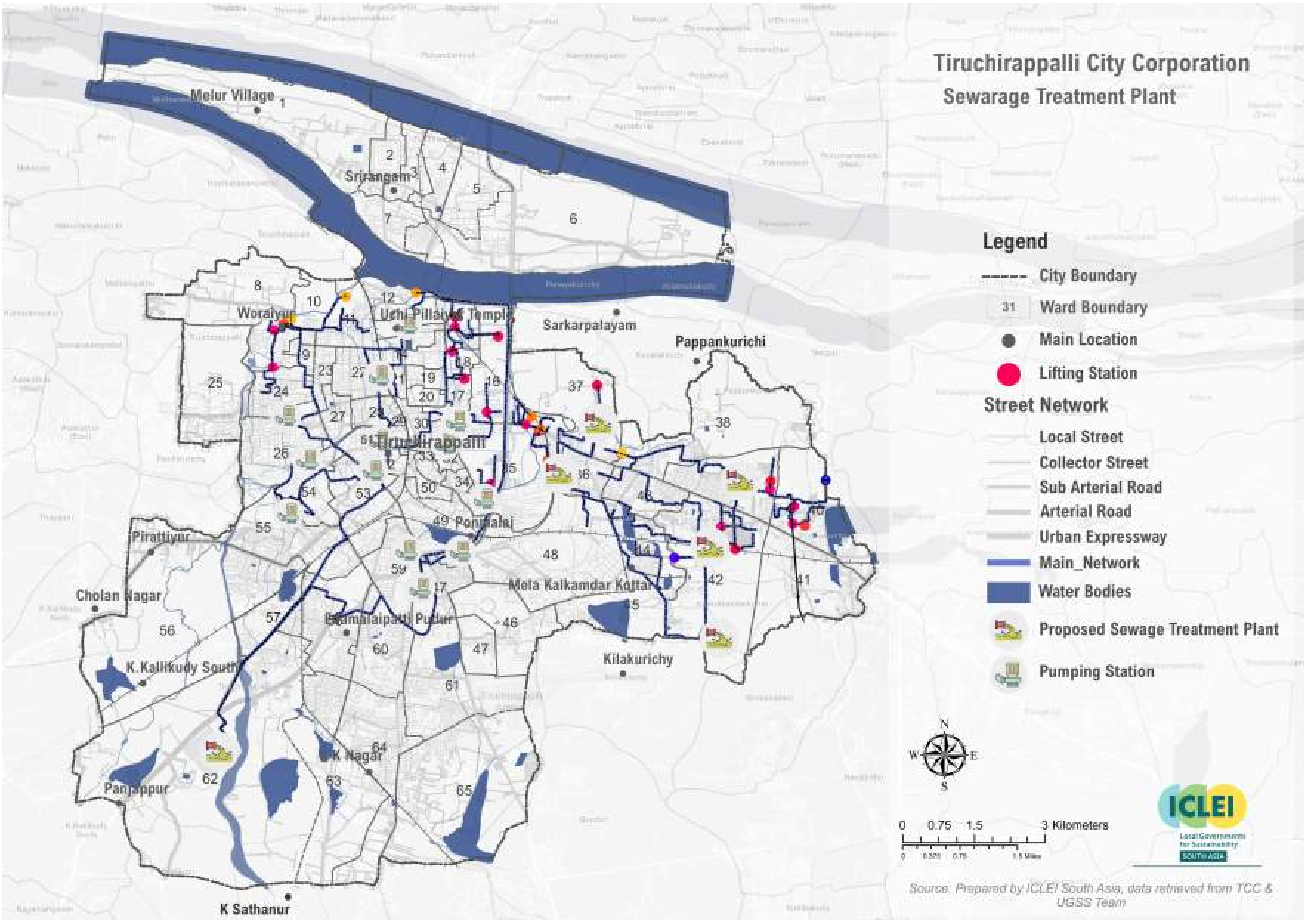



*Figure 4.3: Sewer Mains, Wastewater Pumping, Lifting and STP Infrastructure*
*Source: Trichy City Corporation*

### 4.3.2 Septage

The number of households depending solely on septic tanks in Tiruchirapalli in 2021-22 was about 73,592 households (26%[19] of total households).

### 4.3.3 Proposed Expansion

The City Corporation plans to enhance the Underground Sewerage System (UGSS) in targeted zones to improve citywide wastewater management. Expansion efforts include Ariyamangalam in the East Zone, focusing on areas east and north-east of the town center; Abishekapuram in the West Zone, covering the west and south; and areas from Golden Rock extending south and south-east in the South Zone. This strategic expansion aims to ensure comprehensive wastewater treatment across key areas of the city. The sewage coverage map of Trichy is indicated in Annexure D - Figure D1.

[19] Based on the assessment that only 53% of the overall 49% households in Tiruchirapalli are unconnected by drains and dependent solely on septage system. It is estimated that the balance 47% of the households discharge wastewater directly into drains in spite of having septic systems.

### 4.3.4 Service Level Benchmarks

*Table 4.3: Underground Sewerage System - Performance Indicators*
*Source: Analysis / Tiruchirappalli City Corporation 2021*

| S .No | Parameter | Service Level | Benchmark | GAP/Comment/ Remarks |
|---|---|---|---|---|
| 1 | Sewage Collection System Coverage | ~93%[20] | 100% | ~ 7% |
| 1a | Coverage Based on Road Length | 28.4%[21] | 95% (excluding extension areas not developed) | 66.6% gap Required augmentation |
| 1b | Coverage Based on Assessments / HSCs | 67% | 85% (min) | 18% gap Requires augmentation |
| 2 | Sewage Treatment & Disposal including septage | 93% | 100% | 7% gap Nominal |
| 3 | Revenue from Sewerage Charges / O&M Cost of UGSS (Ration) | 20% | >95 percent | min 75% Low. Uneconomical |

### 4.3.5 Gaps & Issues

- The current service levels mentioned in SLB in section 4.3.4 indicate a significant gap in the sewage collection and treatment in Trichy.
- Discharge of untreated wastewater into drains is a significant health challenge in Trichy including 49% of the houses with septic tanks.
- The total quantum of water supplied in the city is 134.77 MLD. At 31% NRW, the water supply effectively reaching consumers is 92.99 MLD. At 80% norm, the sewage treatment capacity required is about 74.39 MLD which is 15% lower than the current design capacity of 88 MLD. However based on projected water supply in horizon years, the sewage treatment capacity demand is expected to rise to 134.64 MLD by 2030, 166.6 MLD by 2050 and 200.88 MLD[22] by 2070.
- The UGSS coverage in the city is only 67%[23] . Hence there is a significant area of the city that still needs to be brought under UGSS scheme.
- The sewerage system's incomplete coverage is due to scattered urban development, especially in areas like Ariyamangalam and Ponmalai zones, reliance on traditional septic tank sanitation, and a lack of strict enforcement and limited finances.
- Sewage discharge is sometimes let into surface waters and low-lying areas poses severe risks to groundwater and surface water quality, presenting public health hazards.
- Some old city areas have sewage systems incapable of managing current loads, leading to blockages and overflows.
- The newly constructed Sewage Treatment Plant (STP), based on the Waste Stabilization Pond method, is designed for an effluent Biochemical Oxygen Demand (BOD) quality of 26 mg/l, though discharge into the Cauvery River requires a standard of 10 mg/l BOD.
- There is an opportunity to opt for anaerobic treatment systems in new STPs and thereby capture methane gas

[20]Including Septage Coverage
[21]Note: This is road length coverage including mains and sewer lines however is not based on Household coverage.
[22]Based on water supply projections mentioned in 4.2.5 with an NRW of 10% and 150 lpcd supply as per CPHEEO norms for 1 million+ cities.
[23]Note: This includes 53% of HH with septic tank that discharge directly into open drains going to STP

from wastewater and utilize it for energy generation. There is also a possibility to retrofit the existing STPs with secondary treatment technology to improve the current standards of the water quality to a non-hazardous level mandated by WHO after treatment.

### 4.3.6 Proposed Projects

TCC has proposed several projects to reduce emission in the wastewater sector. Some of these projects and actions are:

- The Proposed New Sewerage Treatment Plant with the Capacity of 100 MLD near Panjappur and Kilakurichy by Tamil Nadu Water Investment Company Ltd, Chennai (Hybrid Annuity Method) will provide new and more energy efficient treatment capability thereby reducing emissions. This will also provide treatment capacity as the city migrates from septic tank system to a sewerage network. This will increase the installed capacity in Trichy to 188 MLD[24] .
- Underground Drainage Work Phase IV ((Tamil Nadu Water Investment Company Ltd, Chennai) at the cost of INR 1957.3 Million. This will reduce the dependence of septic tank and pit latrine systems and migrate them to a sewer network system thereby reducing emissions.
- Installation of  Energy Efficiency Pumping Stations in 9 Nos and Lift stations in 14 Nos. These energy efficient motors will reduce emissions.

## 4.4 Storm Water Systems

Tiruchirappalli (managed by TCC) is located along the banks of the Cauvery and Kollidam Rivers and incorporates/has a hierarchical drainage system encompassing a mix of natural and man-made drains, along with water bodies. This setup efficiently channels surface runoff into the Cauvery and Kollidam Rivers. A network of channels and tanks forms the backbone of the city's stormwater drainage, functioning as the primary pathways for directing stormwater towards the rivers and other water bodies within the catchment area. The construction and maintenance of these stormwater drains are carried out by the City Corporation, ensuring the systematic management of stormwater throughout the city. TCC has stormwater drains for a length of 747 km which is about 52% of the road network length. Figure 4.5 indicates the location of water bodies and trunk lines of stormwater drains.


[24]Higher capacity is built to handle waste water from nearby municipalities.

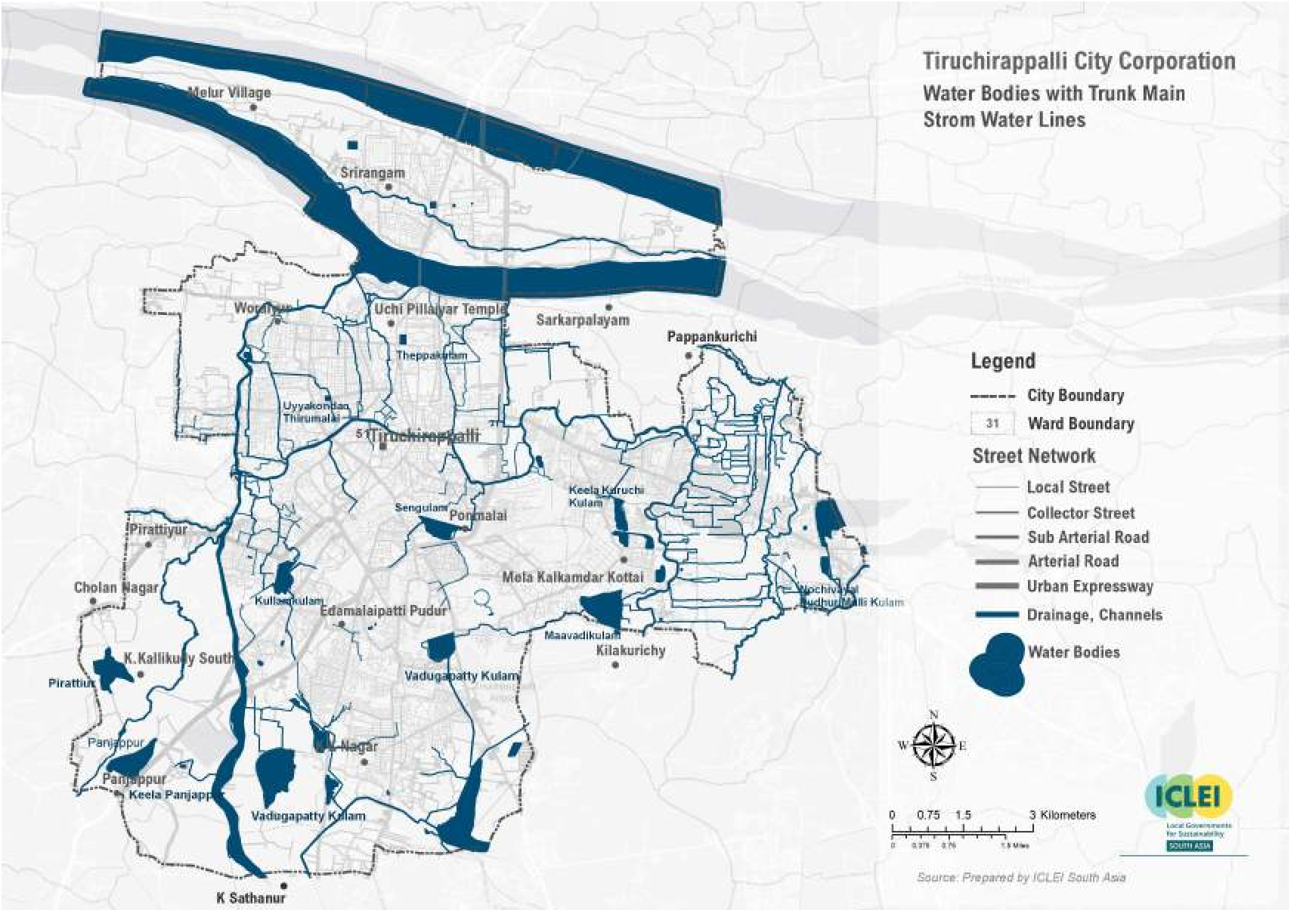
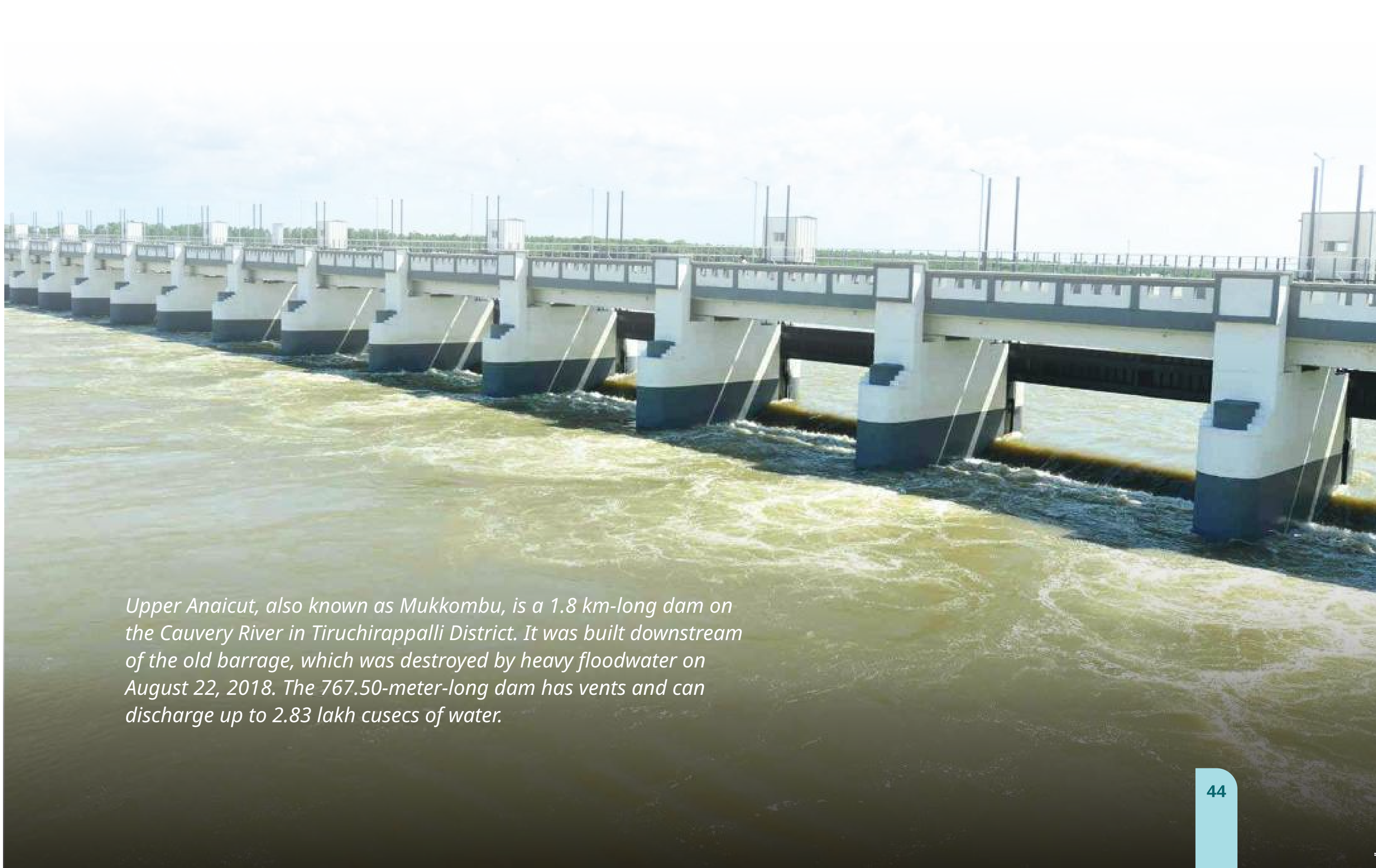



*Figure 4.4: Water Bodies & Trunk Storm Water Drains*
*Source: Trichy City Corporation*



*Upper Anaicut, also known as Mukkombu, is a 1.8 km-long dam on the Cauvery River in Tiruchirappalli District. It was built downstream of the old barrage, which was destroyed by heavy floodwater on August 22, 2018. The 767.50-meter-long dam has vents and can discharge up to 2.83 lakh cusecs of water.*

### 4.4.1 Drainage Zones

Tiruchirappalli's topography generally slopes from south to north, influencing the city's drainage strategy. The entire corporation area is segmented into four drainage zones (detailed in table 4.4) , each tailored to the topography, the level, and existing natural drains for optimal waste disposal. The stormwater drainage system in Tiruchirappalli is structured into three hierarchical levels: primary, secondary, and tertiary drains. The primary drains are the Cauvery and Kollidam Rivers, acting as the main conduits for stormwater. Secondary drains include natural channels or nallahs, characterized by their ability to handle discharges of up to 5 cubic meters per second. Tertiary drains consist of both open and closed roadside drains and unlined kutcha-type drains, facilitating the finer management of stormwater runoff.

*Table 4.4: Existing Drainage Zones - TCC*
*Source: Trichy City Corporation*

| S .No | Zone Boundary | Storm Water Carriers | Ultimate Carrier |
|---|---|---|---|
| 1 | Area between the Cauvery River and the Coleroon River | Distributaries of Malattar Channel | Coleroon River |
| 2 | Area between the Uyyakondan channel and the Cauvery River | Distributaries of Uyyakondan Channel | Cauvery River |
| 3 | Area Bounded between Corporation limit from North, South, West and Koraiyar River from East | Distributaries of New Kattalai High-Level Channel (NKHLC) | Koraiyar River |
| 4 | Area Bounded by Uyyakondan Channel, Koraiyar River and Corporation Limit from South East | Drainage Channels and Distributaries of NKHLC | Uyyakondan Channel & Koraiyar River |

The detailed schematic of the drainage system of the TCC administrative boundary is indicated in Annexure D - Figure D2.

### 4.4.2 Service Level Benchmarks

*Table 4.5: Storm Water Drain network*
*Source: Tiruchirappalli City Corporation 2021*

| S .No | Parameter | Service Level | Benchmark | GAP/Comment/ Remarks |
|---|---|---|---|---|
| 1 | Coverage by road length | 60.4% | 100%[25] | 39.6% |

[25]As per CPHEEO norms

### 4.4.3 Gaps & Issues

- Rapid population growth and surging land prices have led to expansion into low-lying areas without adequate drainage, increasing flood risks.
- In old city districts, the scarcity of space hampers the construction of roadside drainage systems.
- Many residences including residences with septic tanks discharge sewage directly into drains.
- Mechanical pumping structures and shutters need to be provided to reduce flooding when water in Cauvery is high and prevents flow.
- Dumping of waste, especially plastics, in drainage channels severely diminishes their capacity, while encroachments obstruct both water flow and maintenance efforts.
- The primary causes of seasonal flooding include encroachment, silt accumulation, and the improper disposal of solid waste.
- The increase in built-up area (impermeable surfaces) over the years without a comparable increase in water retaining structures has led to increased run-off, putting additional pressure on the city's water management infrastructure.
- Erosion, deforestation, and the resultant loss of topsoil lead to silt buildup in drainage channels, causing overflows and backflows in densely populated regions.
- The city's roads suffer considerable damage during monsoon seasons, attributed to the inadequacy of the stormwater drainage network. This situation is aggravated by long-neglected desilting needs.
- The water table is very high in Tiruchirapalli. This prevents groundwater recharge and prevents this as a strategy for improving groundwater table.
- The expected rise in population demands urgent enhancements to both the road network and stormwater drainage systems to mitigate future challenges.
- As per norms by CPHEEO, 100% of urban streets must have SWDs. In Trichy this is currently estimated to be about 60.4% or about 853.6 km.

### 4.4.4 Proposed Projects

TCC has proposed several projects to improve adaptation. Some of these projects and actions are:

**Desilting and Solid Waste Removal:**

- Desilting and removal of solid waste from existing storm water drainage channels (25 works) for INR 16.78 million to improve flow, prevent stagnation, and enhance micro drainage.
- Dredging and desilting the main trunk storm water drains for INR 21.27 million to increase carrying capacity and improve adaptation to rainfall events.

**New Constructions and Maintenance:**

- Construction of new stormwater drainage structures in low-lying areas like Rettai Vaikkal for INR 14.24 million to aid poor and vulnerable populations.
- Maintenance of stormwater drainage structures at INR 40.73 million to ensure functionality during high cloud burst events.
- TCC has allocated 50 lakhs per ward for constructing stormwater drainage systems totaling INR 325.00 million to enhance micro drainage capabilities.

**Water Storage and Flood Mitigation:**

- Restoration and Capacity Enhancement of Water Bodies: Restoration and desilting of water tanks (Kotappu Kulam, Thulashi Nagar Kulam, Health Colony Kulam, and Sundharadas Kulam) in parts of the city for INR 34.65 million to increase water holding capacity and prevent localized flooding.
- Restoration of a tank near Panjappur under the SuWaSeM scheme for INR 3.00 million to augment holding capacity, reduce flooding, and improve groundwater recharge.

## 4.5 Solid Waste Management

**The responsibility for managing solid waste (including C&D waste) within the Tiruchirappalli City Corporation (TCC) administrative area is with the Engineering Department of TCC**

In fiscal year 2021-22, the city produced approximately 470 tonne of municipal solid waste daily. This waste is from a variety of sources, including residential, commercial, medical, animal, and industrial waste. On an average, each person generated 0.435 kg of waste per day. Wet waste, dry waste, sanitary waste, domestic hazardous waste & inerts account for 52.34%, 37.02%, 1.60%, 0.53% and 8.51% of the total waste respectively. Additionally C&D waste accounts for an additional 25 TPD. The locations of the various SWM infrastructure is indicated in figure 4.6.

### 4.5.1 Collection

90% of households are covered under door-to-door waste collection, serviced by approximately 2,700 primary collection vehicles, achieving a waste collection efficiency of nearly 90%. To manage the municipal solid waste more effectively, the city has set up 20 decentralized facilities for the collection, segregation, and treatment of waste.

Tiruchirapalli is a bin-free city. However in the last 2 years, several bins have been placed in high footfall zones like Central bus stand, Chathiram Bus Stand and Gandhi market for collection of litter.

### 4.5.2 Transportation

Waste is transported from household level to dump yard and processing facilities by a combination of vehicles from push carts to 5 tonne compactors. Currently only 20% of the household level waste collection vehicles are battery operated.

### 4.5.3 Processing

The city currently has an installed capacity of 216 TPD for processing wet waste. The total design capacity of the various types of waste processing facilities in Trichy is given in Table 4.6.

The existing capacity at MCCs is under utilized due to factors like lack of segregated waste and inadequate collection of waste from the catchment area.

Based on the assessments done for the SBM 2.0 Action plan, it estimated that there will be shortfall of 100 TPD[26] for wet waste management facilities, 190 TPD for dry waste managing facilities, 100 TPD for managing C&D waste & 20 TPD for MRFs/RRCs (included in dry waste gap) by 2025-26.

*Table 4.6: Processing Facilities Capacity*
*Source: Tiruchirappalli City Corporation*

| S .No | Type of Unit | Capacity/unit (in TPD) | Number of Units | Total Capacity |
|---|---|---|---|---|
| 1 | Micro Composting Centers (MCC) | 5 | 36 | 180 |
| 2 | Onsite Composting Center (OCC) at the premises of bulk waste generators and small markets. | 0.1 - 1.5 | 100 | 22 |
| 3 | Biomethanation | 2-4 | 4 | 14 |
| **Total** | | | | **216 TPD** |

[26] Note: Average wet waste generated is about 244 TPD (52%) which is about 52% of the total waste

### 4.5.4 Disposal/ Dumpyard

The Tiruchirappalli City Corporation (TCC) manages two significant waste management sites. The first, spanning 47.7 acres in Ariyamangalam village along the Trichy-Tanjore Main Road, is located 10 km from the city centre. This site has been used for solid waste dumping for the past 47 years. Of this, 40 acres are dedicated to open dumping, while 7 acres host the Integrated Waste Management and Urban Services Tamil Nadu (IWMUST) compost plant. It is estimated (as per SBM 2.0 Action Plan) that the site currently has 3.32 lakh cubic meters of legacy Municipal Solid Waste with an average dump height of 6-7 meters above ground. The daily waste receipt stands at 162 TPD. About 7.76 lakh cubic meters of legacy waste has already been bio-mined by TCC.

Additionally, TCC owns a larger 570-acre site at Panjapur village. A Sewage Treatment Plant (STP) is located at this site and a compost yard and sanitary landfill are additionally planned at this location.

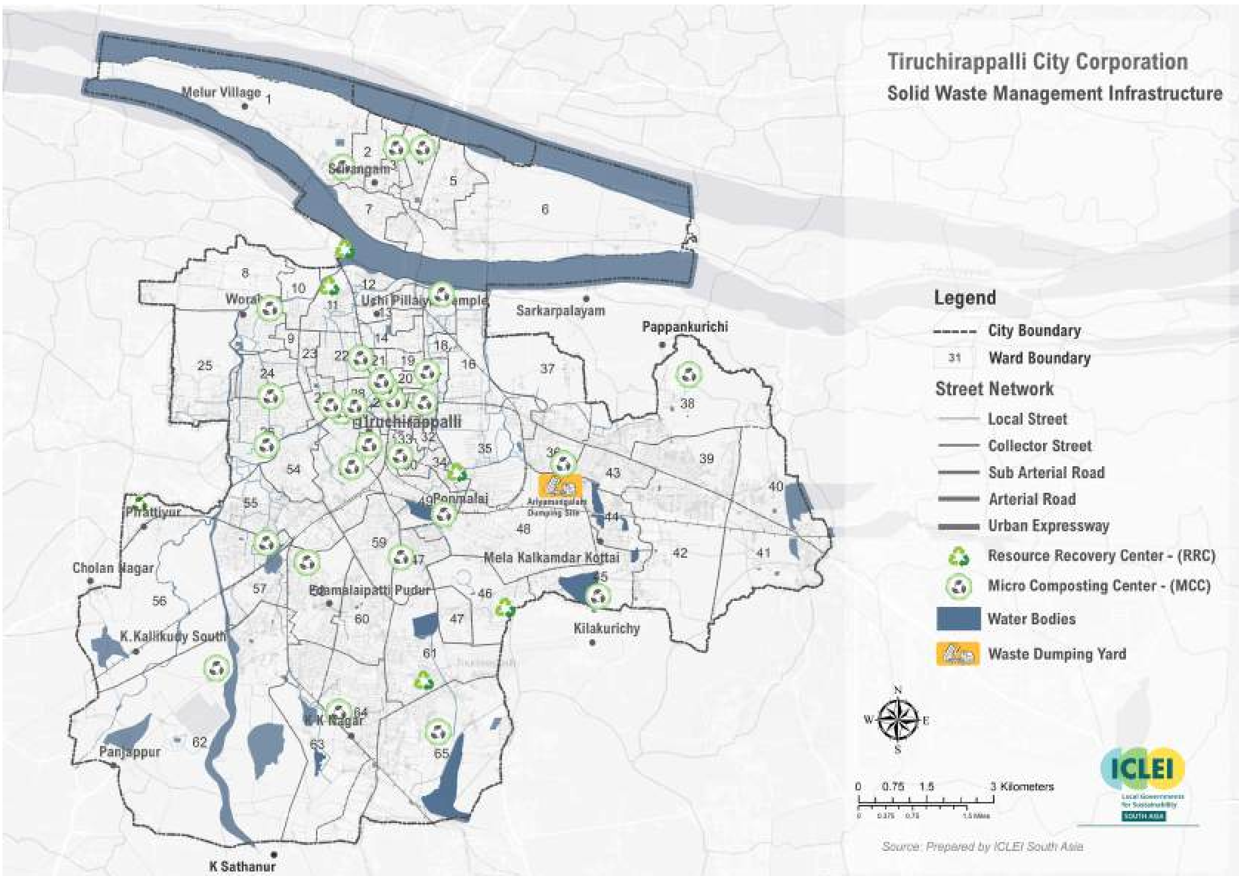



*Figure 4.5 SWM Infrastructure*
*Source: Trichy City Corporation*

### 4.5.5 Construction & Demolition Waste

Currently the amount of C&D waste generated is estimated to be around 25 TPD (based on 50 grams/ capita assumption). To prepare for the future demand, adding another 25% for bulk generators and 20% for contingency, TCC has estimated the future daily capacity needed will be about 36 TPD[27].

Tiruchirappalli Corporation is planning to set up a recycling plant in Panjappur with a capacity of upto 100 TPD[28]. This plant aims to process construction debris that is currently being improperly dumped in vacant plots and water bodies. The proposed plant will charge a fee for accepting construction debris and will recycle this material into flooring tiles and pavement blocks for sale. A two-acre site at Panjappur, in the same waste/

[27]SBM 2.0 Action Plan.

[28]Note: The additional capacity is proposed to handle C&D waste from nearby municipalities and Town Panchayats.

wastewater management complex, has been allocated for the C&D waste management plant. At present, TCC has designated areas where C&D waste can be disposed.

## 4.5.6 E-Waste & Plastic Waste

### 4.5.6.1 Plastic Waste

Inline with the Government of Tamil Nadu notification[29] single-use plastic has already been banned in the city. However, due to ineffective enforcement, SUPs are still widely available. Also several drains in the city are littered with SUPs, causing other issues like clogging of drains and localized flooding.

### 4.5.6.2 E-Waste

In January 2019, Tiruchirappalli inaugurated an e-waste centre at Tennur at the cost of Rs 20 lakhs. This 2,000-square-foot facility, equipped with a dedicated vehicle, was established to facilitate the scientific recycling of electronic waste. This center is awaiting NOC from TNPCB, for commencement.

## 4.5.7 Service Level Benchmark

*Table 4.7: Service Level Benchmark for SWM*

*Source: Tiruchirappalli City Corporation*

| Proposed Indicator | Service level Current 2022-23 | Service level Benchmark | Gap |
|---|---|---|---|
| **Collection Coverage** | 90% | 100% | 10% |
| **Collection Efficiency** | 90% | 100% | 10% |
| **Efficiency in redressal of customer complaints** | 92% | 80% | 12% |
| **Efficiency in collection of SWM Charges** | 60% | 90% | 30% |

## 4.5.8 Issues & Gaps

- There is scope for improvement in the waste management processes and facilities in Tiruchirapalli.
- A large part of the city does not follow source segregation. Not only does it lead to lost revenue from recyclables, this also leads to unusable waste being dumped without being treated, also causing a significant increase in GHG emissions.
- 3.32 lakh cubic meters of legacy waste in Ariyamangalam needs to be bio-mined (This is currently in progress).
- The dumping site at Ariyamangalam is not a sanitary landfill thereby leading to the possibility of causing several environmental hazards, including groundwater contamination.
- One-third of the vehicles are over 10 years old and face frequent operational downtime due to maintenance issues.
- The ban on Single Use (SU) plastic must be strictly enforced.
- Bio-medical wastes are also dumped in the dumping grounds thereby leading to major health hazards
- There is a shortage of manpower at the supervisory level, impacting waste management efficiency.
- The E-Waste facility could be moved to a new location or necessary countermeasures can be undertaken to receive NOC to operate the E-Waste collection center.

[29]Tamil Goverment Government Order No:84 - Banning Single Use Plastic. Accessed Mar 2024.

- On several days, the waste transportation system in Tiruchirapalli is not well-coordinated with the timings for primary waste collection and storage, leading to substantial accumulations of municipal solid waste (MSW) around the city and at storage sites. This mismatch results in transport vehicles covering unnecessary distances without carrying loads, leading to increased emissions and higher operational costs. Furthermore, the lack of technological support, such as route management software, means that the system doesn't utilize resources efficiently, missing opportunities to optimize routes and reduce environmental impact.
- The C&D waste regulations are not fully adhered to. Stricter enforcement by TCC and TNPCB will restrict roadside dumping and in water bodies.

## 4.5.9 Proposed Projects

TCC has proposed several projects to reduce emission in the solid waste management sector. Some of these projects and actions are:

**Transportation**

- Purchasing Battery Operated Vehicle (88 Nos) at INR 19.50 million. This will reduce the emissions from the vehicles that are used for collecting waste.

**Waste Handling and Processing Enhancements:**

- Micro Composting Centers:
- Allocation of funds to create 5 Micro Composting Centers at INR 18.52 million to enhance wet waste handling capacity, reduce emissions, and decrease waste directed to dumpyards.
- Establishment of an additional 4 Micro Composting Centers at INR 14.29 million to similarly enhance wet waste processing capabilities and environmental impacts.

**Advanced Waste Treatment Facilities:**

- Bio-CNG and C&D Waste Processing Plants:
- Implementing a Bio-CNG Plant for 100 TPD, currently under administrative sanction, aimed to reduce wet waste emissions.
- Developing a C&D Plant for 100 TPD, will reduce the need for virgin construction material.

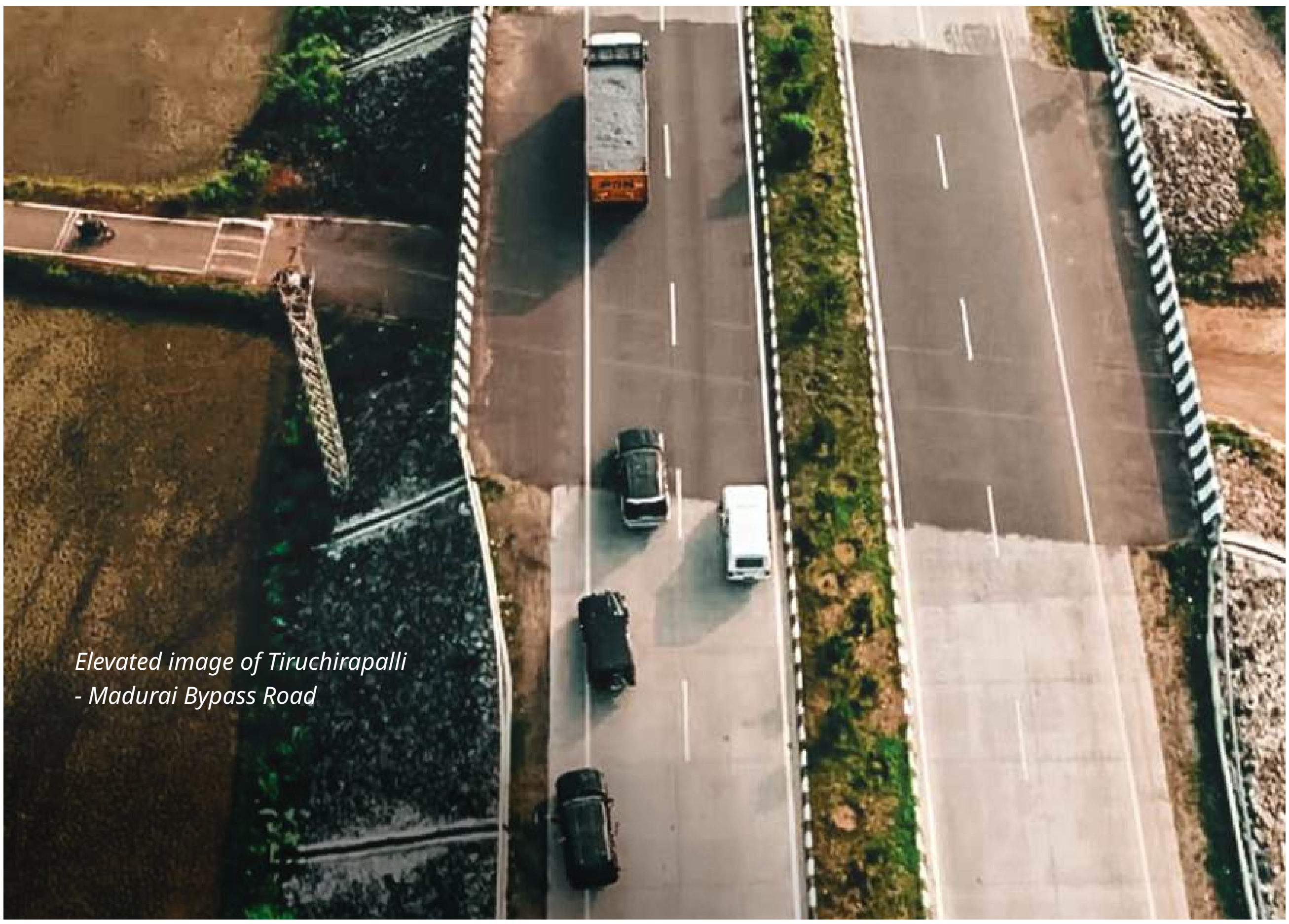
**Legacy Waste Mitigation:**

- Bio Mining Initiatives:
- Bio Mining (Phase—II) project at INR 254.0 million will address emissions from legacy waste in dump yards and reduce the environmental impact of old waste accumulation.

## 4.6 Transport

**The responsibility for managing transport within the TCC administrative areas lies under several agencies. DTCP is the master planning authority. The Traffic Police department is responsible for enforcement of Traffic regulations. Transport Commissionerate is responsible for licensing. State Express Transport Corporation (SETC) and the Transport department is responsible for bus transport. NMT and a significant length of roads are maintained by TCC. State highways department and National highways department maintain respective road networks.**

Tiruchirappalli city, amid rapid population and economic growth, faces significant transportation challenges. Traffic congestion has become increasingly problematic due to a largely unchanged road network within the Corporation area for the last 20 years, leading to frequent gridlocks. The city's transportation needs are primarily met by buses, which account for a 65% modal share, making it the dominant form of public transport. Para-transit, including three and seven-seater autos, caters to nearly 10% of transportation demand. Two- and four-wheeler private vehicles constitute about 25% of total vehicular traffic. The TCC is tasked with constructing and maintaining all roads under its purview, excluding highways and other district-level roads.



*Elevated image of Tiruchirapalli - Madurai Bypass Road*

### 4.6.1 Road Network & Condition

As of 2017, Tiruchirappalli City boasts 1,411.97 km of roads, with approximately 80% of them surfaced (as detailed in Annexure D - Table D2). Key arterial roads include Bharathidasan Road, which serves as a model for the city, along with Bharathiyar Road, Collector Office Road, Thennur High Road, Salai Road, Sastri Road, Madurai Road, Thillai Nagar Main Road, College Road, and Gandhi Road.

With 80% of the roads surfaced, Tiruchirappalli's per-capita road length stands at 1.15 meters, showcasing better infrastructure than other similar-sized cities. However, newly developing areas, particularly in the northwest, still need help in road connectivity. The road network of Tiruchirappalli is depicted in Figure 4.5.

Tiruchirappalli's urban area has seen a swift rise in vehicle numbers, paralleling its population growth. Over the last decade, two-wheelers have seen a compounded annual growth rate (CAGR) of 15%, four-wheelers 8%, and three-wheelers 5%. Private vehicles now account for about 25% of the transportation modal share. This surge is partly due to the deficiencies in the TNSTC bus services, such as inadequate coverage and poor frequency, prompting a shift in public preference towards private transportation. The last two decades have witnessed a significant increase in two-wheelers, motorcars, and three-wheelers. Despite the growth in private and paratransit modes, bus services have not kept up with population growth, leading to an increase in para-transit options like three-wheeled auto rickshaws.

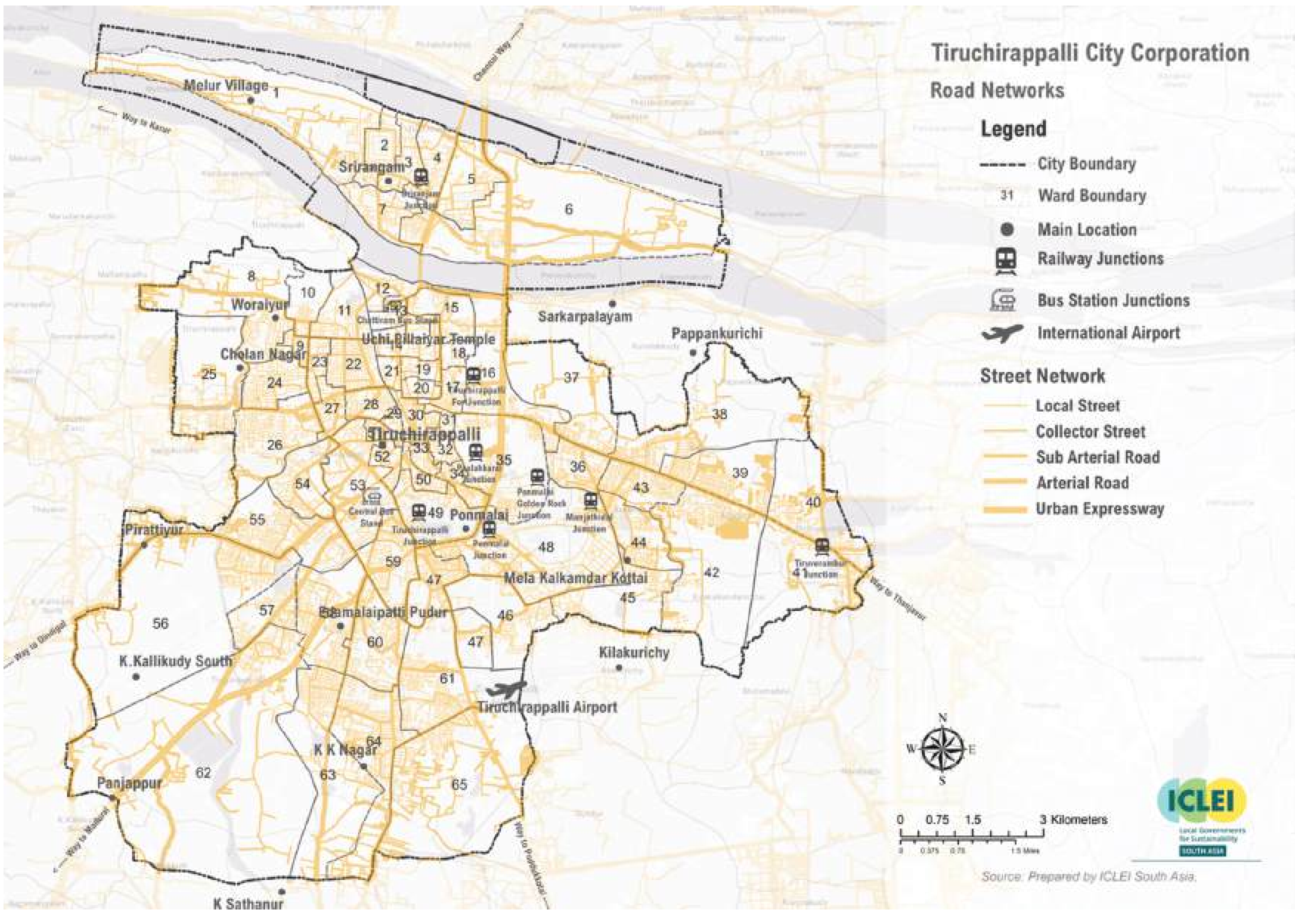



*Figure 4.6: Tiruchirappalli Road Network*

*Source: Trichy City Corporation*

### 4.6.2 Bus Transport & Terminals

There are currently 587 buses (including 147 private and 440 TNSTC city buses), for its metropolitan population of 1.46 million[30] .

Currently, the Trichy Region of the Tamil Nadu State Road Transport Corporation (TNSTC) . Ltd provides city bus services through its seven depots. Trichy features three intra-city bus terminals -Central Bus Stand (C.B.S.), Chathiram Bus Stand, and Srirangam Bus Stand—and one inter-city terminal, which is also located at the Central Bus Stand.

The Central Bus Stand in Tiruchirappalli, operational since 1995, accommodates 50 buses and facilitates approximately 427 bus services (inter & intra city bus services[31]), generating 4,000 trips daily. The Chathiram Bus Stand near Teppakulam, known as Chindhamani, generates 1,300 trips daily. The Central Bus Stand is a crucial hub connecting surrounding areas, witnessing a daily floating population of about 20,000. This influx contributes to traffic congestion around key areas like the Cantonment Area, Gandhi Market, and bus stands. The city's central core struggles with handling the volume of people arriving from the surrounding areas via high-capacity national and state highways.

The CMP has proposed to increase the number of bus stops in the city by an additional 42 by 2042 to achieve increased accessibility. Additionally to reduce congestion in city roads, it is also proposed to relocate the buses by 100 m from every intersection.

The comprehensive mobility plan (2023) proposes the bus fleet size for the years 2027, 2032 & 2042 as shown in table 4.7.

According to the urban fleet specification of 50 buses per lakh (100,000) population, the city's bus fleet is deficient by 145 buses.

*Table 4.8: Proposed Bus Fleet*
*Source: Comprehensive Mobility Plan*

| Horizon Year | Total Fleet | | |
|---|---|---|---|
| | TNSTC | Private | Total |
| **2027** | 693 | 147 | 840 |
| **2032** | 814 | 147 | 961 |
| **2042** | 1110 | 147 | 1257 |

### 4.6.3 Non-Motorized Transport

The city currently has about 1413.5 km of roads. In terms of pedestrian infrastructure, Trichy has only 57 roads with footpaths totalling 48 km in length, split between city corporation roads (34.13 km) and state highways (13.91 km) which is only about 3.4% of the total road network. The city plans to add an additional 58 km of footpaths and 4 km of pedestrian zones, particularly around major temples, to enhance safety and comfort for walkers, at an estimated cost of Rs. 58 crores for footpaths and Rs. 5 crores for pedestrian zones.

### 4.6.4 Parking

Tiruchirappalli is grappling with severe traffic congestion due to a lack of a comprehensive parking policy and inadequate parking facilities. The situation is particularly dire on Big Bazaar Street and West Boulevard Street, with parking surveys showing high accumulations of vehicles during peak hours. Areas like Gandhi Market, Central Bus Stand, and Chathiram Bus Stand are also heavily impacted.

[30]Trichy Comprehensive Mobility Plan.

[31]Paratransit or Intermediate Public Transport, is a type of transportation services that supplement fixed-route mass transit by providing individualized rides without fixed routes or timetables.

To address these issues, a phased development plan for organized parking has been initiated. This includes a proposal for a multi-storied parking facility to accommodate around 200 vehicles at key locations, including Gandhi Market and near Ibrahim Park. Plans also call for constructing off-street parking complexes at five strategic nodal points and establishing para-transit[31] hubs to improve vehicle flow.

For long-term solutions aimed at 2042, proposals are being made to set up on-street parking along Thillai Nagar Main Road and Shastri Nagar Main Road, as well as two multi-level parking facilities near the Central and Chathiram Bus Stands. To further ease congestion, no-parking zones in the surrounding areas will be enforced.

### 4.6.5 Freight Management

TTiruchirappalli did not have a freight management policy or plan till 2022. As a consequence of haphazard operations, there has been chaos and congestion in areas near markets such at Gandhi Market and Central Bus Stand.

The Master Plan 2041 for Tiruchirappalli includes proposals for Special Economic Zones (SEZ) and industrial areas. In alignment with these plans, the Comprehensive Mobility Plan (CMP) suggests the establishment of four Truck Terminals along the National Highway (NH) and bypass routes to manage freight vehicle entry into the city. The proposed locations for these terminals are Thuvakudi along the Tiruchirappalli-Thanjavur road, Kulathur Village along the Outer Ring Road, near Punganur along the Chennai-Theni Highway, and near Sarkarpalayam along the Sarkarpalayam-Kallanai Road.

Additionally, a freight consolidation centre near Gandhi Market is proposed to regulate and streamline freight traffic servicing Gandhi Market.

### 4.6.6 Issues & Gaps

- A detailed freight management plan is necessary for the city, including determining its exact location, space requirements, and types of commodities to be stored.
- Only 3.4% of the city roads have footpaths. More investment is needed to increase this network.
- Private vehicles are rapidly increasing due to the limited public bus fleet and also an ageing public bus fleet.
- The city needs a parking policy
- 40% of the city is currently covered under surveillance from ICCC, this should be further augmented.
- The city needs a total fleet size of 1,257 units by the horizon year of 2042[32]. It is targeted that at least 50% of these buses will be electric, aligning with sustainability goals and reducing carbon emissions. To support the electrification of the bus fleet, upgrades are planned for several depots. Specifically, the Panjapur, Chathiram, Samayapuram, and Srirangam bus terminals will undergo enhancements to accommodate electric buses. This upgrade is essential for the successful integration of electric vehicles into the fleet, ensuring adequate charging infrastructure and maintenance facilities.
- Trichy's electric mobility advancement is hindered by a lack of charging infrastructure.
- The Master Plan 2041 for Tiruchirappalli includes proposals for Special Economic Zones (SEZ) and industrial areas. In alignment with these plans, the Comprehensive Mobility Plan (CMP) suggests the establishment of four Truck Terminals along the National Highway (NH) and bypass routes to manage freight vehicle entry into the city. The proposed locations for these terminals are Thuvakudi along the Tiruchirappalli-Thanjavur road, Kulathur Village along the Outer Ring Road, near Punganur along the Chennai-Theni Highway, and near Sarkarpalayam along the Sarkarpalayam-Kallanai Road.
- A total of 46 km of additional road network is planned for the city, incorporating a new ring road and link road as outlined in the Draft Master Plan (2041). However no land acquisition process has started for the same. An outer ring road is slated for completion by 2041. Out of an 80 km ring road, 32.6 km remains undeveloped. The various planning and land acquisition processes should commence at the earliest.
- Attributing the industrial character and the heavy flow of freight traffic in the city, the outer ring road is also proposed for the horizon year 2041. (Of the total 80

[32]As per Comprehensive Mobility Plan (CMP)

km of Ring Road, 32.6 km of the road network is yet to be developed on ground). This outer ring road will further enhance the connectivity of the study area in the coming decades and would ensure a smooth flow of passing through freight traffic.

- Improvement of Existing Cross - Sections by reclaiming encroached spaces, marking the designated lanes and well-defined pedestrian walkways.
- Traffic Rerouting, providing of Parking Facilities, Junction Improvements in 18 locations and Freight Management as per the CMP.
- The proposed Bus Terminal Locations are (excludes committed proposal): Thiruverambur, Samayapuram, Sir Rangam, Thuvakudi, Thiurvanaikaval, Bharathidasan University, Thillai Nagar and Manachanallur.

### 4.6.7 Proposed Projects

TCC has proposed several projects to reduce emission in the transport sector. Some of these projects and actions are:

- 50 electric buses from the KfW project to modernize bus transport in Tamil Nadu at the cost of Euro 500 million.
- Proposed High Demand Corridors: Stage 1 - Samayapuram to Vayaloor via Central Bus Stand with 18.7 Km, Stage 2 - Panjapur to Airport via Central Bus Stand - 26 Km, Panjapur to Tiruchirappalli Junction Via Airport & Outer Ring Road - 23.3 Km.
- Additional 58 km of footpaths and 4 km of pedestrian zones, particularly around major temples, to enhance safety and comfort for walkers, at an estimated cost of INR 580 million for footpaths and INR 50 million for pedestrian zones.

## 4.7 Urban Green Spaces & Biodiversity

As part of the Jal Shakti Abhiyan initiative, 21,864 saplings have been planted in 2021, increasing the green cover by 0.06 sq.km. Moreover, from 2020 to 2021, under the Smart City Mission scheme, Tiruchirappalli City developed 21 parks at a cost of Rs. 157.1 million, further enhancing its urban greenery.

The responsibility for planning and managing parks, gardens and open spaces is largely with the Engineering & Town Planning departments of TCC. However, for several afforestation projects, the District Forest Department (DoECC & F) is actively involved.

As per the LULC classification for the year 2023 (Annexure C - Figure C3), TCC has a green cover of 90.98 sq.km which includes trees (very high density forest[33] ) and shrubs. The dense tree cover in Trichy extends over 1.06 sq.km.

[33] Very High Density Forest (VDF) of crown density > 70%.

The current tree cover of Tiruchirapalli city is indicated in Figure 4.8.

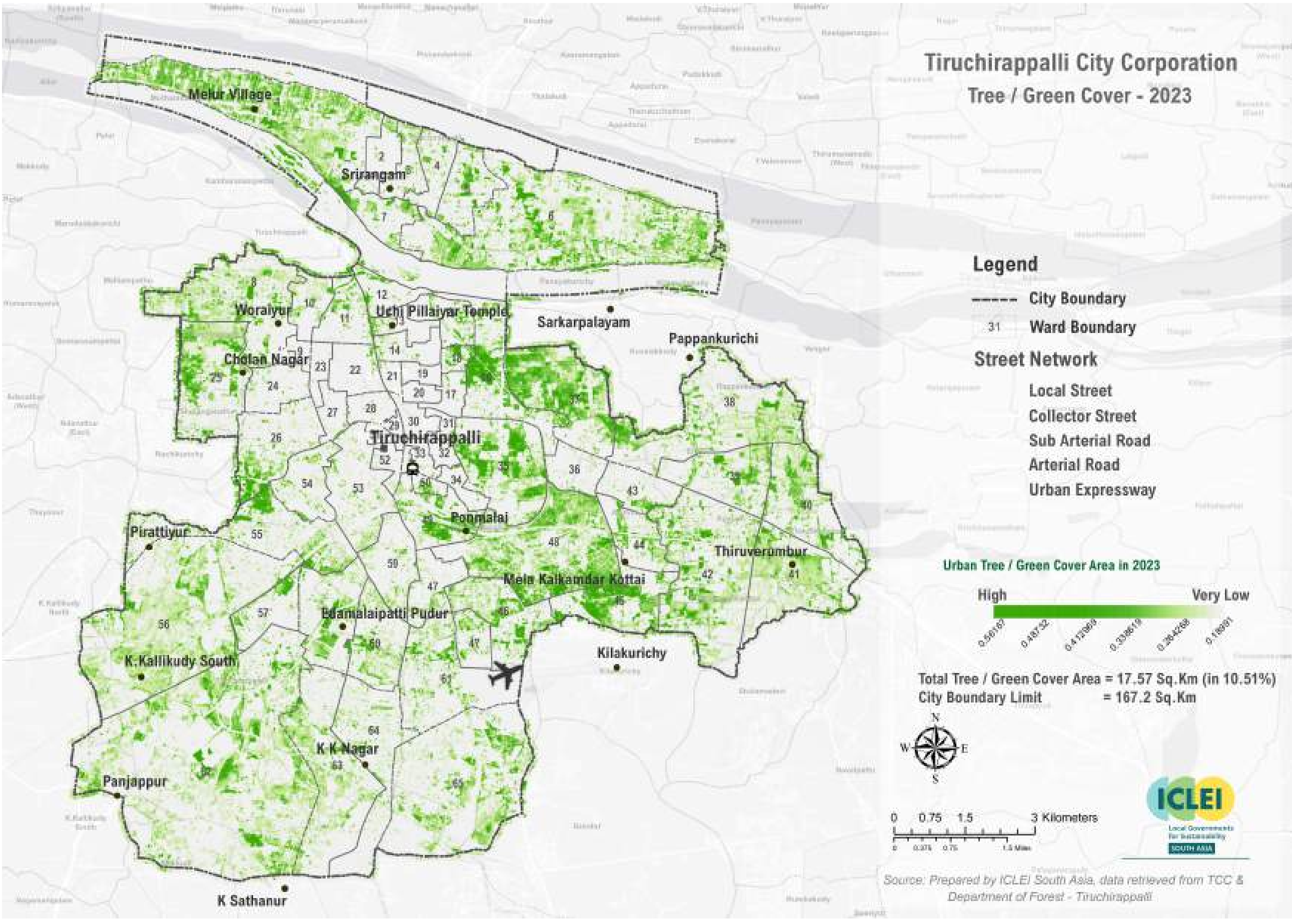



*Figure 4.7: Tiruchirapalli Tree Cover*
*Source: Trichy City Corporation*

## 4.7.1 Issues & Gaps

- Trichy already has 10.6 sq.m of green cover per person, which is greater than the WHO recommended minimum of 9 sq.m per person. However, considering the higher temperature range in the city compared to the state average, the city must increase its green cover to better adapt to heat stress. While carrying out plantations to increase the green cover, the city needs to focus on native tree species[34].
- Better alignment between the schemes of TCC, Forest Department and Tamil Nadu Horticulture Department, will lead to more organized and sustained greening.
- Tiruchirappalli does not have a Local Biodiversity Strategy and Action Plan. This should be created by partnering with the Forest Department and utilizing the Biodiversity Management Committee. The aim is to map Local Natural Assets and identify the existing species, understand the present biodiversity governance environment and then develop a Local Biodiversity Strategy and Action Plan, which will be in line with the State Biodiversity Strategy and Action Plan and National Biodiversity Action Plan.

[34]Special Emphasis on Air Pollution Tolerant Plant Species, Department of Environment Gov. of Tamilnadu

### 4.7.2 Proposed Projects

TCC has proposed several projects to improve biodiversity and increase carbon sequestration potential in the city. Some of these projects and actions are:

- Park Redevelopments / Improvements at the cost of INR 16.53 million in 2023-24. This will increase the green cover and also the carbon sequestration potential of TCC. Care needs to be taken to focus on native floral species.

## 4.8 Disaster Management & Emergency Systems

**The responsibility for managing disasters in the TCC area is with the Tiruchirappalli collector who works closely with the Commissioner of TCC at the ground level and with the Commissioner of Revenue Administration (CRA) at the state level. Tiruchirappalli Smart City also operates an ICCC that serves as a war room during disaster events, mostly during the North East Monsoon.**

The district of Tiruchirappalli has frequently faced severe weather events over the past century, including numerous cyclones and floods. Significant cyclones occurred in 1924, 1952, 1954, 1965, 1977, 1979, 1983, 1998, and 1999, with the most notable being Cyclone Gaja in 2018. Gaja hit with devastating wind speeds of 175-180 km/h, severely affecting agriculture, healthcare, and public services. More recently, Cyclones Nivar and Burevi in 2020, though less severe, emphasized the continuous threat and highlighted the importance of ongoing preparedness.

The district also suffers from severe flooding, particularly during the North East Monsoon season from October to December. The Cauvery and Coleroon rivers, along with their tributaries, often overflow during periods of intense rainfall, inundating vast areas. This flooding causes substantial damage to infrastructure such as roads, electrical and telecommunication lines, and severely impacts urban poor habitations. Notable floods occurred in 2005, 2018, and 2022, each causing significant disruption and highlighting the challenges in managing such natural disasters.

The Tiruchirappalli District Administration has created a Flood Contingency Plan to mitigate these effects. However, TCC must also develop a specific plan focussed on its administrative area to respond effectively to urban flooding.

### 4.8.1 Issues & Gaps

- Trichy city should develop a disaster management plan for the ULB area in accordance with the SENDAI framework[35] and include administrative SOPs before, during and after natural calamities leading to urban flooding.
- The city has created an Integrated Command & Control Center (ICCC) that serves as an emergency response center during extreme weather conditions. Currently 175 cameras and 22 smart poles are linked to the ICCC. However, this currently covers about 40% of the city area (taking 1 km radius as influence zone). Additional investment is required to extend the camera surveillance to the entire city area.
- The city does not have an Early Flood Warning system to warn against upstream increase in river levels. This is critical as rise in water level in the Cauvery almost always has a flooding impact on the city.
- There is no disaster resilience plan in place to address livelihood and sustainability issues or to aid in recovery from the adverse impacts of natural disasters.

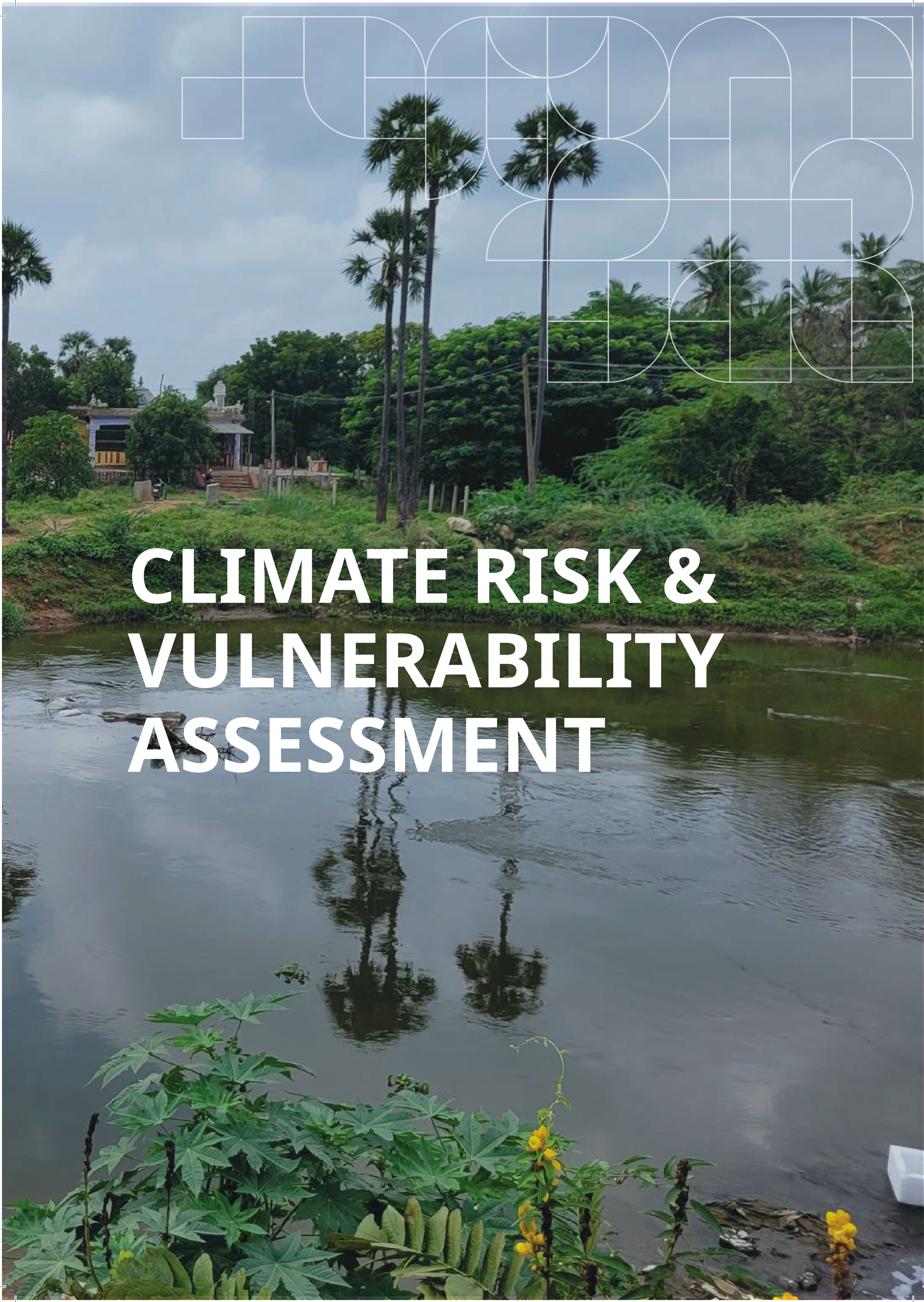
[35] India is Signatory to the SENDAI Framework. Accessed March 2024.

## 4.8.2 Proposed Projects

TCC has proposed several projects to improve disaster response and emergency services. Some of these projects and actions are:

- TCC has received funds from the State Disaster Response Fund for Emergency for procuring equipment (such as rescue boats, communication equipment, etc.) worth INR 10.36 million. This will significantly improve disaster response, especially for the vulnerable population identified in Chapter 5.

# 05



# CLIMATE RISK & VULNERABILITY ASSESSMENT

05

# CLIMATE RISK & VULNERABILITY ASSESSMENT

## 5.1 Introduction

The Intergovernmental Panel on Climate Change (IPCC) highlights that climate-related risks arise from climate hazards, vulnerability, and exposure, impacting both human and natural systems. This report, prepared by TCC, assesses the risks and vulnerabilities specific to Tiruchirappalli's urban infrastructure and population due to climate hazards and air pollution. The goal is to provide critical insights for adopting climate-sensitive urban planning strategies. By effectively managing climate-induced risks and adopting resilient policies, Tiruchirappalli can proactively address the challenges of climate change.

**This chapter is structured into three main sections:**

i. Analysis of climate trends and projection scenarios,

ii. Assessment and prioritization of hazards and risks, evaluating their likelihood and consequences,

iii. Vulnerability assessment, focusing on identifying areas and populations at risk.

### Methodology

The Climate Risk and Vulnerability Assessment (CRVA) for Tiruchirappalli city adopts the "Net Zero Climate ResilientCITIES" methodology. This approach is further improved by insights from the climate core team and the stakeholder committee of the Tiruchirappalli City

Corporation (TCC), which were obtained through Shared Learning Dialogues (SLDs). Moreover, the analysis is grounded in data from various government departments of Tamil Nadu, ensuring a comprehensive understanding of the city's climate hazards and vulnerabilities. This collaborative effort has helped in providing TCC with actionable information for developing climate-sensitive urban planning strategies, enhancing the city's resilience against climate-induced challenges.

## Step 1 - Climate Trends & Projections

Tiruchirappalli's historical climate and weather data from 1981 to 2023 was analysed to identify patterns and trends in air temperature and rainfall changes. Future climate projections up to 2070, based on Representative Concentration Pathways (RCPs), were informed by the Tamil Nadu State Action Plan on Climate Change[1]. Expert insights further validated these projections during stakeholder consultations. The outcomes of this climate trend analysis and the future projections are comprehensively detailed, section (Observed Temperature Trend) in TNSAPCC, which includes the development of climate scenario statements. This section provides a robust foundation for understanding climate-related changes and their implications for Tiruchirappalli, aiding in the city's climate resilience planning efforts, which are detailed in chapter 08.

## Step 2 - Risk Assessment

Following the initial climate trends and projection analysis, Step 2 focused on identifying and analysing climate vulnerabilities, evaluating both their likelihood of occurrence and potential consequences. This risk assessment utilised GIS & Geo-Spatial analysis alongside a review of relevant climate data. Information from stakeholder consultations was also included in the assessments. To validate the findings from the risk assessment, results were cross-checked with information from the Community Based Disaster Risk Management in District Disaster Management Plan[2] (Tiruchirappalli 2023), underscoring Tiruchirappalli's susceptibility to urban heat & urban flooding. The detailed indicators employed to assess risks associated with urban heat and urban flooding, offering a structured framework for understanding and addressing the city's climate vulnerabilities. Based on this analysis, the

*Table 5.1: Parameters considered for Risk Assessment*

| Risks | Parameters Considered for Risk Assessment |
|---|---|
| **Extreme Heat** | 1. Air temperature trend analysis (including change in hot and cold days/ nights)<br>2. Analysis of heatwave events/ alerts and heat stroke cases<br>3. Surface Temperature analysis and hotspot areas<br>4. Feel like temperature analysis (developing heat index) |
| **Urban Flooding** | 1. Trend of rainfall pattern and intensity<br>2. Spatial analysis of flooding / water logging points and causes<br>3. Ward level analysis of water and vector borne diseases |
| **Air Pollution** | 1. Analysis of annual and monthly air quality data (primary pollutants like PM PM 10)<br>2. Identification of critical areas and source of air pollution<br>3. Ward level acute respiratory illness |

[1] Tiruchirappalli District RCPs

[2] Tiruchirappalli District Disaster Management Plan (2023). Accessed Mar 2024.

climate fragility of various urban systems was assessed. Section 5.6 presents in detail inferences from the risk assessment.

## Step 3 - Vulnerability Assessment

Based on the climate risk assessment insights, this step integrates data from Tiruchirappalli City Corporation (TCC) departments and qualitative input from stakeholder consultations and individual meetings with CSOs & Academia to assess urban system vulnerabilities and their impacts on the community. Special focus was placed on identifying and addressing the needs of vulnerable groups such as low-income individuals, including hawkers and street-side vendors in slums, as well as women, children, people with disabilities, and the uneducated. Spatial analysis was employed to pinpoint vulnerable areas, with detailed maps included in Section 5.6 and base maps in Annexure E.

The methodology used for creating the CRVA is indicated in Figure 5.A1

This chapter examines the effects of climate hazards and air pollution on critical urban and emergency

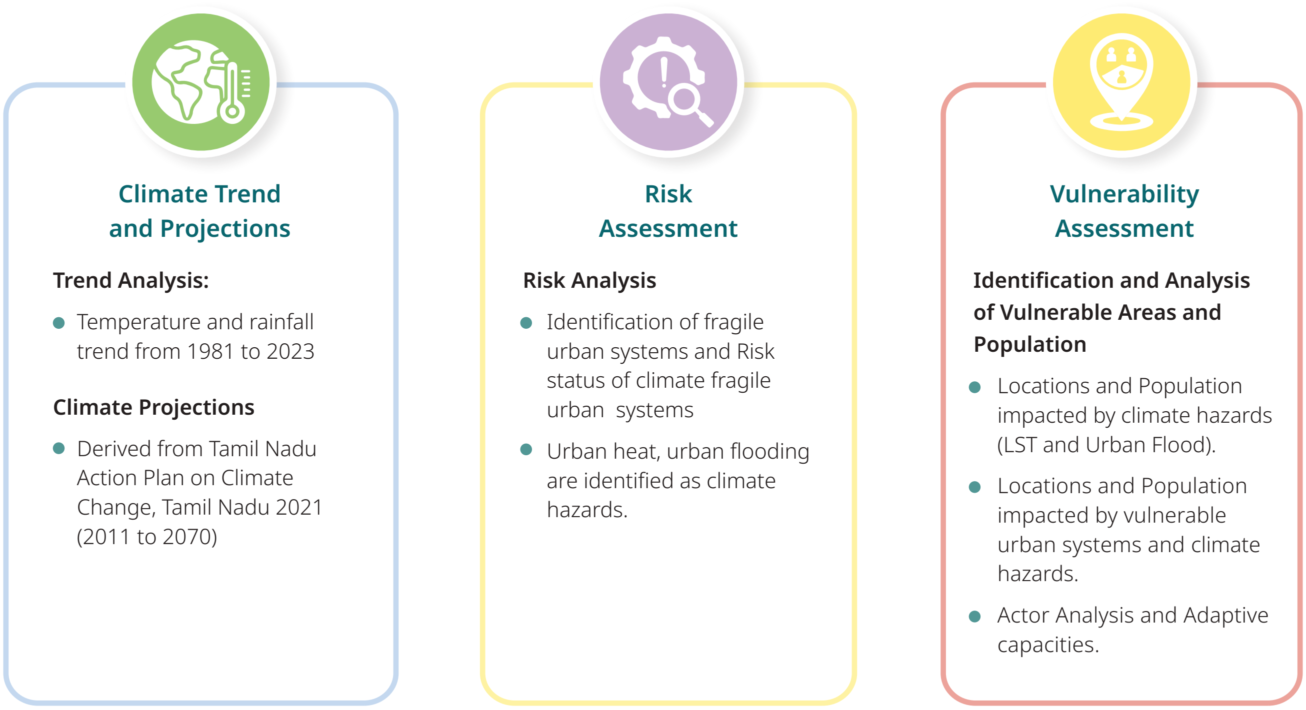



*Figure 5.1: Methodology used for conducting the Climate Risk and Vulnerability Assessment (CRVA)*

services, including water supply, wastewater management, stormwater handling, solid waste management, transportation, urban green spaces, and disaster & emergency services. Information available from secondary assessments like vulnerable hotspots and ICLEI SA city wide watershed assessment and the complaint management system of TCC was also included in the study.

Section 5.6 presents comprehensive findings and conclusions drawn from the climate vulnerability assessment, offering a nuanced understanding of the city's urban systems to climate-related challenges and the populations most at risk.

# 5.2 Climate Trends and Projections

Annual and seasonal trends of air temperature and rainfall from 1981 to 2023 were analysed based on data received from the Indian Meteorological Department (IMD), to understand the temporal change in minimum, average and maximum temperatures, and rainfall intensity. Changes in the annual number of extreme hot days and nights, and cold days and nights, and in the frequency of climate events etc., have also been analysed. Climate scenario statements were prepared for TCC and validated through stakeholder consultations.

## 5.2.1 Climate Trend Analysis

### 5.2.1.1 Air Temperature Trend Analysis

An analysis of annual average air temperature from 1981 to 2023 indicates that it increased by +0.016 ˚C per decade during this period (Figure 5.2). The average maximum air temperature is increasing by 0.49 °C and minimum air temperature is increasing by 0.011 °C per decade. A corresponding increase in the number of hot days and nights is also observed

From 1981 to 2023, days and nights have become hotter in general. An increase of 14 to 21 hot days and 16 to 22 hot nights was observed[3] .

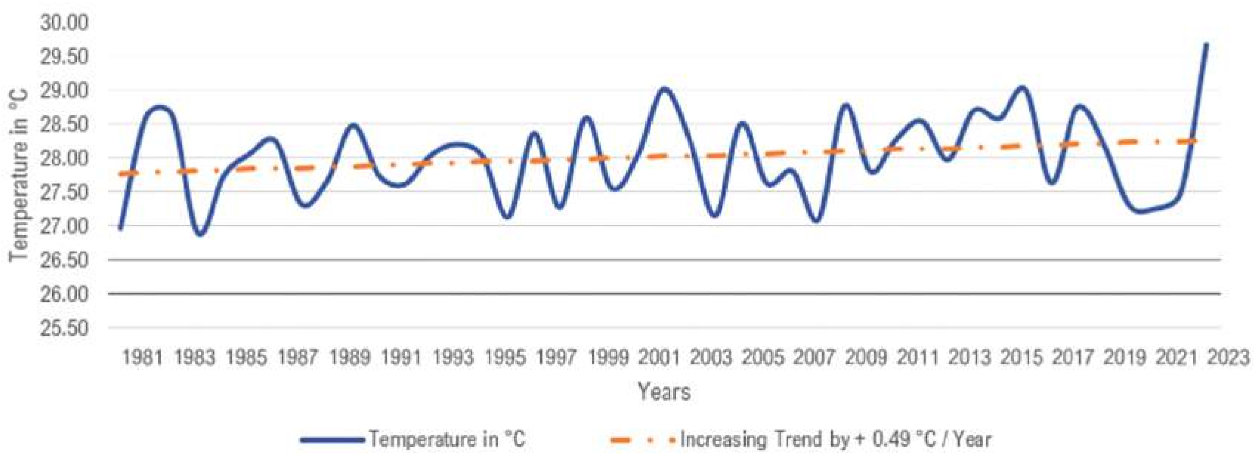



*Figure 5.2: Average air temperature trend in Trichy (1981 to 2023)*
*Source: Analyzed by ICLEI South Asia, based on data received from IMD from year 1981 to 2023*

In the absence of effective measures, increase in air temperature may lead to an increase in the land surface temperature and heat index, resulting in more frequent heatwave events.

From 1981 to 2023, there is an increase in the frequency of hot years per decade; from 35°C between 1981 and 2017 to 37-43°C between 2015 and 2023 (Figure 5.3).

[3]As per the Hazard Atlas of IMD, the cold days are not available for analysis. Its trend has not available.

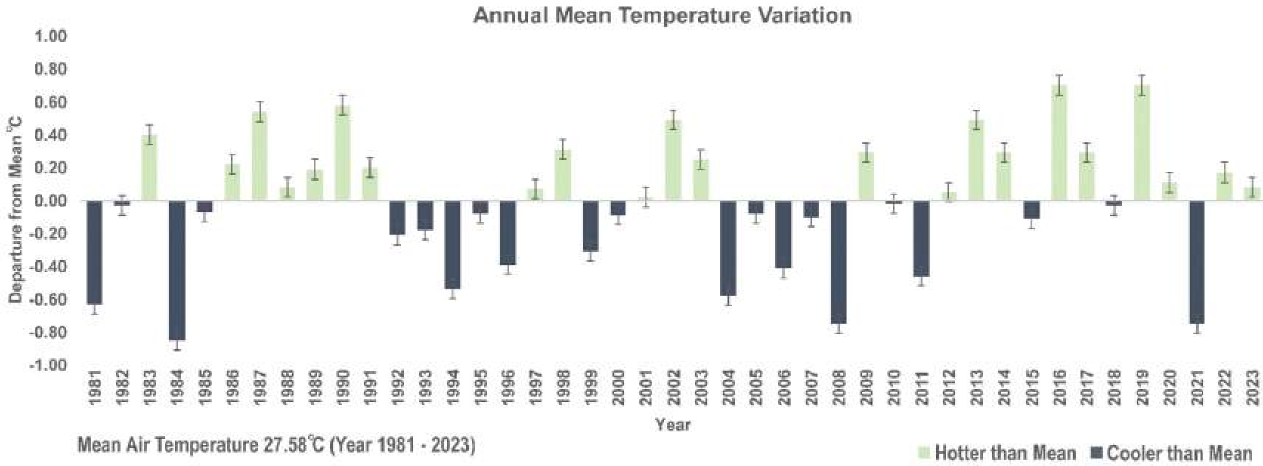



*Figure 5.3: Anomalies in average air temperature in Trichy (1981 to 2023)*
*Source: Analyzed by ICLEI South Asia, based on data received from IMD from year 1981 to 2023*

*Table 5.2 Temperature trend based on IMD (Tamil Nadu) and analysis from IMD data from 1981 - 2023*

| Temperature Trend (1981 to 2023 as per IMD) | Specifics (Tiruchirappalli City) |
|---|---|
| Change in Maximum Temperature | Increase by 0.07°C based on analysis from IMD data from 1981 to 2023 for Tiruchirappalli City |
| Change in Average Temperature | Increase by 0.016°C based on analysis from IMD data from 1981 to 2023 for Tiruchirappalli City |
| Change in Minimum Temperature | Increase by 0.06°C based on analysis from IMD data from 1981 to 2023 for Tiruchirappalli City |
| Change in Number of Hot Days | Increased to 21 days (1969 to 2023) |
| Change in Number of Hot Nights | Increased to 22 days (1969 to 2023) |
| Number of Heatwave[4] days | 14 heatwave events (1969 to 2019)[5] |

### 5.2.1.2. Rainfall Trend Analysis

Annual rainfall shows a decreasing trend for the period 1901 to 2023, with an average rainfall by 860.3 mm per year (Figure 5.4). Annual rainfall recorded in Tiruchirappalli city was 1339 mm in 1920 and the recent record is 761 mm in 2023. The intensity of rainfall however has significantly increased. The average rainy days is 46.7[6] per year. There are at least 5 years with rainfall exceeding 1,200 mm (Figure 5.4). Certain areas of the city were impacted with urban flooding and water logging during 1889, 1891, 1909, 1930, 1964, 1976, 1983, 1999, 2008, 2005, 2020, 2021, 2023 due to heavy rain, compromised carrying capacity of storm water drains and low infiltration rate.

[4]IMD Heat Wave Definition. Accessed March 2023.
[5]Hazard Atlas of IMD. Accessed March 2023.
[6]IMD Data Information for Trichy. Accessed March 2024.

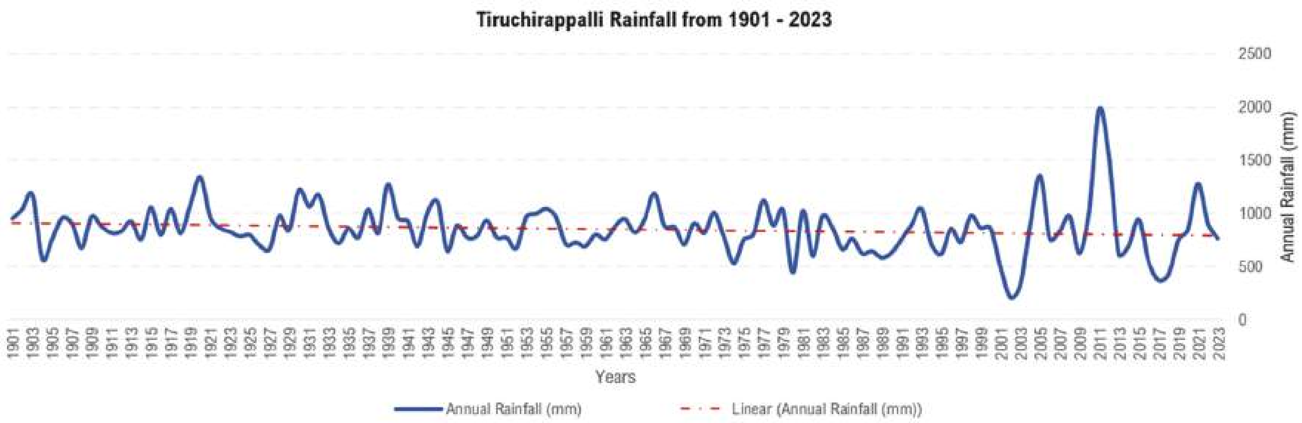



*Figure 5.4: Annual rainfall trend in Trichy (1901 to 2023)*

*Source: Analysed by ICLEI South Asia, based on data received from IMD from 1901 to 2023.*


*Figure 5.5 : Anomalies in annual rainfall and rainy days (1901 to 2023)*

*Source: Analysed by ICLEI South Asia, based on data received from IMD from year 1901 to 2023*

*Table 5.3 Rainfall trend based on SAPCC (Tamil Nadu) and analysis from IMD data from 1901 to 2023*

| Rainfall Trend (1901 to 2023) | Specifics (Tiruchirappalli City) |
|---|---|
| **Change in Precipitation** | The deviation from average rainfall has significantly increased in the last 2 decades as visible in figure 5.4. The deviation fluctuation is evident from a deficit of 655 mm in 2002 to a surplus of 1121 mm in 2011. |
| **Number of Flood Events** | 24 Days [7] |

## 5.2.2 Climate Projections and Scenario Statements

The revised Tamil Nadu SAPCC[8] has considered the SSP2[9] These scenarios are modelled for near century (2020 to 2046), mid-century (2047 to 2073) and end century (2074 to 2100) periods. Given that the target year for the Net Zero Climate Resilient City Action Plan for Trichy is 2070, climate scenarios for the Near century & Mid-Century are considered for further analysis.

[7]Period 1969-2023 as per IMD Flood Atlas (Including data from TCC for years 2021 & 2023)

[8]Under Draft Preparation

[9]SSP2 Middle of the Road (Medium challenges to mitigation and adaptation): The world follows a path in which social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceeds unevenly, with some countries making relatively good progress while others fall short of expectations. Global and national institutions work toward but make slow progress in achieving sustainable development goals. Environmental systems experience degradation, although there are some improvements and overall the intensity of resource and energy use declines. Global population growth is moderate and levels off in the second half of the century. Income inequality persists or improves only slowly and challenges to reducing vulnerability to societal and environmental changes remain.

#### 5.2.2.1. Climate Scenario Statements[10]

*Table 5.4: Trichy Climate Scenario Statement*

| Projection Period | Increase in Annual Average Maximum Temperature (°C)[11] | |
|---|---|---|
| | SSP2 4.5 Scenario | SSP5 8.5 Scenario |
| **Near Century (2020 - 2046)** | 0.3 | 0.5 |
| **Mid Century (2047 - 2073)** | 1.1 | 1.7 |
| **End Century (2074 - 2100)** | 1.6 | 3.3 |
| **Projection Period** | **Increase in Annual Average Maximum Temperature (°C)** | |
| | SSP2 4.5 Scenario | SSP5 8.5 Scenario |
| **Near Century (2020 - 2046)** | 0.7 | 0.9 |
| **Mid Century (2047 - 2073)** | 1.4 | 2.3 |
| **End Century (2074 - 2100)** | 2.0 | 4.3 |

| Parameter | SSP2 4.5 Scenario | | |
|---|---|---|---|
| | Near Century (2020 - 2046) | Mid Century (2047-2073) | End Century (2074-2100) |
| **Percentage Changes in Annual Average Rainfall (%)** | 6.3 | 13.6 | 21.9 |

**Climate Risk 1**: Average temperatures, heat wave events and number of hot days and nights may increase in future.
**Climate Risk 2**: Total rainfall and extreme rainfall events are expected to increase in the future.

## 5.3 Risk and Vulnerability Assessment

Based on climate trends and projections, climate risks were identified and analysed, according to the likelihood of occurrence and consequences. Inferences drawn from GIS based spatial analysis and analysis of relevant climate and qualitative information received during stakeholder consultations, informed the climate risk assessment.

Information from the State Disaster Management Plan (Tamil Nadu) and Disaster Management Plan (Trichy 2023)[12] corroborated the results. It was observed that the city of Trichy is vulnerable to urban heat, urban flooding, and air pollution. Indicators used to analyse risks due to urban heat, urban flooding and air pollution are mentioned below.

[10]Based on SSP 2 prepared by Center for Climate Change and Disaster Management, Anna University. Accessed March 2024
[11]Temperature Projection with reference to baseline (1985-2014)
[12]District Disaster Management Plan - Tiruchirappalli - 2023. Accessed Dec 2023.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Years** | **1888** | **1892** | **1886** | **1906** | **1921** | **1923** | **1926** | **1929** | **2022** | | | |
| **Heat Wave** | | | | | | | | | | | | |
| **Years** | **1889** | **1891** | **1909** | **1930** | **1964** | **1976** | **1978** | **1983** | **1999** | **2008** | **2005** | **2021** |
| **Flood** | | | | | | | | | | | | |
| **Years** | | | | | | | | | | | | |
| **Drought** | **Nill** | | | | | | | | | | | |
| **Years** | | | | | | | | | | | | |
| **Cyclone** | **1924** | **1952** | **1954** | **1965** | **1977** | **1979** | **1998** | **2012** | **2018** | **2020** | **2023** | |
| **Years** | | | | | | | | Nilam | Gaja | Nivar | Michaung | |
| **Earthquake** | | | | | | | | | | | | |

*Figure 5.6: Historical Occurrence of heat waves, flood and cyclones in Trichy*
*Source: Disaster Management Plan*

## 5.3.1 Climate Risk and Fragile Urban Systems

The climatic fragility of urban systems is analysed in terms of service levels and baseline infrastructure in the city, with the repercussions of climate risks identified above – increased temperature and heat wave events and increased rainfall and extreme rainfall events. Urban heat, urban flooding, and air pollution may directly or indirectly impact various urban services. The vulnerability of urban services such as water supply, storm water and wastewater management, solid waste management, transportation, emergency services, and public parks is assessed in this section. By superimposing the climate risks on these fragility statements, climate fragility statements (CFS) were developed for each urban system and a risk assessment was conducted in terms of their likelihood and consequence. The risk assessment exercise included in-person meetings with senior TCC officials. Fragile urban systems, their criticality, actual and predicted problems caused by fragility, and specified fragility assertions are presented in Table 5.6.

Fragile urban systems and prevalent climate hazards impact the city and citizens. These impacts are captured in the climate fragility statements. The risk status of the climate fragility statements is assessed by estimating the likelihood of occurrence of these impacts and consequence of these impacts on urban systems and populations. The risk assessment exercise involved in-person discussions with key officials of VMC and with members of the stakeholder committee.

The analysis of climate hazards on urban systems in Trichy is done further. According to the risk assessment detailed in Table 5.6, flooding poses a more significant threat to urban infrastructure compared to the effects of urban heat. However, urban flooding and urban heat present serious risks to water-related infrastructure, such as water supply and sewerage systems, highlighting their vulnerability. In terms of solid waste management, the impact of urban flooding is considered extreme, while the impact from urban heat is categorised as high. These insights are crucial for shaping the interventions in the climate action plan, helping to prioritise which areas require the most urgent attention and resources.

*Table 5.5: Critical urban systems and climate fragility statements*

| Urban System | Why is it critical or fragile? |
|---|---|
| Water Supply | • Significant extraction from the banks of River Cauvery and Coleroon.<br>• Decrease in groundwater levels in south side of the city (in locations like KK Nagar, Kundan Nagar, Iyappan Nagar & parts of K.Sathanur)<br>• Increased groundwater consumption in developing areas, particularly by private water supply tanker companies and real estate developers.<br>• Limited intervention for groundwater recharging<br>• Increased strain on the current water delivery infrastructure as demand grows.<br>• Old pipeline network increases chances of contamination |
| Wastewater | • Frequent breakdown and leakages in old sewerage network in centre and eastern part of the city areas, contaminating ground water.<br>• Discharge of excess wastewater in natural drains due to limited wastewater pumping and sewage treatment plant capacity.<br>• Sludge generated from wastewater treatment is allowed to be used by farmers for agricultural purposes, increases risk of heavy metal contamination in soil.<br>• Improper septage discharge in natural drains by private contractors, particularly in newly merged areas.<br>• Lack of recycling and reuse of treated wastewater<br>• Citizens opening sewerage manhole cover during extreme rainfall events, solid/ plastic waste entering and blocking sewerage network. Wastewater overflow issues in several areas, leading to health hazards. |
| Solid Waste | • Lack of holistic approach for effective solid waste management<br>• Lack of segregation at source results in inefficient treatment<br>• Illegal waste dumping on streets and natural drains chocks up sewage lines leading to stagnation, health and hygiene issues<br>• Significant dependence on external funding schemes like SBM 2.0 |

| | Existing and anticipated problems caused by the fragility of this system | Responsibility | Climate Fragility statement |
|---|---|---|---|
| | • Limited surface water resources available for supply, particularly during summer<br>• Contamination of ground water especially in location like Rettai Vaikkal<br>• Contaminated piped water supply and pressure drop issues<br>• Disruption in water supply<br>• Increased cases of water borne diseases, especially in wards vulnerable to flooding | Engineering Department of TCC<br><br>TWAD<br><br>PWD | Increase in temperatures may lead to increased water demand, greater use of groundwater and ultimately lead to the depletion of the water table. Use of sources that have questionable water quality can impact public health and productivity.<br><br>Increased intensity of rainfall may lead to urban flooding, disrupting water distribution systems and impacting public health. |
| | • Environmental and groundwater pollution due to combined sewer overflows during rainy season and due to by-passing of excess untreated wastewater<br>• Increased water and vector borne diseases cases<br>• Direct methane emission due to compromised gas chamber and direct use of dry sludge for agricultural purposes may lead to severe health hazards | Engineering Department of TCC | Mixed discharge of rain water and sewerage in sewer lines in times of high intensity rainfall, may render sewage treatment systems ineffective and lead to untreated wastewater flowing into channels and river, causing public health risks. |
| | • Increased sewerage network blockages<br>• Increased chances of vector borne diseases<br>• Unhygienic conditions for workers | Health Department, TCC | Increasing temperatures accelerate decomposition rates and also create potentially hazardous conditions in open dumpsites by increasing the probability of landfill fires.<br><br>Increased rainfall causes uncollected solid waste to block drainage network, causing urban flooding, leading to public health risks. |

| Urban System | Why is it critical or fragile? |
|---|---|
| Transport | • Inadequate public transport fleet.<br>• Lack of integration between various modes of public transport, limited first and last mile connectivity, inadequate NMT infrastructure; particularly.<br>• Limited ITMS coverage makes remote management of traffic challenging<br>• Traffic congestion due to limited parking facilities, vendor encroachment on roads, erratic vehicle movement, and the absence of planned traffic movement.<br>• Unorganized operations of autorickshaws, is unsafe mode of travel due to overloading and poor services |
| Emergency Services | • 27% of slum population has limited accessibility (beyond 2500 m distance) to government health centres. They are compelled to use expensive private health care facilities or risk an illness and fatality.<br>• Access to emergency services is hampered during significant rainfall occurrences owing to water logging and urban flooding.<br>• Dwellings in slum regions are damaged by heavy rain and are prone to fire during periods of intense heat. |
| Urban Green Spaces and Biodiversity | • The city has 10.57% of green cover which includes 234 public parks and gardens with good accessibility. Green cover is less in the southern side of the city.<br>• Increased built-up area with low permeability decreases percolation, and hence diminishes ground water recharge. |

| | Existing and anticipated problems caused by the fragility of this system | Responsibility | Climate Fragility statement |
|---|---|---|---|
| | • Increased reliance on private vehicles<br>• Increasing air pollution<br>• Regular chaos on major corridors and traffic congestion<br>• Increased chances of road accidents, particularly cyclists and pedestrians are vulnerable | SETC<br>Engineering Department, TCC<br>Transport Department, GoTN<br>Transport Commissionerate, GoTN<br>Traffic Police | Increased temperatures and rainfall may limit the use of public transport and increase dependence on personal vehicles, leading to greater emissions.<br>Increased temperatures may adversely impact the health of commuters, riders using two wheelers, pedestrians and cyclists, especially, elderly, and young children.<br>Extreme rainfall events are likely to worsen the road infrastructure, especially the already damaged sections. During periods of intense rainfall, waterlogged roads will further exacerbate road congestion, affects connectivity and lead to high air and noise pollution. |
| | • Due to paucity of affordable critical health care services, during an epidemic outbreak, extreme heat conditions and extreme rainfall, population in the lower income group may not have access to adequate health care facilities. | Health Department - TCC<br>Fire & Rescue Services Department, Trichy Region | Increased heat and heat waves may increase the number of heat stroke and heat stress related cases with a higher impact on the elderly, children and populations working in outdoor conditions. This may be exacerbated with limited accessibility to healthcare and/or emergency services.<br>Increase in extreme rainfall and water logging may lead to disease outbreak, with higher impact on populations living in slums with limited accessibility to healthcare and/or emergency services. |
| | • Increased runoff resulting from an increase in paved surfaces | Parks and Garden Department, TCC | Increased heat conditions may intensify urban heat island impacts, because of expanding built-up areas. Increased rainfall may increase urban flooding, due to an increase in impermeable surfaces. |

*Table 5.6: Risk Status of Fragile Urban Systems*

| Urban System | Climate Fragility Statements | Likelihood (a) | |
|---|---|---|---|
| | | **Probability of occurrence of an event<br>Almost certain- 5<br>Likely- 4, Possible- 3<br>Unlikely- 2, Rare- 1** | |
| Water Supply | Increase in temperatures may lead to increased water demand, greater use of groundwater and ultimately lead to the depletion of the water table. Use of sources that have questionable water quality can impact public health and productivity. | 5 | |
| Wastewater | Increased intensity of rainfall may lead to urban flooding, disrupting water distribution systems and impacting public health. | 4 | |
| | Mixed discharge of rain water and sewerage in sewer lines in times of high intensity rainfall, may render sewage treatment systems ineffective and lead to untreated wastewater flowing into channels and river, causing public health risks. | 4 | |
| Solid Waste | Increasing temperatures accelerate decomposition rates and also create potentially hazardous conditions in open dumpsites by increasing the probability of landfill fires. | 4 | |
| | Increased rainfall causes uncollected solid waste to block drainage network, causing urban flooding, leading to public health risks. | 4 | |
| Transport | Increased temperatures and rainfall may limit the use of public transport and increase dependence on personal vehicles, leading to greater emissions. | 4 | |
| | Extreme rainfall events are likely to worsen the road infrastructure, especially the already damaged sections. During periods of intense rainfall, waterlogged roads will further exacerbate road congestion, affects connectivity and lead to high air and noise pollution. | 4 | |
| Emergency Services | Increased heat and heat waves may increase the number of heat stroke and heat stress related cases with a higher impact on the elderly, children and populations working in outdoor conditions. This may be exacerbated with limited accessibility to healthcare and/or emergency services. | 4 | |
| | Increase in extreme rainfall and water logging may lead to disease outbreak, with higher impact on populations living in slums with limited accessibility to healthcare and/or emergency services. | 4 | |
| Urban Green Spaces and Biodiversity | Increased heat conditions may intensify urban heat island impacts, because of expanding built-up areas. Increased rainfall may increase urban flooding, due to an increase in impermeable surfaces. | 3 | |

| | Consequence (b) | Risk Score (axb) | Risk Status |
|---|---|---|---|
| | **Impact of an event**<br>**Catastrophic- 5**<br>**Major- 4, Moderate- 3**<br>**Minor- 2, Insignificant- 1** | **Risk= Likelihood Consequence** | **Extreme- >15**<br>**High- 11-15**<br>**Medium- 5-10**<br>**Low-<5** |
| | 4 | 20[1] | Extreme |
| | 4 | 16 | Extreme |
| | 4 | 16 | Extreme |
| | 3 | 12 | High |
| | 5 | 20 | Extreme |
| | 4 | 16 | Extreme |
| | 5 | 20 | Extreme |
| | 4 | 16 | Medium |
| | 5 | 16 | High |
| | 4 | 12 | Medium |

## 5.3.2 Climate Vulnerability Assessment

Further analysis of the Land Surface Temperature and spatial analysis of areas susceptible to flooding supported the identification of vulnerable hotspots. Parameters used to assess vulnerable hotspots, vulnerable urban systems and population are mentioned in Table 5.7.

*Table 5.7: Parameters Considered for Risk Assessment*

| Climate Hazards | Parameters Considered for Risk Assessment |
|---|---|
| Urban Heat | 1. Air temperature trend analysis (including change in hot and cold days/ nights),<br>2. Analysis of heatwave events,<br>3. Surface temperature analysis and hotspot areas,<br>4. Feel like temperature analysis (developing heat index) |
| Urban Flooding | 1. Trend of rainfall pattern and intensity,<br>2. Spatial analysis of flooding / water logging points and causes,<br>3. Ward level analysis of water and vector borne diseases |
| Air Pollution | 1. Analysis of annual and monthly air quality data (primary pollutants like $PM_{10}$ as rest is within CPCB norms)<br>2. Identification of critical areas and source of air pollution |

Discussions among key officials of TCC and other stakeholders informed the climate vulnerability assessment exercise. Impacts of urban heat, urban flooding and air pollution on the population and various urban systems and the climate fragility of urban systems were evaluated through this exercise. Fragile urban systems that have a high-risk status were investigated further.

#### 5.3.2.1 Vulnerability to Urban Heat

Hotspots vulnerable to urban heat are assessed by analysing i) Land surface temperature, ii) Heat index analysis (feels like temperature), and iii) Heatwave event scenario in the city.

Table 5.8 describes the indicators and methodology used for the vulnerability assessment of urban heat.

*Table 5.8: Indicators and methodology used for Extreme Heat risk assessment*

| Indicator | Methodology |
|---|---|
| **LST Analysis** | **Methodology Used**: Temporal analysis (pixel-based statistical analysis) of satellite imagery for day and night times for years 2015, 2018, 2021, 2022 and 2023 was conducted to understand the trend of LST. LST hotspots were identified. Hotspot areas with consistently higher land surface temperature as compared with median temperature above 40°C were considered.<br>**Data Used**: Satellite imagery from 2015, 2018, 2021, 2022 and 2023 – day and night time analysis considered for hotspot identification)3. Surface temperature analysis and hotspot areas,<br>**Data Source**:<br>1. Daytime Surface Temperature: 30X30m resolution LandSat8 image<br>2. Nighttime Surface Temperature: 500 X 500m resolution MODIS image |
| **Heat Index Analysis (Feel Like Temperature)** | **Methodology Used**: Heat index (feel like temperature) was analysed based on correlation between air temperature and humidity to establish and understand levels of thermal comfort in the city as per 'National Guidelines for Preparation of Action Plan – Prevention and Management of Heat Wave', prepared by NDMA.<br>**Data Used**: Air temperature and humidity data for May 2021<br>**Data Source**:<br>1. Air temperature data: 5 environmental sensors[13] (TNPCB, IMD & Tamil Nadu Agricultural Wether Network)<br>2. Relative Humidity data: 5 environmental sensors (TNPCB, IMD & Tamil Nadu Agricultural Wether Network) |
| **Heat Wave Events[14] and Trend** | **Data Used**: Information derived from the '**Heat wave Action Plan of Tamilnadu**'<br>**Data Source**: IMD Data, District Disaster Management Profile |

[13]Sensor distribution - TNPCB (5), IMD (1), Agriculture Department (4) - Locations indicated in Annexure E - Table E1

[14]Heat wave events: Heat wave event is said to occur when maximum temperature of a station reaches at least 40°C or more for plains and at least 30°C or more for hilly regions (IMD)

#### 5.3.2.1.1 Land Surface Temperature Analysis

Land Surface Temperature (LST) is a result of emissivity of surfaces across various types of land use, different materials used, blue and green infrastructure, and various anthropogenic activities. Figure 5.6 shows the LST analysis for 2015, 2018, 2021, 2022 and 2023.

The LST of vacant or barren land is observed very high as compared with other built-up areas during the day; and vis-à-vis during night time. Soil type in Trichy is alluvial with crystalline formations in several location. Due to low water levels in the larger parts of the years on the river bed of Cauvery and Araiyar, heat is absorbed at higher levels during daytime and releases heat faster and gets cooler at night. As concrete absorbs heat during the day and releases it during cooler hours at night, the surface temperature of land parcels with built infrastructure is high at night. Annexure E - Table E1: shows analysis results and correlation between day and nighttime LST, and built-up area for 2015, 2018, 2021, 2022 and 2023. Heat risk locations with high LST during the day have been identified (Figure 5.7).

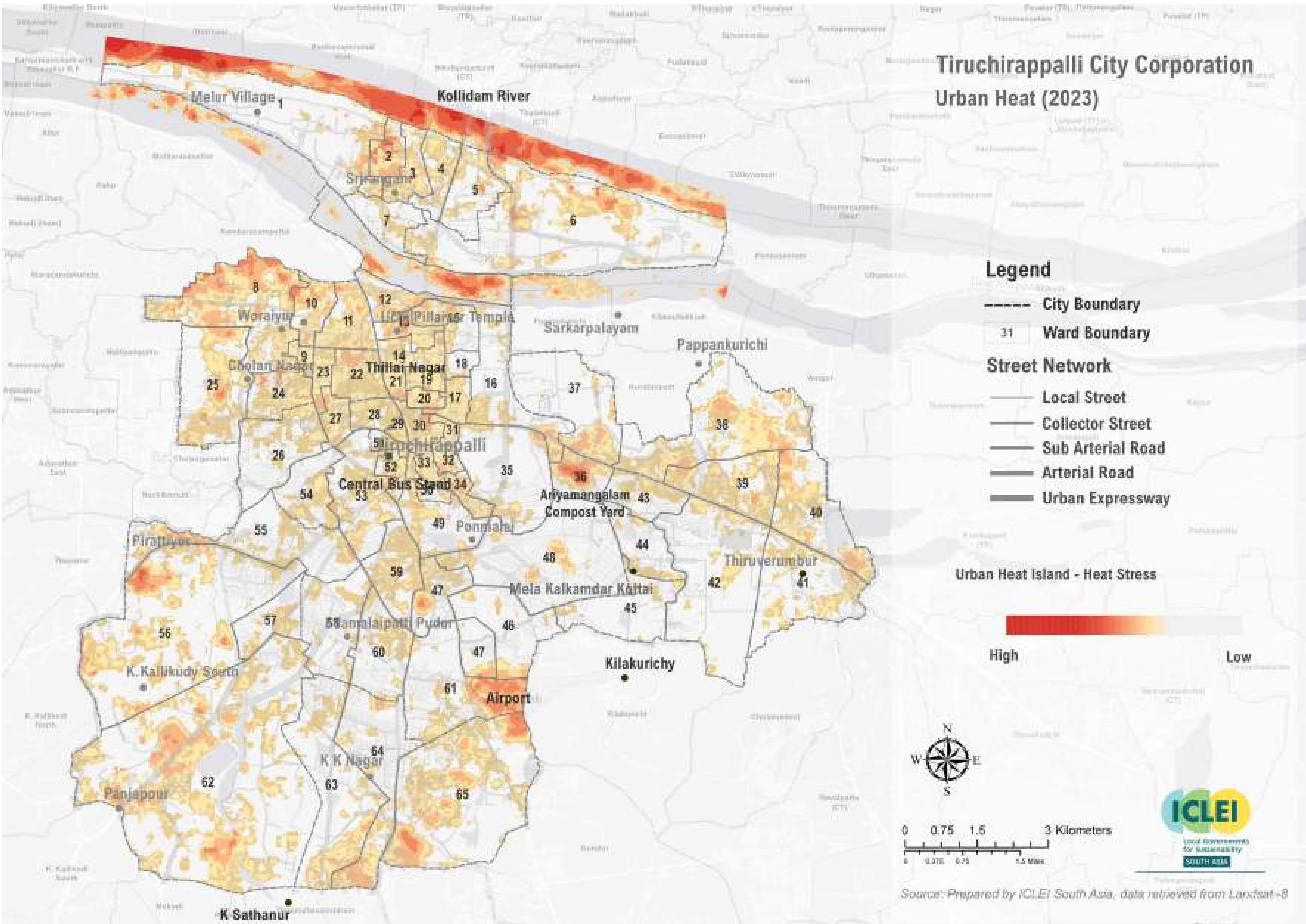



*Figure 5.7: Land Surface Temperature heat risk areas, May - 2023*
*Source: Prepared by ICLEI South Asia*

**Hotspots with high surface temperature (>40°C) in Trichy include:**

- Central Bus Terminal, Ariyamangalam, Railway Stations, Paalpannai, Head Post Office Junctions, Gandhi Market, Pirattiyur and Thillai Nagar.

**Land Surface Temperature Scenario :**

LST varies from 37.5°C to 43°C during the day and from 22.1°C to 25.7°C at night.

32% of the total city area falls under hotspot areas, with LST more than median of 40°C, impacting 18% of the population in 2023.

### 5.3.2.1.2 Heat Index Analysis (Feel Like Temperature)

Feel-like temperature (also known as apparent temperature or heat index) is used to represent thermal comfort levels and reflects how the temperature is experienced by the human body when the effect of ambient relative humidity is combined with air temperature.

The analysis uses the heat index chart of the National Weather Service of the United Statesin the absence of a chart specific to the Indian conditions. It indicates that the city experiences heat conditions varying from 'extreme caution' to 'danger' during summer. Heat conditions[15] classified as 'danger' are experienced on most days. These conditions pose an increased risk of heat cramps, heat exhaustion or even heat strokes to vulnerable population groups.

A spatial analysis of the heat index shows that the north centre and central areas of the city (i.e Central bus stand, Sir Ranjam, Ayyappa Nagar, Railway St) experience a high heat index of more than 42.7˚C (Figure 5.8). Areas with a feel-like temperature of more than 37°C have been considered as hotspot areas with high risks. This is the threshold temperature above which IMD/Trichy District Administration issues a heat wave yellow alert.

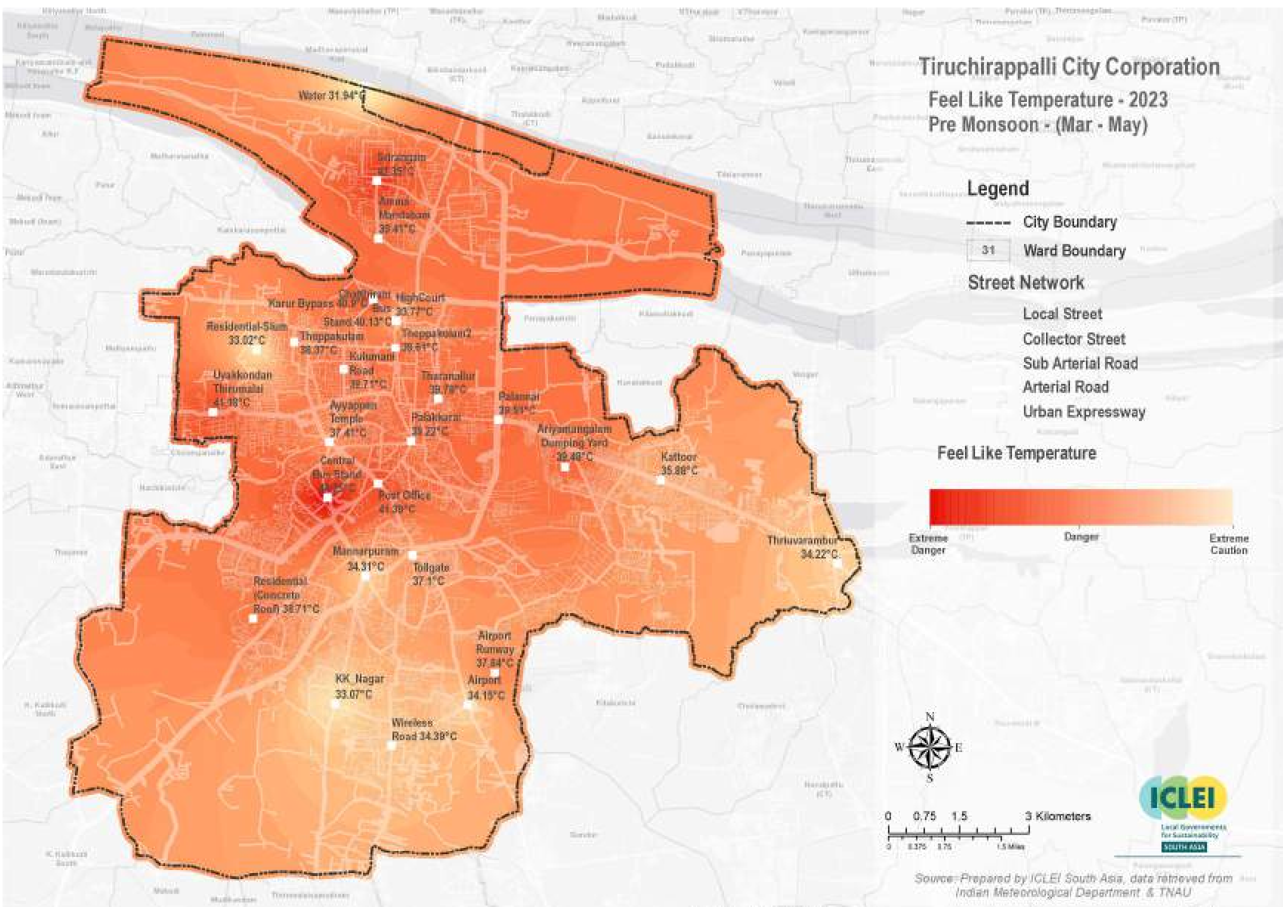



*Figure 5.8: Feel Like Temperature, Tiruchirappalli (May 2023)*
*Source: Prepared by ICLEI South Asia*

[15] Heat index conditions classification: Caution(<=32°C), Extreme Caution (33°C to 39°C), Danger (40°C to 52°C) and Extreme Danger (>52°C) as per 'National Guidelines for Preparation of Action Plan – Prevention and Management of Heat Wave'.

**High heat index hotspots in Tiruchirappalli include:**

- Central Bus Terminal, Ariyamangalam Dumping Site, Gandhi Market, Paalpannai, Chindamani.

**Heat Index Scenario :**

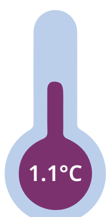
- Tiruchirappalli experiences heat conditions varying from 'extreme caution' to 'danger' during summer
- Risk areas include 8% of the city area, with feel like temperature of more than 39.4°C impacting 23% of the population

### 5.3.2.1.3 Heat Wave Events and Trend

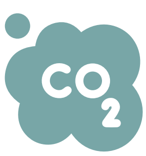
Data from IMD and TN-SAPCC indicates that the number of heatwave events has increased to 21. Increase in the number of heatwave events per year will have a significant impact on people's productivity and health, particularly vulnerable people, including slum dwellers and vendors. Heat-related mortality is not recorded in the city's Disease Surveillance and Death Record System, but heat stress morbidity cases are increasing during the summer.

## Heat Wave Events and Trend:


The number of hot days has increased to 21 days in the period of analysis




and the average temperature is expected to rise by 1.1°C in SSP 2 - 4.5.



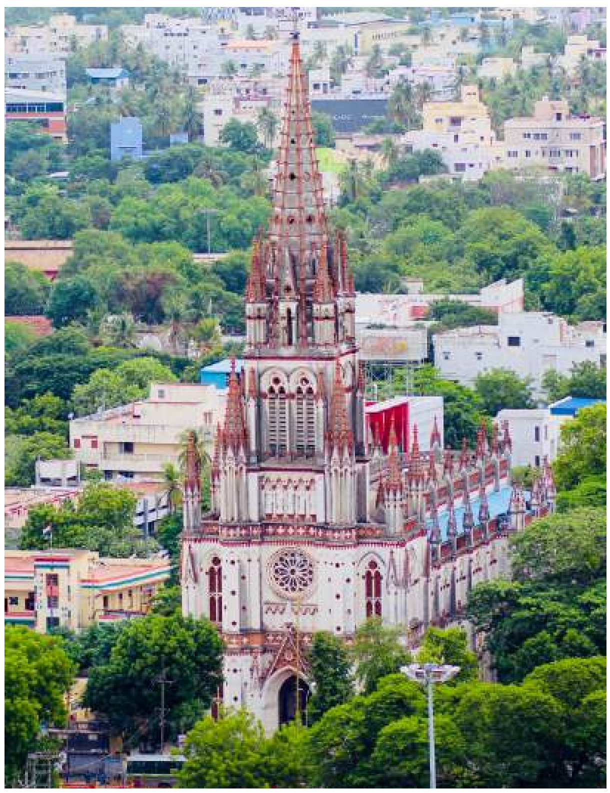

The actual increase depends on the level of efforts made to curb greenhouse gas (GHG) emissions. This increase in heat wave events may have severe public health implications.

### 5.3.2.1.4 Urban Areas Vulnerable to Extreme Heat

This section identifies areas impacted by high LST (more than 40°C temperature) (Figure 5.6), high feel like temperature (more than 40°C temperature) (section 5.7). This information is used to examine vulnerabilities due to heat risks.

**Heat Risk Areas (impacted by high LST and high Feel-Like Temperature) in Trichy include:**

- Areas: Central Bus Terminal, Ariyamangalam Dumping Site, Gandhi Market, Paalpannai, Chindamani.
- Industrial areas that are highly vulnerable to urban heat conditions may severely impact the health of workers (Figure 5.9).



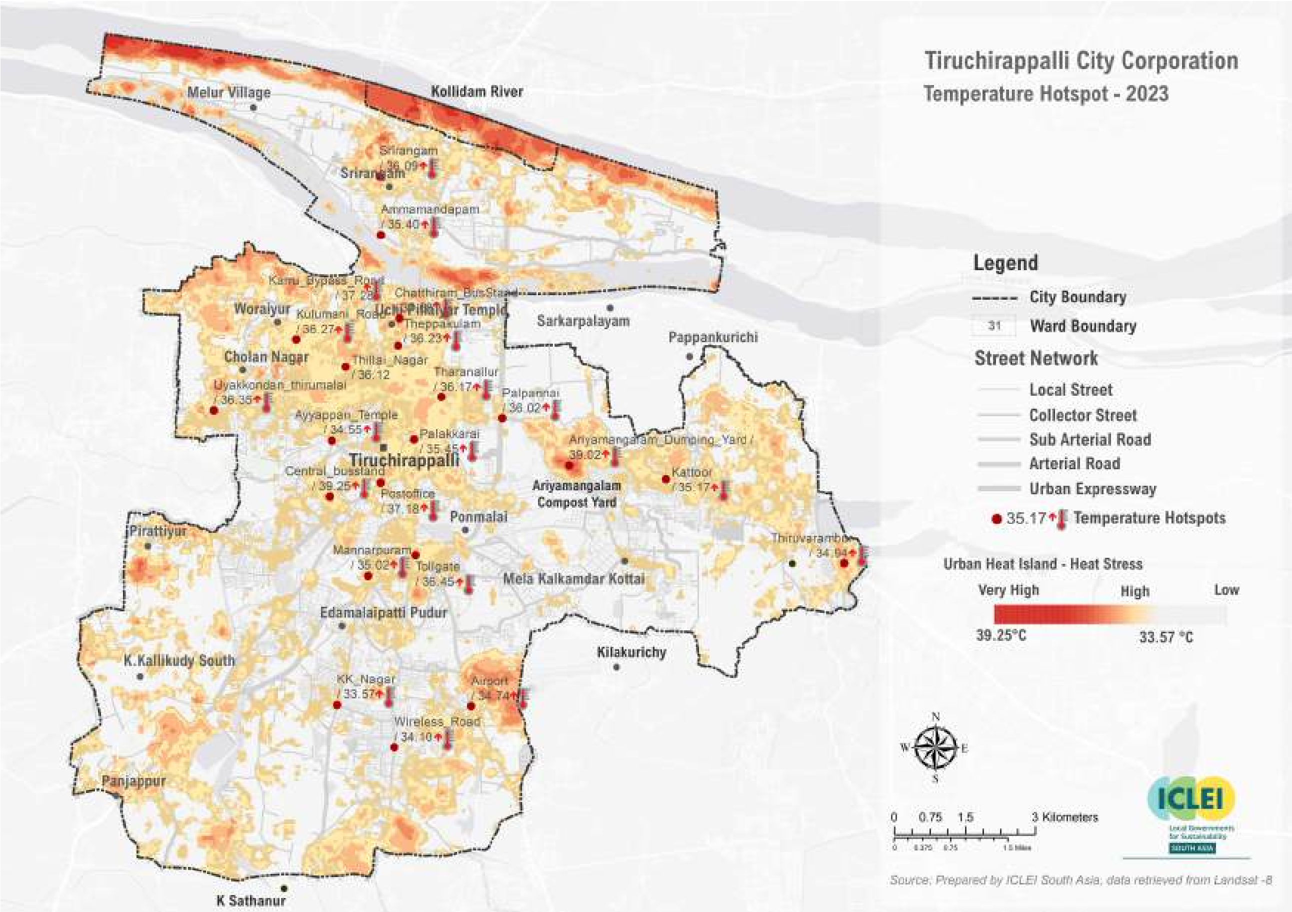



*Figure 5.9: Areas vulnerable to Urban Heat[16]*
*Source: Prepared by ICLEI South Asia*

#### 5.3.2.1.5 Population Groups Vulnerable to Heat

Figure 5.10 shows the spatial distribution of vulnerable population groups.

**Population Groups Vulnerable to Urban Heat[17]**

**Vulnerable population:**

12% of the total population in the city (0.12 million people - 60,720 females and 59,280 males)

**Vulnerable population by age:**

Total 11.292 children

**Vulnerable population by income group:**

14,400 people living in slum localities

[16]Areas impacted by urban heat include areas impacted by high surface temperature (>40°C) and/or high feel like temperature (>36.4°C). The classification of vulnerable, highly vulnerable, and extremely vulnerable areas is based on ArcGIS analysis using the 'weighted overlay' tool.

[17]These values are estimated based on total population of identified hotspot areas; actual numbers may vary.

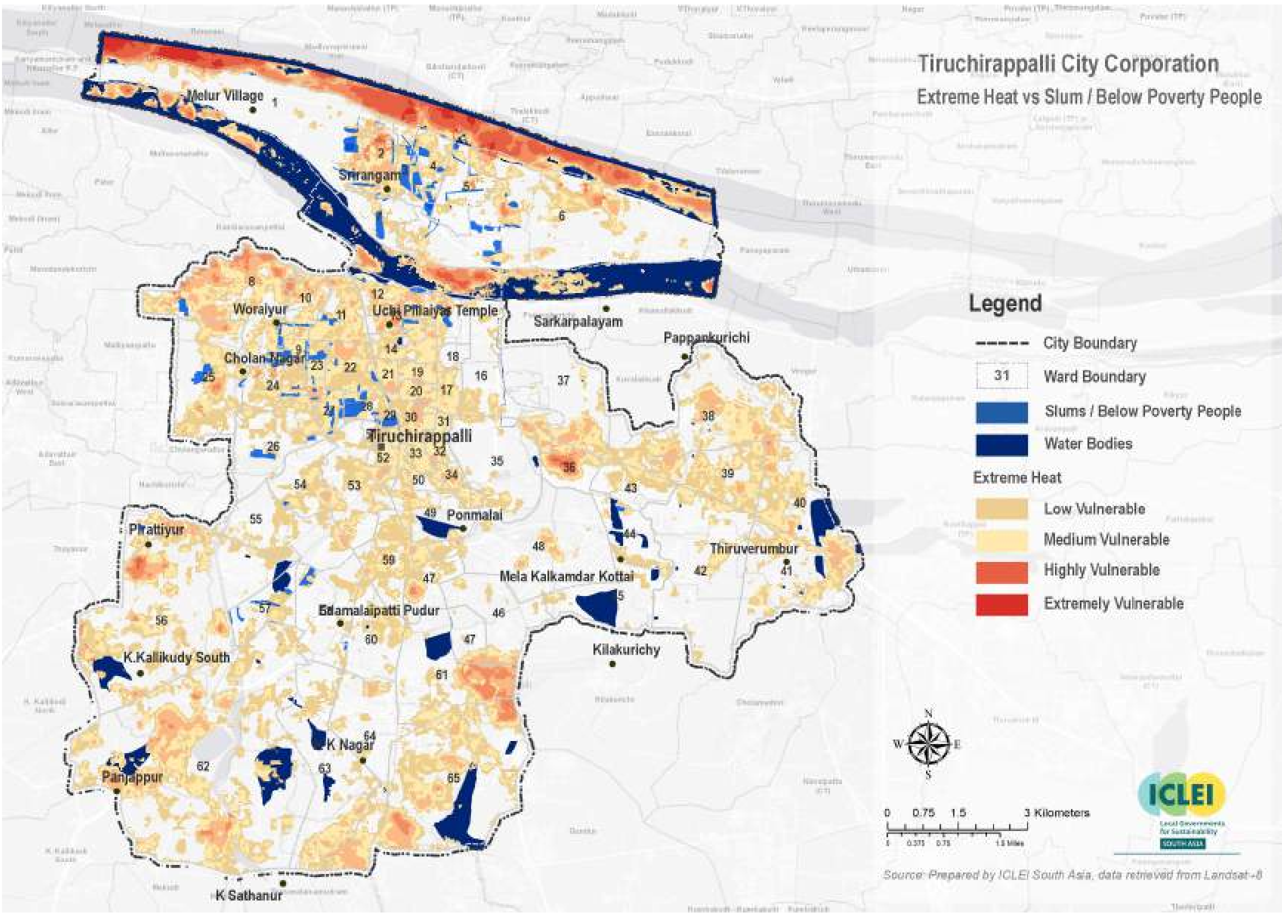



*Figure 5.10: Slums vulnerable to Urban Heat*
*Source: Prepared by ICLEI South Asia*

#### 5.3.2.2 Vulnerability to Urban Flooding

The urban flood risk is assessed by analysing i) spatial analysis of water-logged or flood areas by overlaying natural drainage, city's storm water drainage network and road network layers, and ii) ward level analysis of water and vector borne diseases. This analysis resulted in the identification of areas most affected by waterlogging/flooding and probable causes that need attention. Table 5.9 describes the indicators and methodology used for urban flood vulnerability.

Waterlogging is most prevalent in the areas that are on the banks of the various channels and the main carriers of flood water namely Uyyakondan, Koraiyar & the Cauvery itself. Insufficient storm water drainage network, degraded condition of natural drainage, and lack of consideration of natural contours during road and building planning are some of the issues, which leads to flooding and water stagnation issues. Urban flooding affects health and hygiene, mobility, and economic productivity in the long run. People living within a 250m buffer zone of flood or water-logged locations are at higher risk.

Ward numbers 28, part of 2, 27, 21, part of 17, part of 31, part of 33, part of 53, 52 and part of 30 are some of the critical wards severely impacted by waterlogging. (Figure 5.11).

Since each of the vulnerable have a combined risk level based on the height of the ground level and population, the assessment was done at a pixel level (100 m x 100m) based on the population density to help prioritize flood interventions reducing population impact. Each pixel has a population density as indicated in the legend of Figure 5.12. It is estimated that out of the areas vulnerable to urban floods 2% of the area has a high population density of 125-157 persons per 100m x 100m grid.

*Table 5.9: Indicators and methodology used for Urban Flood vulnerability assessment*

| Indicator | Methodology |
|---|---|
| **Analysing Water Logging or Flooding Causes** | **Methodology Used**: Analysis from satellite imagery using Digital Elevation Model. Natural contours and streamlines were overlaid with flood points, storm water network, road network, and built-up area (using Google Earth) layers, to identify most affected areas and causes of flooding or water logging. Areas located within a 250 m buffer of 200 flood points[18] have been identified as high-risk areas. Urban flood risk is examined by analysing and correlating spatial information with qualitative information and data received from TCC, and through stakeholder consultations. Based on data provided by TMC, 73 water-logged areas or flood points were mapped spatially (Figure 5.10).<br><br>**Data Used**: Water Logging Points (FY 2022-23 from TCC),<br><br>**Data Source**: 30X30m resolution LandSat8 image (May 2023) |
| **Analysis of Water and Vector Borne Diseases and Correlation with Urban Flooding** | **Methodology Used**: Flood risk areas and spatial analysis of ward level water and vector borne disease cases are overlaid to build a correlation between flood prone areas and occurrence of water and vector borne diseases.<br><br>**Data Used**: Water and vector borne disease data for 2021.<br><br>**Data Source**: Health Department, TCC |

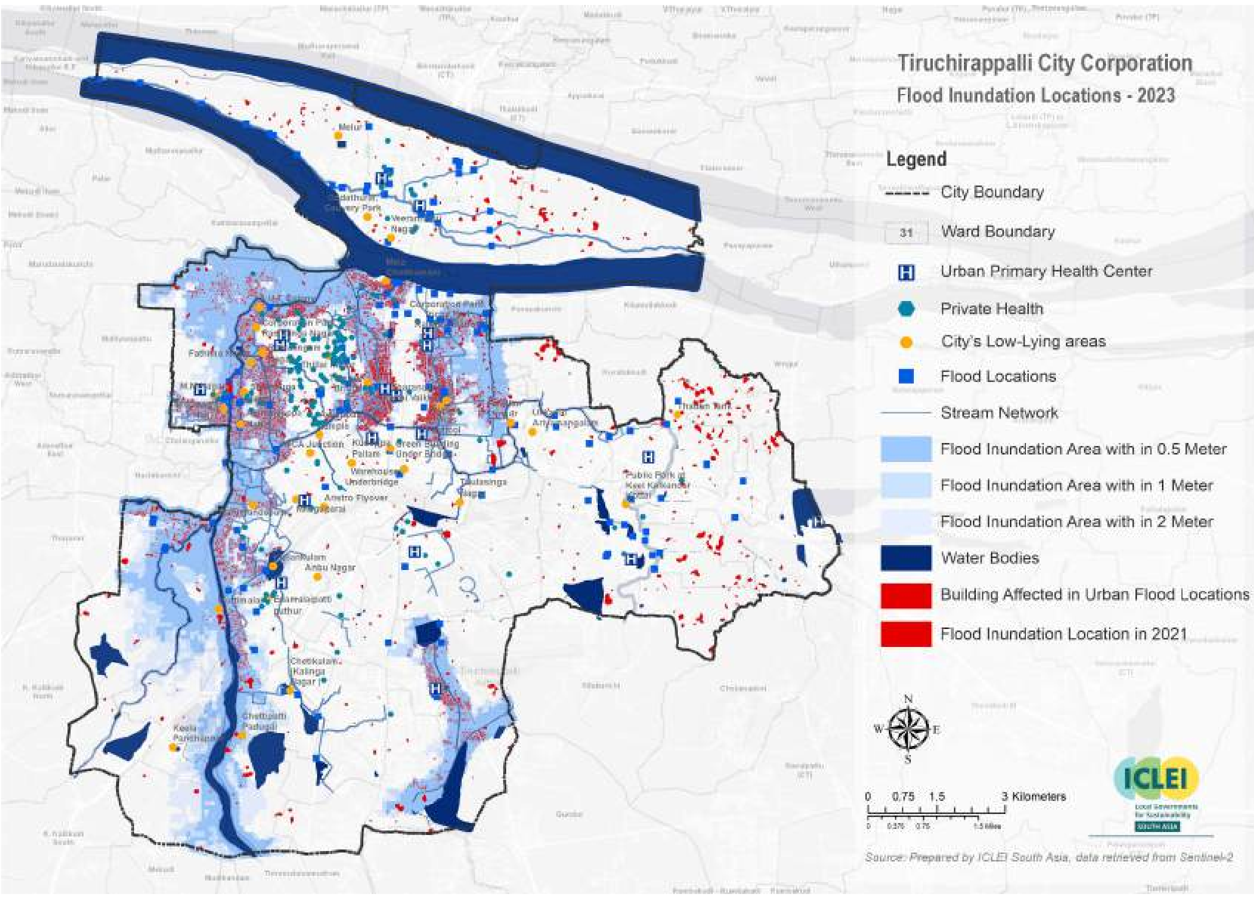



*Figure 5.11: Population vulnerable to Urban Flooding*
*Source: Prepared by ICLEI South Asia*

[18]Many of these locations are mostly clustered together due to their proximity.

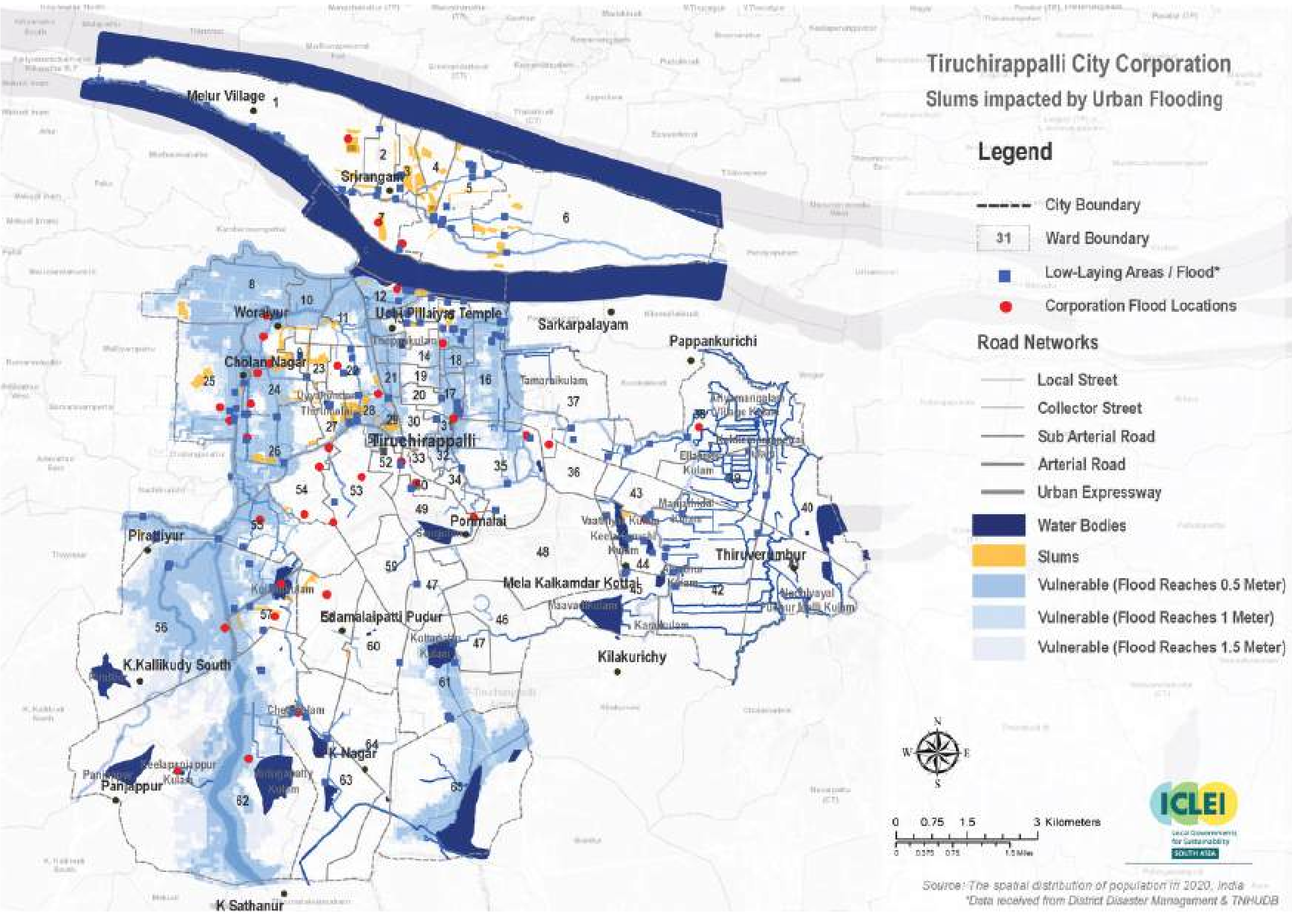



*Figure 5.12: Population vulnerable to Urban Flooding risk at varied depths*
*Source: Prepared by ICLEI South Asia*

The vulnerability of Trichy to both urban and riverine flood for various water levels. It was determined that about 21% of the city falls with the influence area of urban floods impact or river-based floods.

Approximately 20% of all buildings, including residential, commercial, institutional, industrial, and other sectors, are experiencing damage due to flooding within the city limits. Though TNCDBR allows for raising GI level of buildings by 1.5 above the surrounding area, several buildings built over the last 30 years now fall significantly below road level. This leads to flooding of up to 0.5 m.

### Urban Flooding

Urban flood risk in the city is increasing with extreme rainfall events. People residing within a 250m buffer zone of 200 water-logged areas or flood points are at high risk and prone to severe health hazards.

### Vulnerable population:

Ward numbers 28, part of 2, 27, 21, part of 17, part of 31, part of 33, part of 53, 52 and part of 30 are some of the critical wards severely impacted by water logging.

**21% of the city area is impacted by urban flooding or water logging, affecting 0.23 million population.**

#### 5.3.2.2.1 Population Groups Vulnerable to Urban Flooding

The vulnerable population groups impacted by urban flooding have been mapped (Figure 5.13). A 250 m buffer zone area around the flood points is considered for the identification of vulnerabilities due to urban flood risk.

**Population Groups Vulnerable to Urban Flooding**[19]

**Vulnerable slum population:**

21% of the total population in the city (Total 0.228 million people – 1,16,000 females and 1,12,000 males).

**Vulnerable population by age:**

21,480 children.

**Vulnerable population with poor workplace condition**

Urban flooding renders public infrastructure, such as roads, pumping stations; inaccessible emergency services; impacting the daily livelihood of street side vendors and slum dwellers.

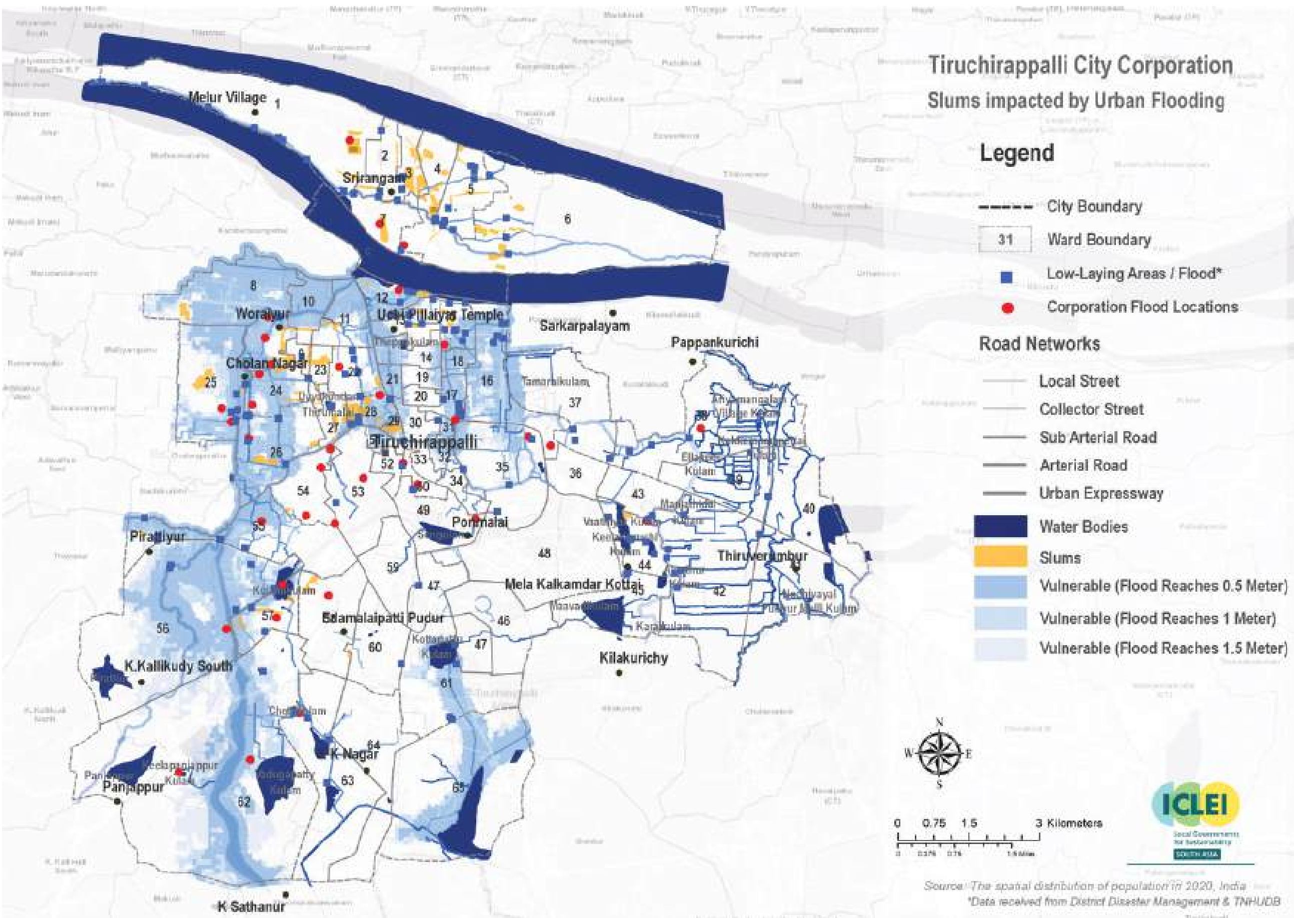



*Figure 5:13: Slums impacted by Urban Flooding*
*Source: Prepared by ICLEI South Asia*

[19]Numbers are estimated as per total population numbers; actual numbers may vary.

#### 5.3.2.3 Air Pollution Risk

Air pollution has a direct effect on the microclimate of the city. The air pollution risk for Trichy is assessed by examining i) the trend of primary air pollutants (i.e., $PM_{10}$), and ii) spatial analysis of pollution in the city. Table 5.10. presents the indicators and methodology used for air pollution risk assessment.

*Table 5.10: Indicators and methodology used for Air Pollution risk assessment*

| Indicator | Methodology |
|---|---|
| **Air Pollution Trend Analysis** | **Methodology Used**: Air pollution trend analysis by using daily data for primary air pollutants ($PM^{10}$). Annual average pollutant concentration is compared with NAAQS to identify critical air pollutants in the city.).<br>**Data Used**: Air pollutants data from 2016 to 2023.<br>**Data Source**: Environmental sensors integrated with command-and-control centre |
| **Analysing Air Pollution Risks** | **Methodology Used**: Spatial distribution of average concentration of critical air pollutants PM10 is analysed to identify critical areas and associated risks. Annual pollutant concentration/level exceedance days are also considered. Major air pollution sources, such as industrial areas, ongoing construction sites with built up area, and major traffic junctions, are marked spatially to understand the cause of air pollution.<br>**Data Used**: Daily pollutant wise air quality data for FY 2016-23<br>**Data Source**: 10 Environmental sensors integrated with command-and-control centre (ICCC) |

##### 5.3.2.3.1 Air Pollution Trend Analysis

Daily primary air pollutants concentration data from 10 Environmental sensors has been analysed to determine the air pollution trend from 2016 to 2023 (Figure 5.15). The annual average $PM_{10}$ concentration in the city is almost 50% higher than the prescribed limit of 60 $\mu gm^3$ by NAAQS, while annual PM2.5 concentration, NOx and $SO_2$ concentrations in the city are within prescribed limit by CPCB.

Almost ~70% of total monitored days are breaching the maximum $PM_{10}$ concentration prescribed by CPCB. Although all areas of the city are at risk due to $PM_{10}$, areas with more than 60 $\mu g/m^3$ $PM_{10}$ concentration have been identified as critical areas.

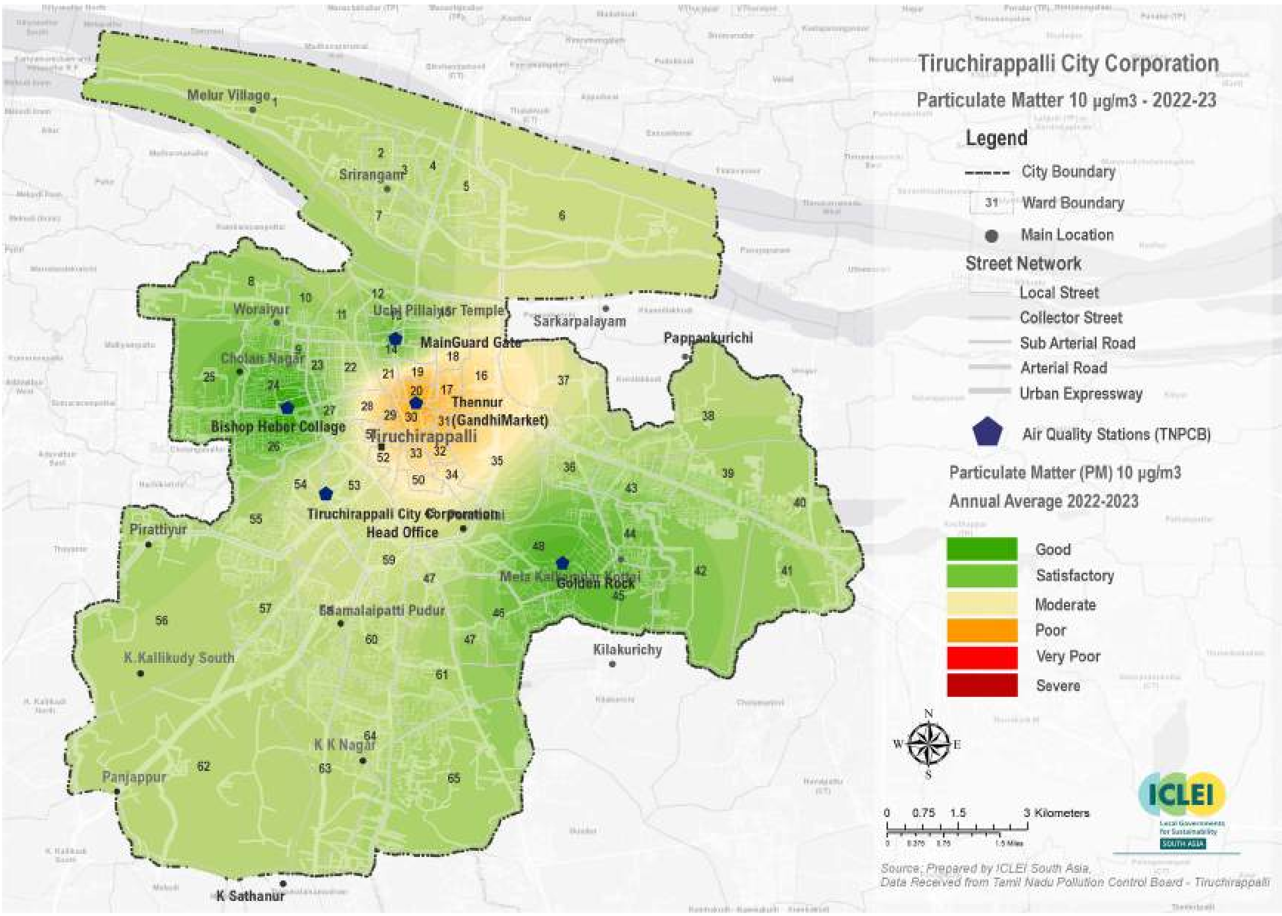



*Figure 5.14: PM₁₀ concentration across Trichy*
*Source: Prepared by ICLEI South Asia*

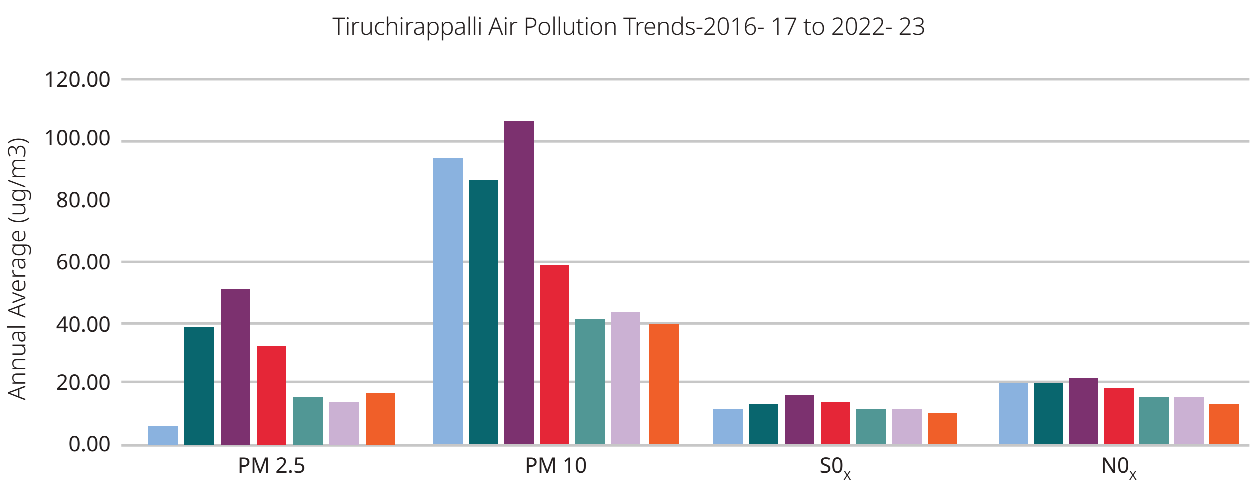



*Figure 5.15: Trend - concentration of Air Pollutants (2016-17 to 2022-23)*

### 5.3.2.3.2 Urban Areas Vulnerable to Air Pollution

Areas impacted by high $PM_{10}$ concentration (more than 60 μg/m³) are identified (Figure 5.16). Total 3.8% of the city area is vulnerable to high air pollution sources, which impacts 5.9% of the city population.

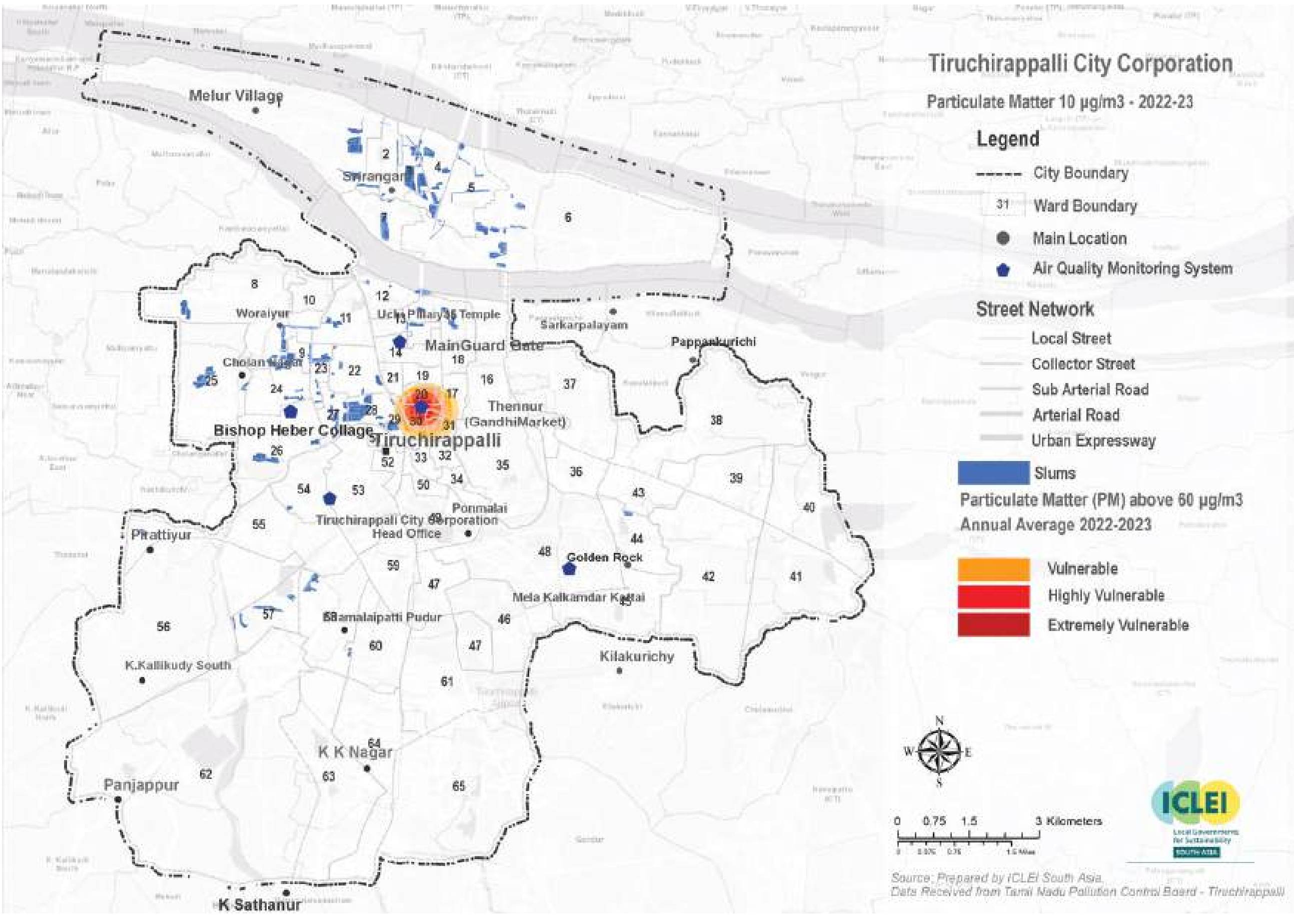



*Figure 5.16: Area vulnerable to Air Pollution (2023)*
*Source: Prepared by ICLEI South Asia*

**Air Pollution Risk**

High $PM_{10}$ concentration (more than 60 μg/m³) may severely impact the health of people. Exceedances are observed 70% of all monitored days.

**Vulnerable population by age:**

3.8% of the city area is vulnerable to high air pollution sources, which impacts 5.9% of the city population.

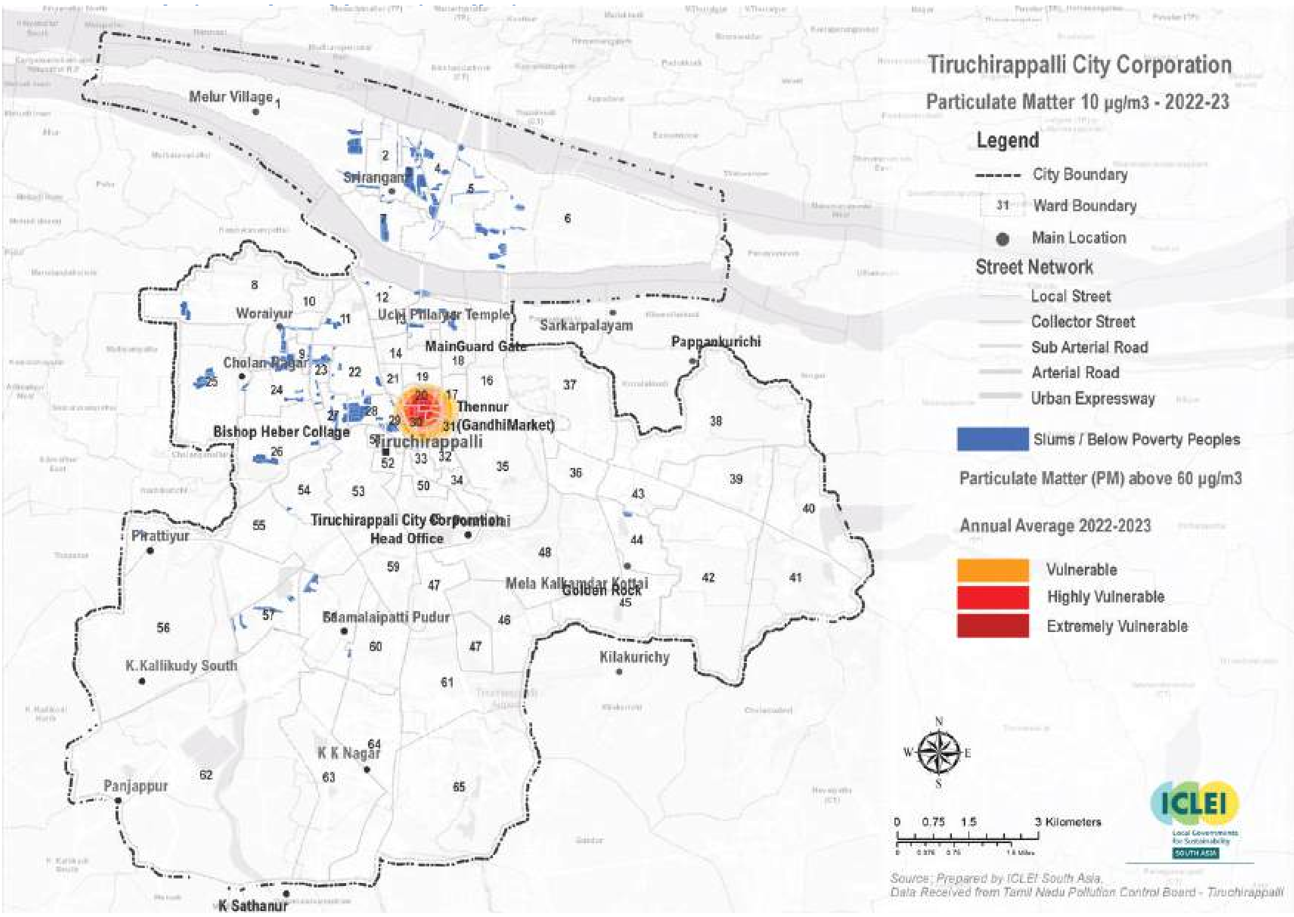



*Figure 5.17: Slums impacted by Air Pollution*
*Source: Prepared by ICLEI South Asia*

**Population Groups Vulnerable to Air Pollution[20]**

**Vulnerable slum population:**

6480 people living in slums (3321 females and 3210 males).

**Vulnerable population by age:**

approximately, 609 children

## 5.3.2.4 Urban Infrastructure Services Vulnerability

Results from the risk assessment, along with data received from various departments of TCC, and qualitative information received during stakeholder consultations and one-to-one meetings, were used to assess the vulnerability of urban systems and their impact on people.

Fragile urban systems vulnerable to climate change were identified based on technical analysis and consultations with the stakeholder committee and climate core team. Through the vulnerability assessment, specific areas and actors impacted by climate fragile urban systems are identified. The impacts on vulnerable groups such as low-income populations (focusing on hawkers, street side vendors, and slums), women, children, people with disabilities and the uneducated were also assessed. Vulnerable areas were identified following spatial analysis

The following elements are considered in identifying vulnerable places and actors:

1. **Identification of vulnerable places:** The impacts of climate risks and air pollution on basic urban services (water, wastewater, stormwater, solid

[20]Numbers are estimated as per total population numbers; actual numbers may vary.

waste management, transport, urban greens) and emergency services (hospitals and fire services) were examined. Ward wise complaints, by urban sector and complaint types, from TCC's Comprehensive Complaints Redressal System (CCRS), were spatially analysed; this information supported the identification of areas that are vulnerable to fragile urban systems. Sector and service status and issues identified through TCC's Complaints Redressal System (CRS) are correlated and mapped to arrive at vulnerable hotspots affected by maximum number of issues and fragile urban systems[21] .

2. **Identification of vulnerable actors and their adaptive capacity:** For each of the fragile systems, the actors impacted and those that play a critical role towards building urban resilience were identified. Their adaptive capacity was assessed in terms of their ability to organise and respond to threat or disruptions, access to necessary resources (manpower, technology, funds) to respond to such threats and access to information necessary to develop effective plans and actions to improve responses to disruptions.

3. **Hotspot areas or highly vulnerable wards:** Were identified through a map overlay technique, wherein geospatial information on complaints, climate risks/ hazards and gaps in urban infrastructure and/or services were superimposed and analysed.

#### 5.3.2.4.1 Water Supply

**Vulnerability due to Urban Heat**

All the water supply infrastructure that are falling within the impact areas of heat stress (both LST and Feel Like Temperature) are considered vulnerable. The vulnerable locations are indicated in Figure 5.18.

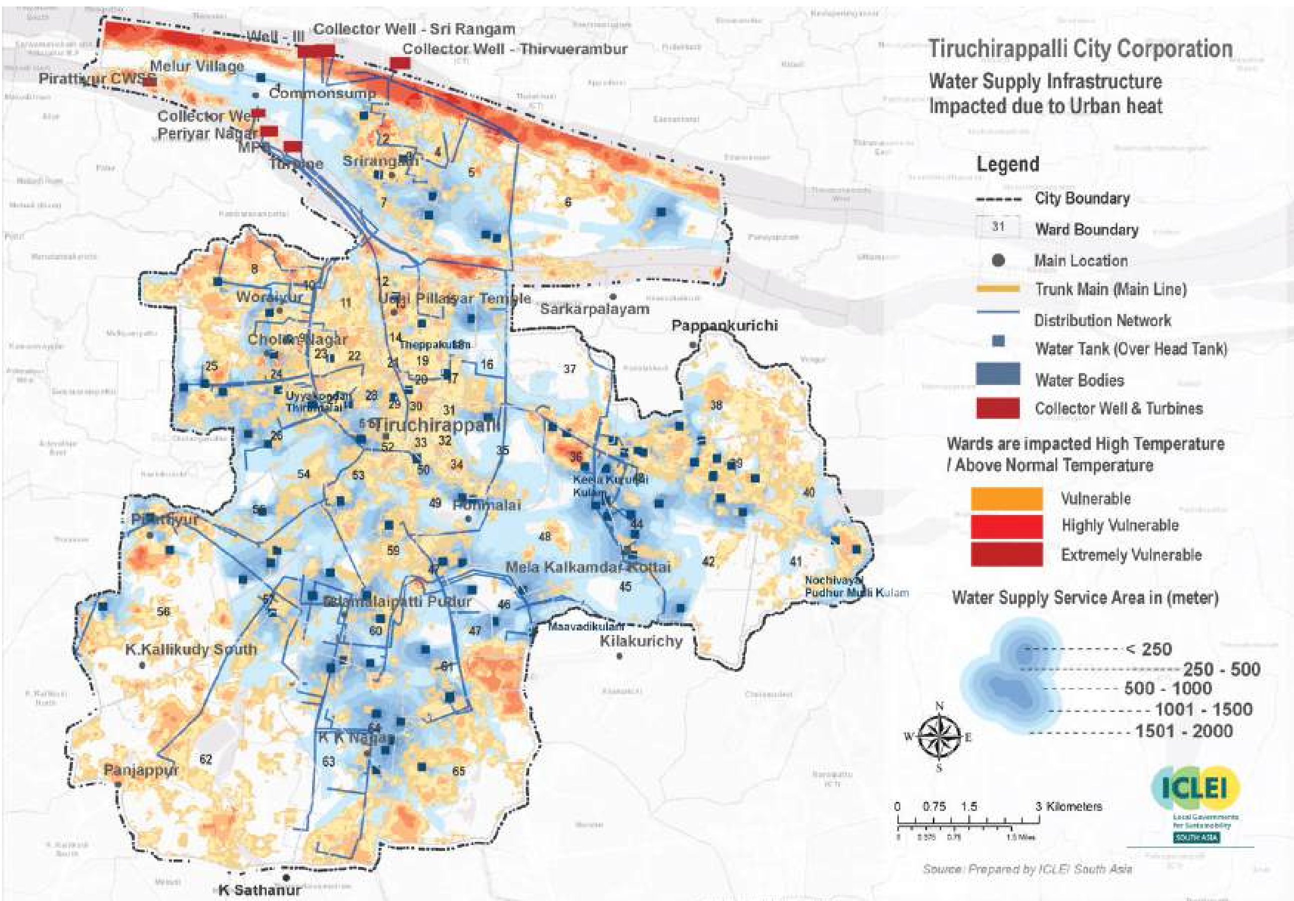



*Figure 5.18: Water Supply Infrastructure Impacted due to Urban heat*
*Source: Prepared by ICLEI South Asia*

[21]In some cases the CRS has not captured all the complaints, in such cases entire infrastructure in the impact area is considered vulnerable.

### Vulnerability of Water Supply Sector to Urban Heat

**Vulnerable areas**

Wards 35, 36, 2, 25, part of 56, part of 47, 22, 13, 8 are vulnerable to impacts on water supply systems due to Urban heat.

**Vulnerable population by age:**

Around 37% of population are impacted due to urban heat and limited access to water during extreme heat events

### Vulnerability due to Urban Flood/Flooding

Tiruchirappalli's water distribution stations were spatially marked to identify vulnerable stations located in flood prone areas and subject to implications on water supply during flooding events (Figure 5.19). Such wards were then correlated with flood prone areas to identify vulnerable wards with higher chances of receiving contaminated water supply during periods of urban flooding.

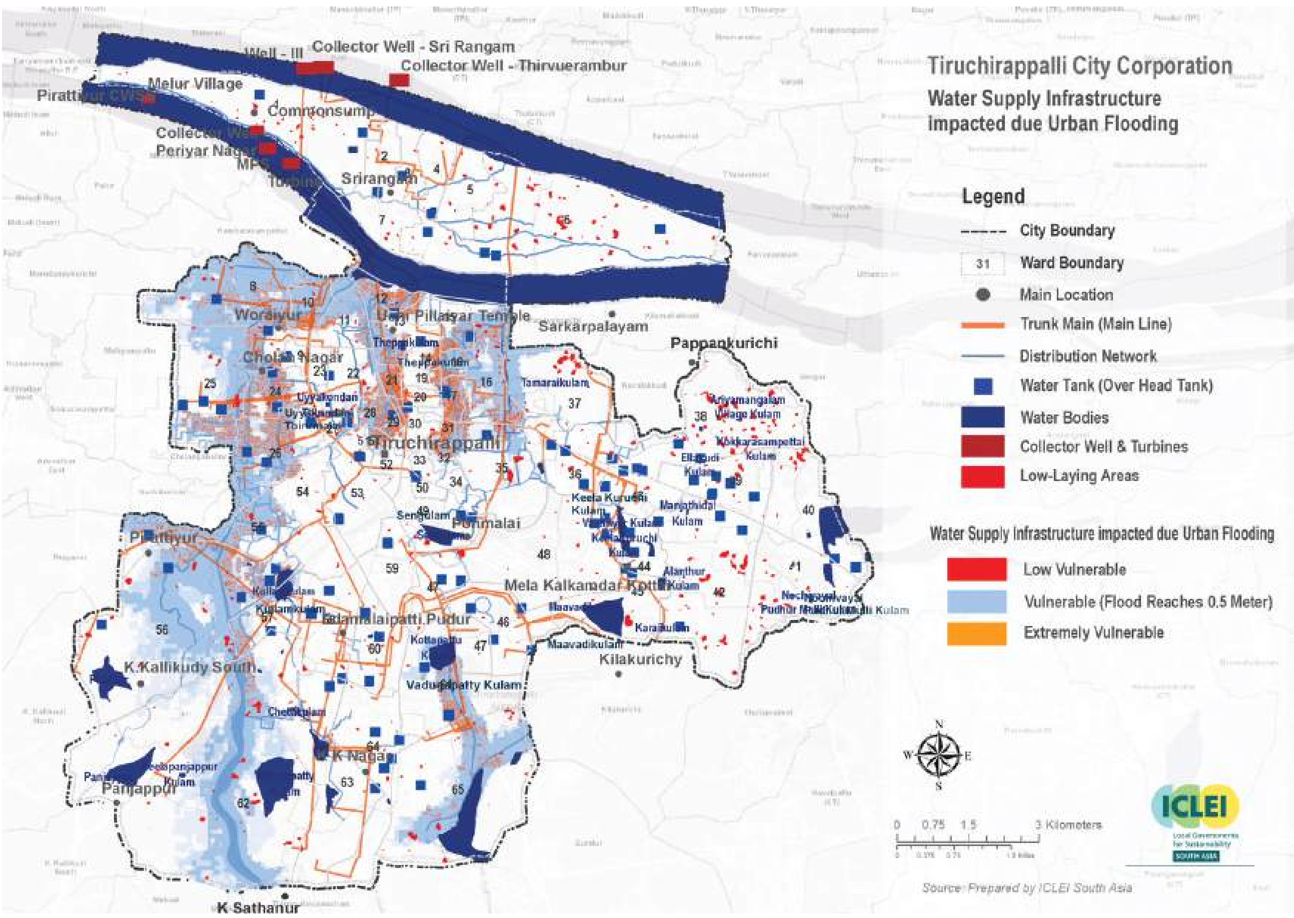



*Figure 5.19: Water Supply Infrastructure impacted due to Urban Flooding*
*Source: Prepared by ICLEI South Asia*

### Vulnerability of Water Supply Sector to Urban Flooding

- **WDS at risk:** 19 out of 109 OHTs, 16 km of pipeline network
- **Vulnerable wards:** 55, 26, 56, 16, 17, 21, 29, 24, 26, 12, 10, 5, 2, part of 11, part of 54

### 5.3.2.4.2 Wastewater Management System

**Vulnerability due to Urban Flood/Flooding**

Ward level complaints related to the sewerage network and sewage treatment were analysed spatially to identify critical wards and correlated with urban flood areas (Figure 5.20). Sewage Pumping Stations (SPS) were spatially marked and overlaid to identify critical SPS that may be impacted by urban floods or stagnation.

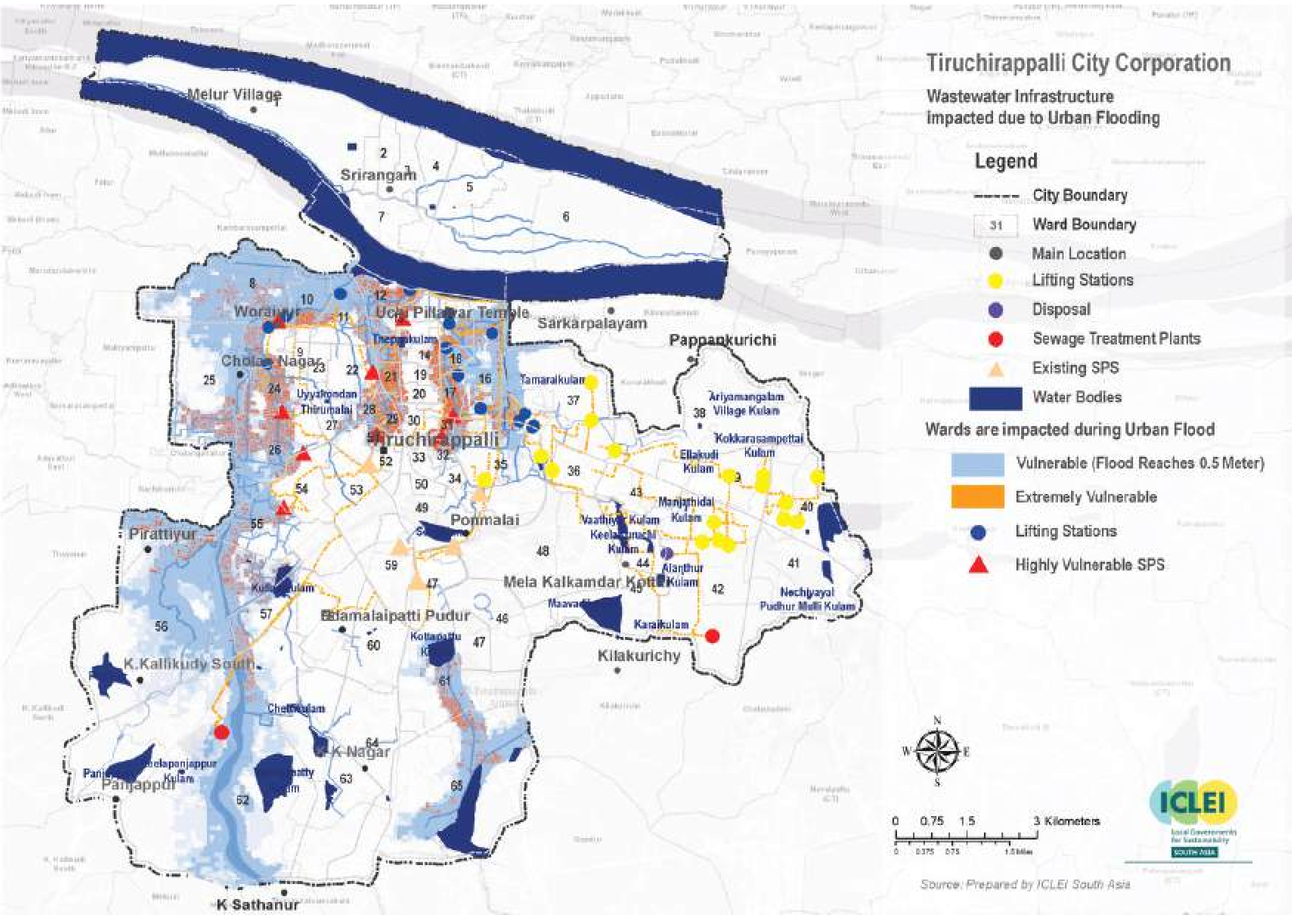



*Figure 5.20: Wastewater Infrastructure impacted due to Urban Flooding*
*Source: Prepared by ICLEI South Asia*

**Vulnerability of Wastewater Management to Urban Flooding**

**SPS & Lifting Stations at risk:**

9 out of the total 14 SPS are impacted due to urban flood. 3 out of 11 lighting stations.

**Vulnerable wards:**

57, 55, 26, 24, 8, 10, 29, 28, 21, 11, 12, 16 and 17

#### 5.3.2.4.3 Solid Waste

**Vulnerability due to Urban Flood/Flooding**

All the solid waste infrastructure (including MCC, OCC, RRC, Bio methanation plants, Compost Yard) that are falling within the impact areas of flood (Figure 5.21).

**Vulnerability of Solid Waste Management to Urban Flooding**

**Vulnerable population**

16% of city population

**Vulnerable wards:**

56, part of 57, 26, 24, 21, part of 20, 28, part of 27

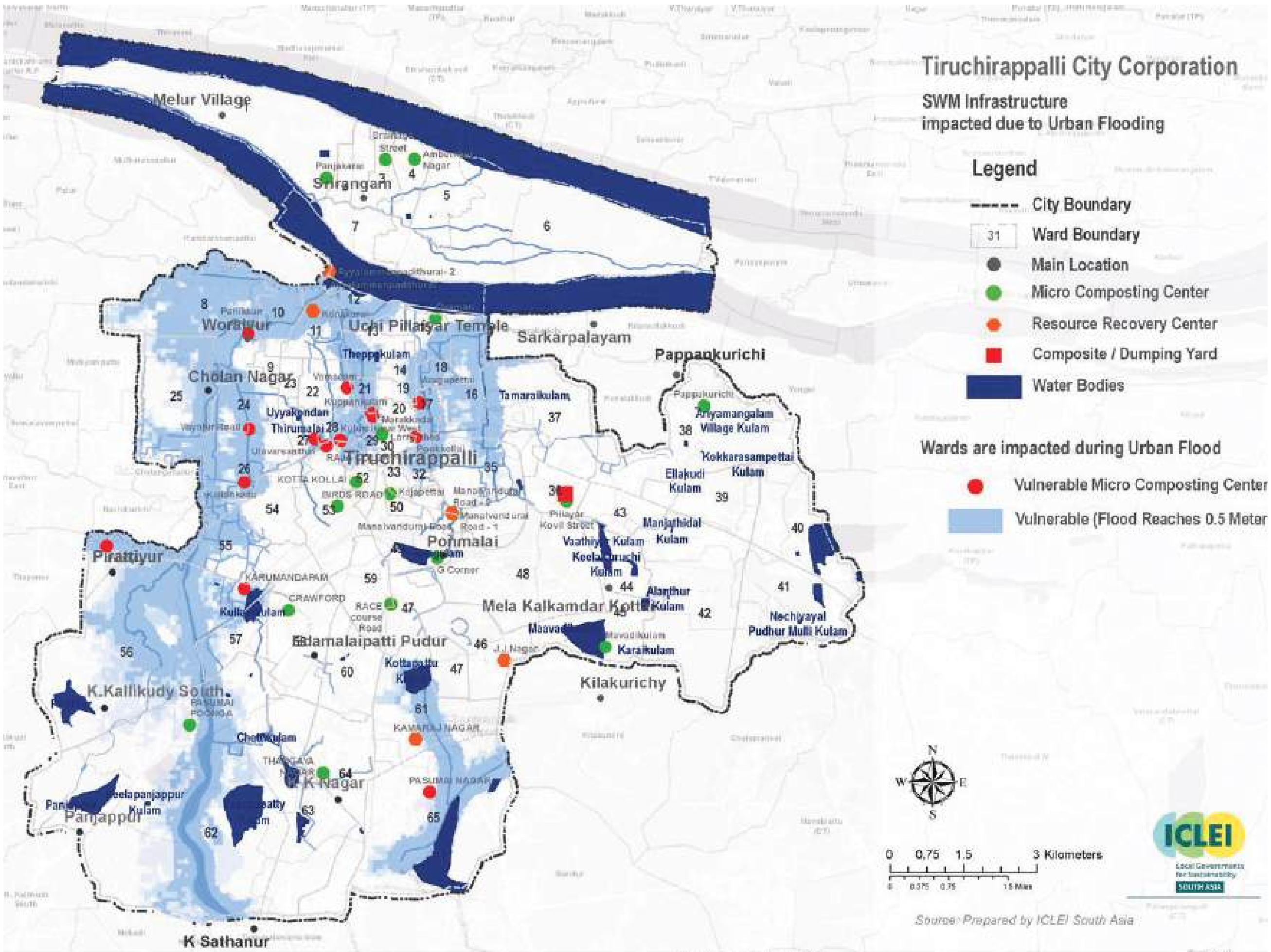



*Figure 5.21: Wards exposed to Urban Flood and Solid Waste Management related issues*
*Source: Prepared by ICLEI South Asia*

#### 5.3.2.4.4 Transport

**Vulnerability due to Urban Heat**

Existing public transport infrastructure is not conducive for use during high heat conditions. Commuters using public transport during heat wave or increased heat conditions are at a greater risk than commuters using climate controlled personal transport. Public transport stations within the TCC area, terminals, roads and major traffic junctions are superimposed on the Urban Heat map to identify vulnerable public transport stations and traffic junctions (Figure 5.22). In the absence of well shaded facilities and stops, people using public transport are more vulnerable to extreme heat. People accessing public transport at these stations are also highly vulnerable to extreme heat, especially the elderly, young children, and women.

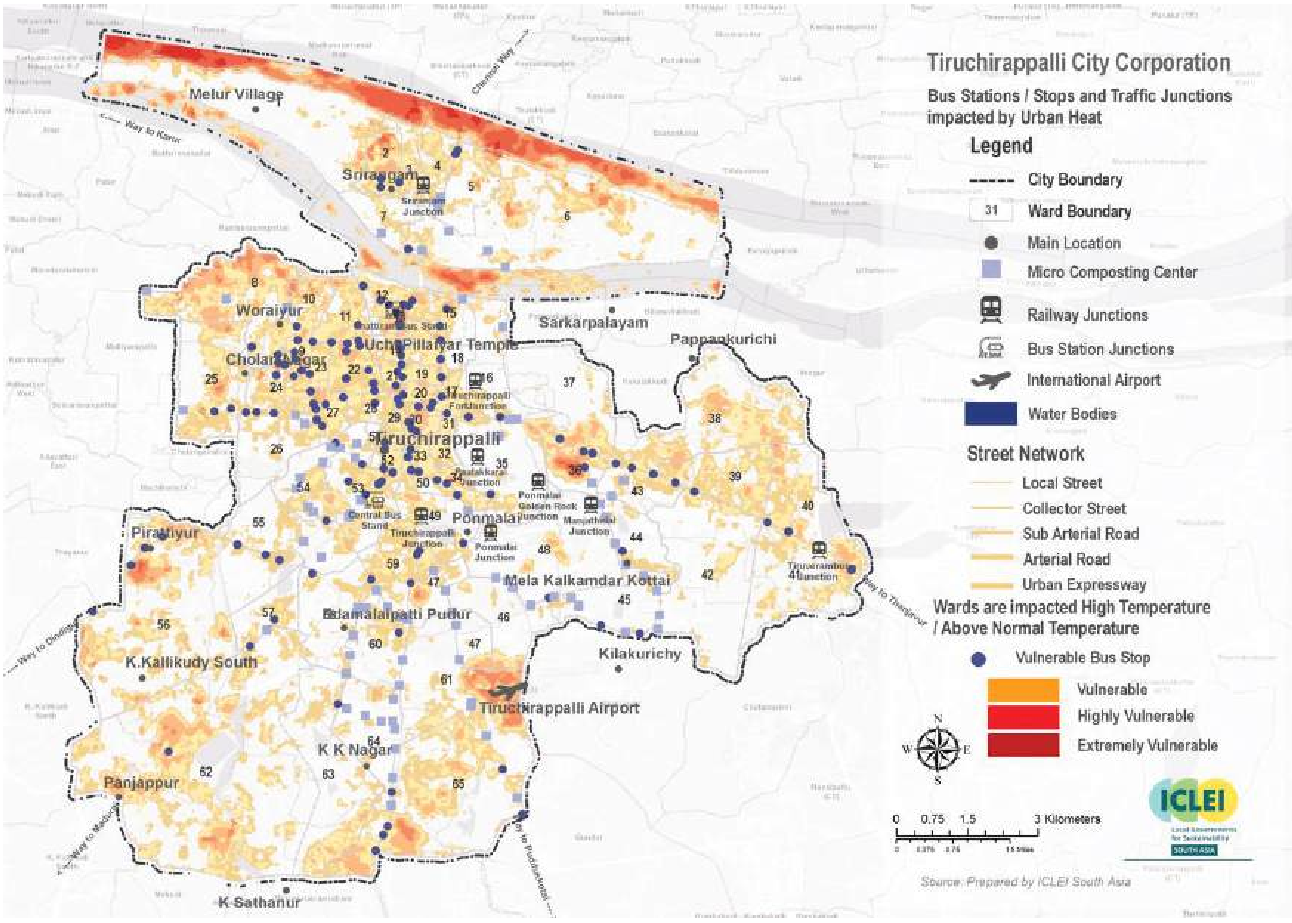



*Figure 5.22: Public transport stations and traffic junctions impacted by Increased Heat conditions*
*Source: Prepared by ICLEI South Asia*

**Vulnerability of Transport Sector to Urban Heat**

**Public transport:**

152 bus stations (55% of bus stations) are in Urban Heat areas.

**Traffic junctions**

8 major traffic junctions with heavy traffic are in urban heat areas.

**Vulnerable people:**

Children and women

**Vulnerability due to Urban Flood/Flooding**

Public transport stations and major traffic junctions getting impacted due to urban flooding are spatially analysed (Figure 5.23).

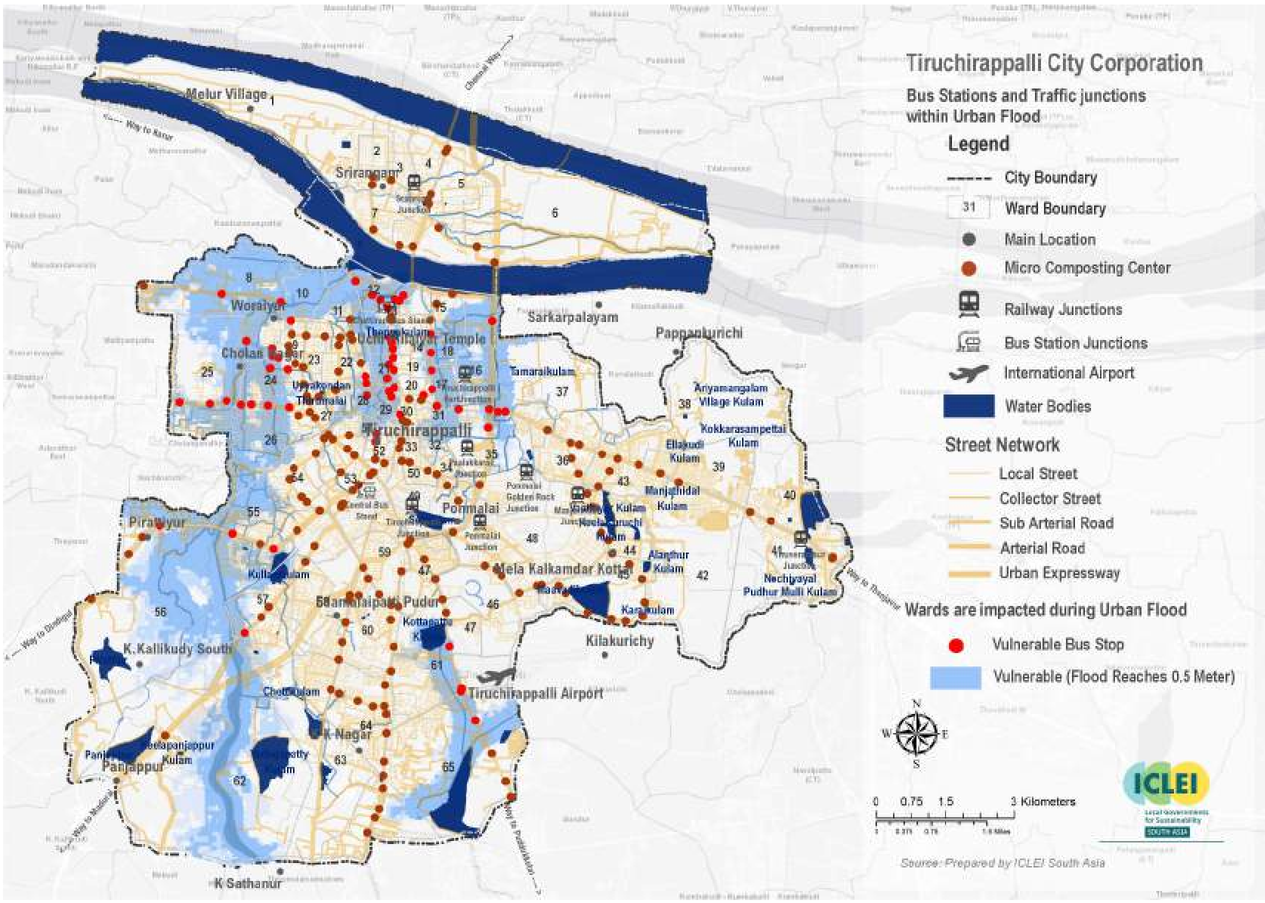



*Figure 5.23: Bus Stations and Traffic junctions within Flood Zone (250m buffer around flooding points)*
*Source: Prepared by ICLEI South Asia*

**Vulnerability of Transport Sector to Urban Flooding**

**Public transport stations at risk:**

61 bus stops (21% of bus stops)

**Major traffic junctions at risk:**

6 of the major or heavy traffic junctions.

### 5.3.2.4.5 Emergency Services

Accessibility to emergency services (fire and health infrastructure) is essential to provide better quality of living in the city and reduce vulnerability to climate and other disasters. Slum dwellers and people with special needs, with limited access to emergency service infrastructure, public transport, and green spaces, are more vulnerable to extreme climate events.

Accessibility to emergency services (fire and health infrastructure), in line with the Fire Hazard and Risk Analysis in the Country for Revamping the Fire Services in the Country[22] (Figure 5.24). The Standing Fire Advisory Council (SFAC) in India recommends specific response times for the first fire tender based on the risk category and location in urban areas. For a risk category of A, about 3 minutes is considered the response time[23]

[22]Fire Hazard and Risk Analysis Tiruchirappalli (Page 163): Depending upon the risk category, the recommended response time for first fire tender is 5 to 7 minutes in urban areas
[23]For Peak Time speed of 31 km/hr and Off-peak speed of 44 km/hr.

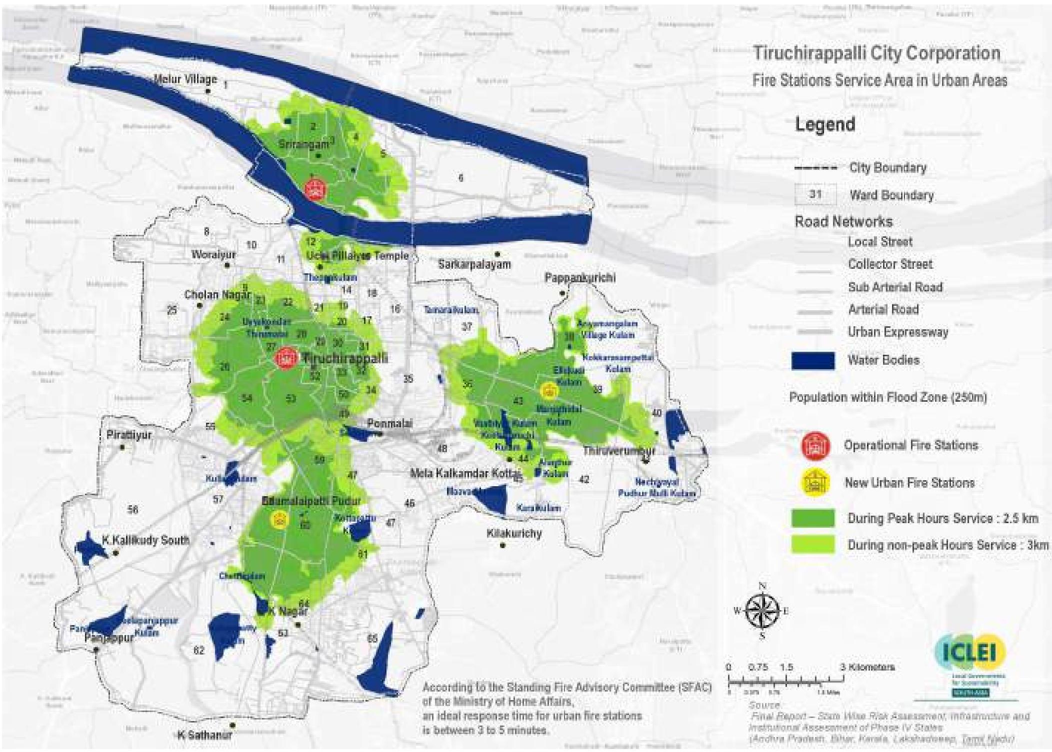



*Figure 5.24: Service Area of Fire Stations guidelines*
*Source: Prepared by ICLEI South Asia*

**Vulnerability due to Urban Flooding**

Hospitals and fire stations are marked spatially and overlaid with urban flooding to identify critical areas with limited accessibility due to waterlogging/ urban flooding. 34 out of 181 major hospitals & 6 out of 18 PHCs and 1 out of 4 fire stations are affected due to urban flooding (Figure 5.25).

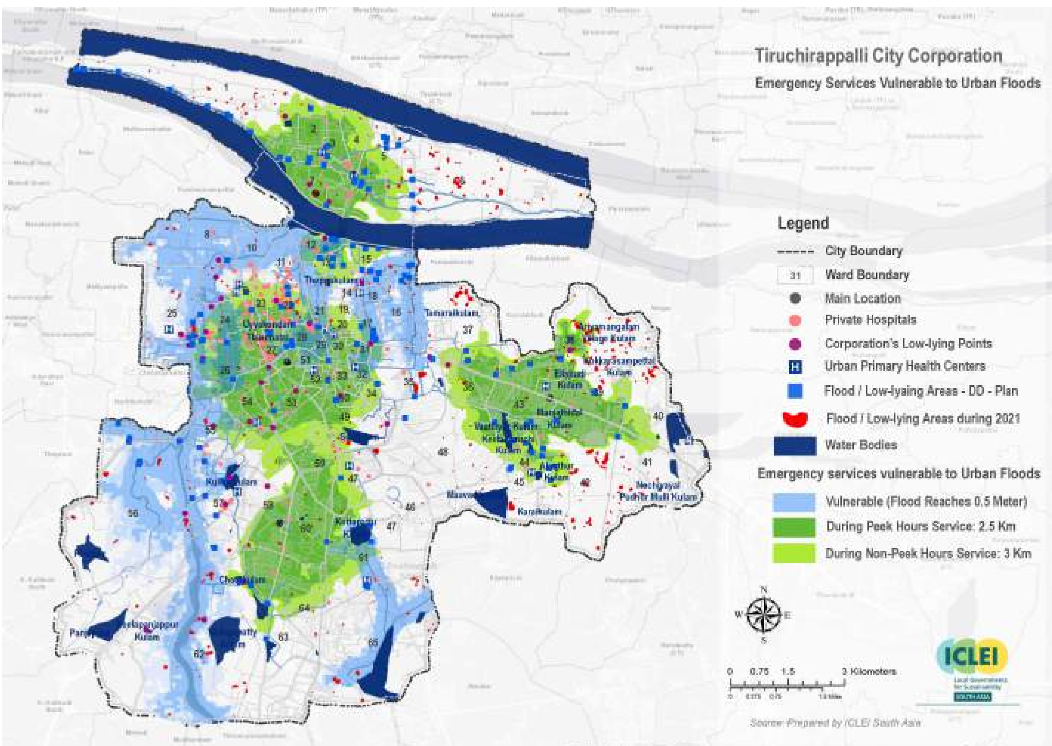



*Figure 5.25: Emergency services vulnerable to Urban Flooding or Stagnation*

*Source: Prepared by ICLEI South Asia*

**Vulnerability of Emergency Services to Urban Flooding**

**Wards impacted due to Emergency Services Accessibility:**

52, 62, 63, 46, 47, 57, 42, 35, 1, 6

**Hospitals at risk**

34 out of 181 private hospitals

### 5.3.6.2.3 Critical Wards

Combined urban systems vulnerability hotspot map is prepared for heat risk. 47 out of 65 wards (ward number 24, 29, 36 & 47) have at least one vulnerable urban system. The urban systems impacted are water supply, wastewater, solid waste, transport, disaster management & emergency services (Figure 5.26).

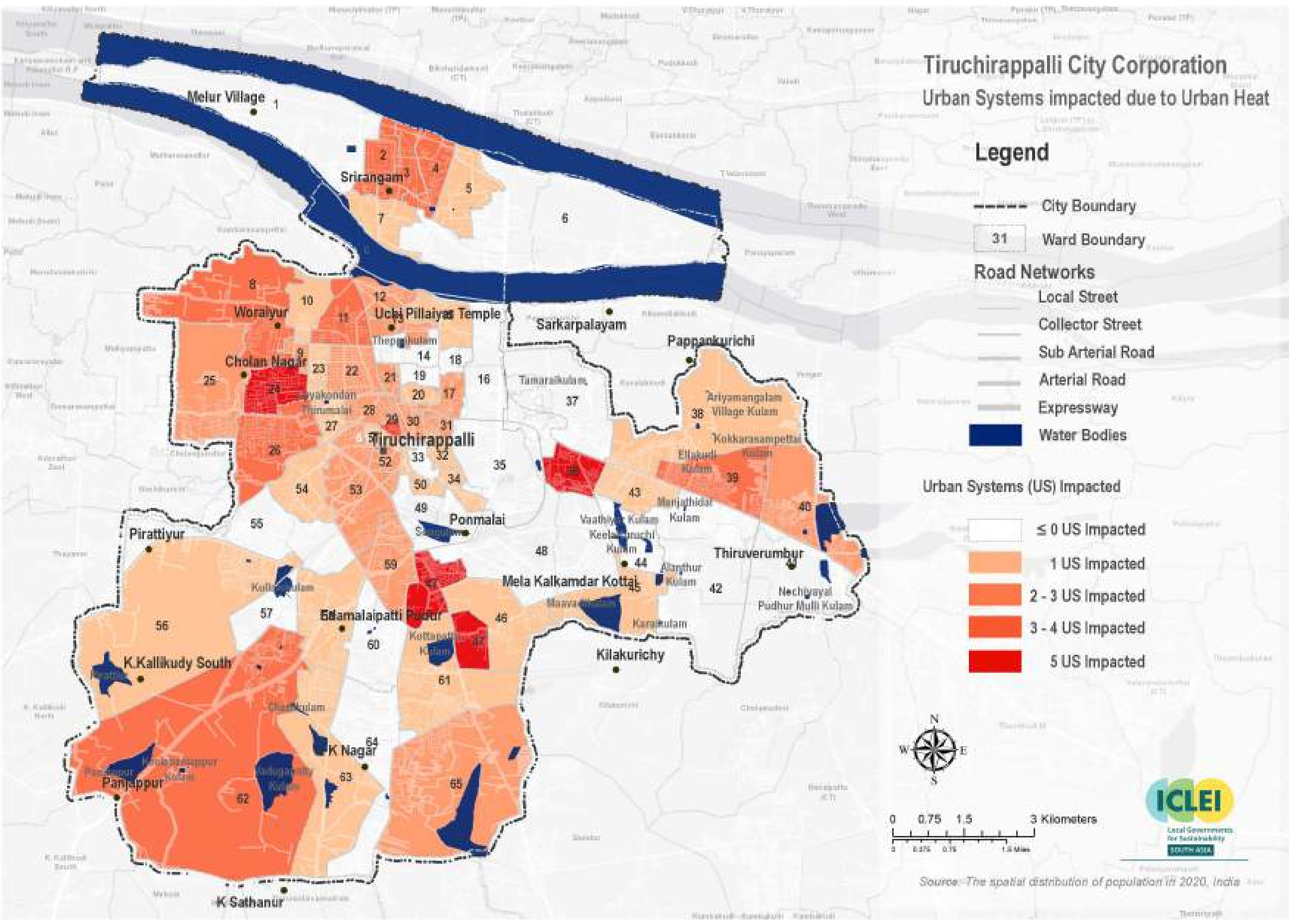



*Figure 5.26: Consolidated vulnerable hotspots for Tiruchirappalli due to Urban Heat*

*Source: Prepared by ICLEI South Asia*

Combined urban systems vulnerability hotspot map is prepared for urban flooding. Twenty-five out of 65 wards have at least one urban system impacted due to urban flooding. Ward number 24, 29, 8, 17, 7 have 5 vulnerable urban systems impacted due to urban flooding. The urban systems impacted are water supply, wastewater, solid waste, transport, disaster management & emergency services (Figure 5.27).

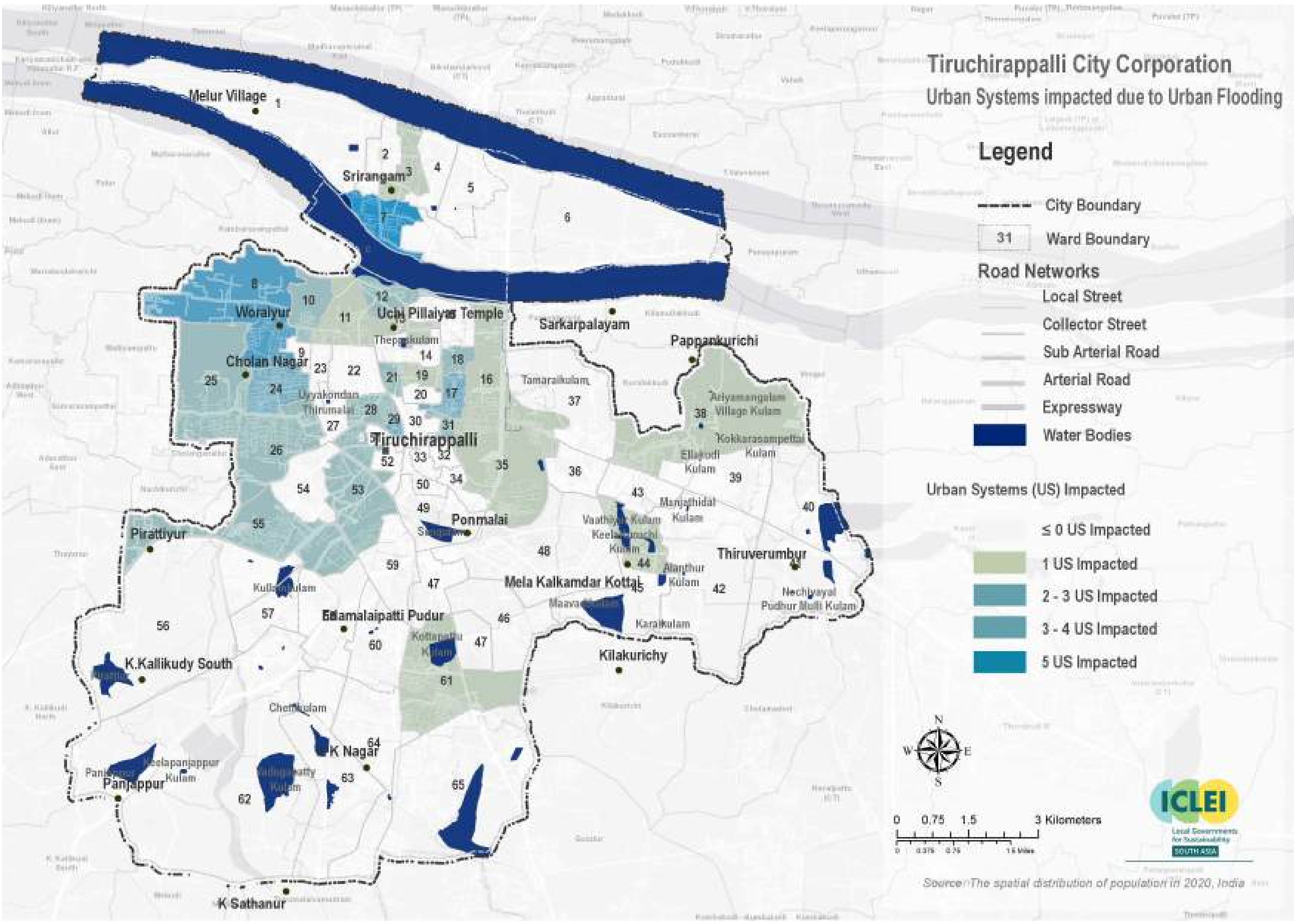



*Figure 5.27: Consolidated Vulnerable hotspots for Tiruchirappalli due to Urban Flooding*
*Source: Prepared by ICLEI South Asia*

Based on climate hazard and vulnerability assessment carried out due to urban heat and flooding, the composite map has been prepared to identify wards that are impacted Urban systems included are water supply, wastewater, stormwater management, solid waste management and transport. (Figure: 5.28)[24]

[24] Raw data for computation is mentioned in

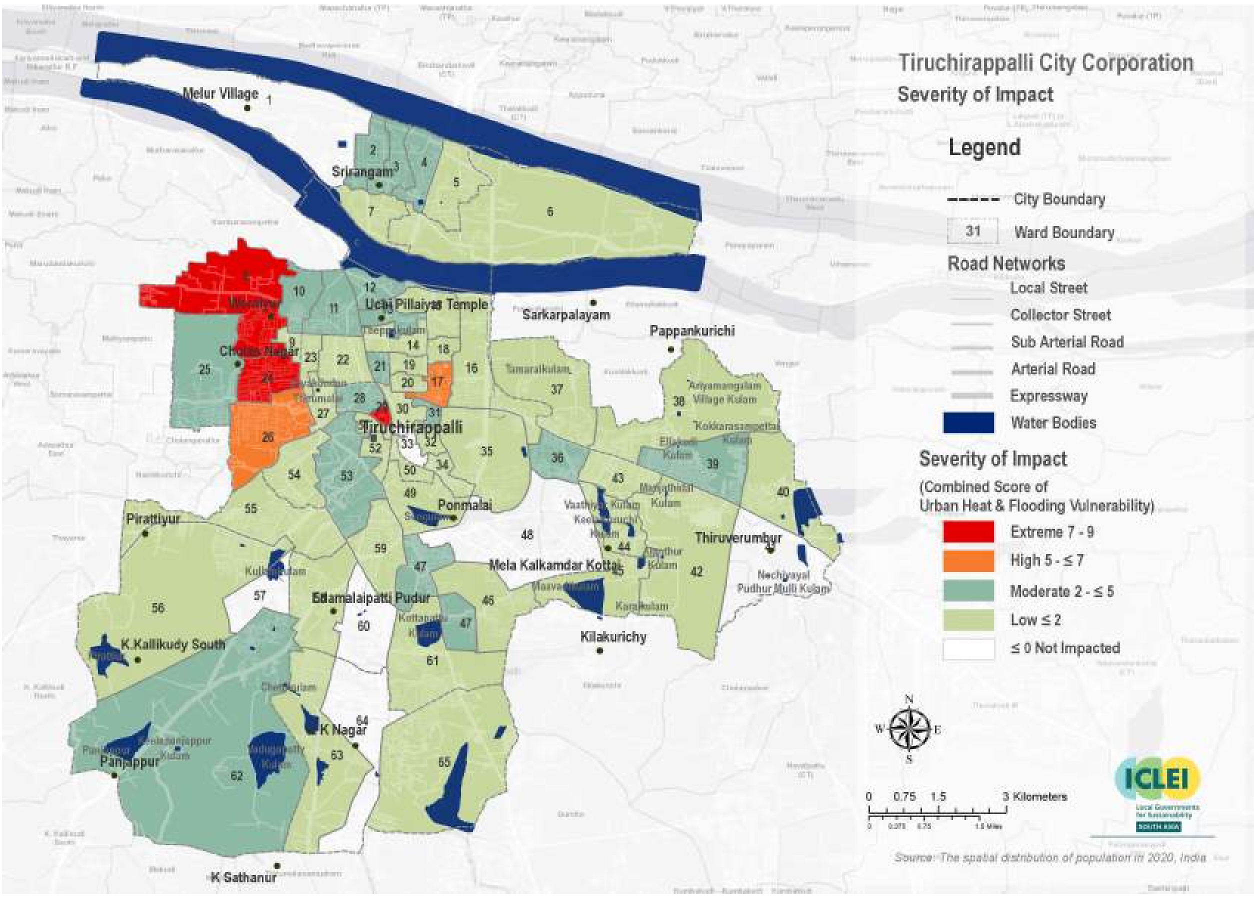



*Figure 5.28: Consolidated Vulnerable hotspots for Tiruchirappalli due to Urban Heat and Flood*
*Source: Prepared by ICLEI South Asia*

Based on the analysis, ward 24 & 8 are extremely vulnerable.

## 5.3.3 Actor Analysis and Adaptive Capacity

Groups vulnerable to climate and air pollution risks and the urban systems issues are identified and their adaptive capacities are assessed, especially of slum dwellers, street vendors, children, and patients in hospitals. Adaptive capacities of supporting actors such as the government departments and private sector are also assessed. Actor analysis along with their adaptive capacity is shown below in Table 5.10.

The elderly, children, women, differently abled, non-schooled, and poor people are more vulnerable and may be severely impacted due to increased urban heat and flooding conditions.

- Elderly, children, women and people with special needs are especially vulnerable to heat related morbidity.
- Differently abled persons face the most difficulty when trying to access emergency support, due to limited availability of disability inclusive infrastructure and limited or no consideration of special needs in disaster and/or emergency management plans, rendering them especially vulnerable to climate disasters. Limited access lowers their ability to contend with disease outbreaks. They are especially affected by any breakdown in urban services due to constrained coping mechanisms. As an example, daily commute and access to safe spaces is limited since the public transport system is not designed to cater to their special needs during periods of water logging or urban flooding. Their dependence on other means of support increases, which further increases their vulnerability to such situations.
- Effective information and communication are critical for reducing impacts of climate disasters. Non-schooled people are more vulnerable due to limited access to and understanding of timely information. The urban poor remain highly sensitive to an increase in temperature due to poor living and workplace conditions along with limited access to affordable cooling options and community

health centres/ government hospitals. Urban poor with compromised housing conditions and limited access to community health centres and government hospitals are also vulnerable to disease outbreaks due to floods.

The analysis in Table 5.11 shows that different government departments and the private sector have high adaptive capacity and can support climate resilient interventions in the city by using their resources, information and ability to respond. However, most of the community groups, including slum dwellers, elderly, children, women, people with special needs and vendors have lower adaptive capacities and are vulnerable to climate change impacts. The Net-zero CRCAP includes interventions that benefit the vulnerable populations and utilise the strengths of the supporting actors. Government departments and the private sector are key enabling actors for the transition to a "Climate Resilient Net Zero" city.

*Table 5.11: Actor analysis and their adaptive capacity*

| **Associated Actors** | **Capacity to Respond (a)** | **Resources Available (b)** | **Capacity to Access Information (c)** | **Adaptive Capacity Score** (a*b*c) | **Adaptive Capacity** |
|---|---|---|---|---|---|
| Trichy City Corporation | 3 | 3 | 3 | 27 | High |
| Trichy Collectorate | 3 | 3 | 3 | 27 | High |
| Traffic Police Department | 3 | 2 | 3 | 18 | High |
| City Police Department | 3 | 1 | 3 | 9 | Medium |
| Public Works Department | 1 | 3 | 3 | 9 | Medium |
| SETC, Trichy | 2 | 2 | 2 | 8 | Medium |
| Regional Transport Office (RTO) | 3 | 2 | 3 | 18 | High |
| Tamil Nadu Pollution Control Board (TNPCB) | 2 | 3 | 2 | 12 | Medium |
| Agriculture department | 2 | 2 | 2 | 8 | Medium |
| Highways department | 3 | 3 | 3 | 27 | High |
| Government health care facilities | 3 | 2 | 3 | 18 | High |

| Associated Actors | Capacity to Respond (a) | Resources Available (b) | Capacity to Access Information (c) | Adaptive Capacity Score (a*b*c) | Adaptive Capacity |
|---|---|---|---|---|---|
| Private hospitals | 3 | 3 | 2 | 18 | High |
| Contractors/ private sector players managing urban infrastructure services for TCC | 3 | 3 | 1 | 9 | Medium |
| Vulnerable people (elderly, children, women, people with special needs) | 1 | 1 | 1 | 1 | Low |
| Migrant labour/ floating population | 1 | 1 | 1 | 1 | Low |
| Uneducated people | 2 | 1 | 1 | 2 | Low |
| Slums | 1 | 1 | 1 | 1 | Low |
| Rag pickers and people working at dump sites | 1 | 1 | 1 | 1 | Low |
| Street vendors | 1 | 1 | 1 | 1 | Low |
| Pedestrians, cyclists, commuters using two-wheeler | 2 | 2 | 2 | 8 | Medium |
| Residents Welfare Associations | 3 | 2 | 2 | 12 | High |
| NGOs / charitable Institutions | 3 | 3 | 2 | 18 | High |


06

# GHG INVENTORY

06

# GHG INVENTORY

## 6.1 Introduction

The GHG emissions inventory for Tiruchirappalli has been prepared for the period 2017-18 to 2021-22. The baseline year for the GHG inventory is 2021-22. The emissions inventory has been prepared following the Global Protocol for Community-Scale GHG Emissions (GPC)[1] (Annexure J). This inventory complies with the BASIC[2] level reporting of GPC.

**The GHG emissions inventory consists of two analyses -**

**1. Community-Level emission inventory –** includes GHG emissions from energy consumption and emission sources in residential buildings, commercial buildings, institutional/public buildings and facilities, transportation, and those resulting from solid waste and domestic wastewater within the municipal boundary. This community-level inventory establishes the baseline status of GHG emissions and informs the development of evidence-based mitigation strategies and actions for different -sectors at the city scale.

**2. Local Government emissions inventory –** includes GHG emissions from the consumption of energy in municipal operations and services such as municipal buildings, street lighting, water supply, wastewater treatment, municipal vehicle fleet, and waste management facilities. In Tiruchirappalli, these services are administered by **Tiruchirappalli City Corporation**.

The community-level energy consumption and GHG emissions data already account for data related to local government operations. For example, the electricity consumption in municipal facilities for water supply, wastewater management, and street lighting is already accounted for in the community dataset's commercial and institutional facilities sub-sector.

Thus, the local government energy consumption and emissions profile is a subset of the community-level profile. Assessing energy use and emissions for municipal operations separately helps city governments take targeted low-carbon action in their municipal infrastructure and urban service delivery. It enables cities to demonstrate leadership in implementing transformative climate efforts in their communities.

[1]Refer for more information on GPC - https://ghgprotocol.org/ghg-protocol-cities (accessed 24 January 2024)

[2]Scope 1 emissions include GHG emissions from sources located within the city boundary; Scope 2 emissions include- GHG emissions occurring because of the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary; Scope 3 emissions include all other GHG emissions that occur outside the city boundary as a result of activities taking places within the city boundary

## 6.2 Methodology

The GHGs considered in the GHG inventory include carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$); gases which account for nearly 99% of global GHG emissions.

The GHG emissions inventory has been reported in terms of total tonne of $CO_2e$ ($tCO_2e$) emissions. To arrive at the $CO_2e$ values, the global warming potential (GWP) of each gas for a 100-year timeline is factored. The GWP reflects the climate change impact, in terms of the warming effect on the atmosphere, for each GHG with reference to $CO_2$. The GWP values used in the GHG inventory based on the IPCC's Fourth Assessment Report (2007) are presented in Table 5.1

*Table 6.1: 100-year GWPs of the GHGs with respect to $CO_2$*

| Gas | Lifetime (Years) | GWP for 100 years |
|---|---|---|
| $CH_4$ | 12 | 25 |
| $N_2O$ | 114 | 298 |

### 6.2.1 Emission Factors

For estimating GHG emissions from various activities or sources in a city, it is not feasible to carry out a direct physical measurement of GHGs emitted. The common methodology for estimating GHG emissions is through the use of emission factor[3] and the relevant activity data[4] to estimate the emissions.

$GHG_A = EF_A \times D_A$

Where,

$GHG_A$ = GHG emissions resulting from activity A

$EF_A$ = emission factor for activity A

$D_A$ = data for activity A

For Tiruchirappalli's GHG inventory, relevant emission factors as available in the HEAT+ tool, developed by ICLEI, have been used to arrive at GHG emissions from different sources and activities.

For emissions from solid waste disposal in the city, the First Order Decay (FOD) methodology has been employed[5]. Since the GHG emissions from solid waste disposal continue for several years even after the disposal, the FOD methodology assumes that the Degradable Organic Component (DOC) in waste decays slowly over time, during which emissions are released. It therefore helps to account for GHG emissions that are released as waste decomposes over longer periods.

To estimate on-road transportation emissions, the fuel sales method has been utilized. This method calculates on-road transportation emissions by considering the total fuel sold within the city limits. This approach regards fuel sold as an indicator of transportation activity within the city[6].

Emissions from rail transit within the city boundary have been accounted for using the distance-based method based on passenger-km travelled. Estimation of passenger-km travelled relies on two key indicators:

[3]The emission factor for a particular activity is dependent on the energy use and the direct emissions of GHGs resulting from the activity. As a result of this dependency, emission factors tend to vary over locations and for different technologies. For example, the emission factor per kWh of electricity used would vary over countries or regions due to the varying energy mix, characteristics of fuel used, and the efficiency of electricity generation. The emission factor per km travelled would vary depending on the fuel characteristics, the engine characteristics for the vehicle, and the driving and traffic patterns prevalent. For accurately estimating a GHG emissions inventory, it is important to use the emission factor best suited to the location.

[4]Activity data is a quantitative measure of a level of activity that results in GHG emissions occurring during the given period of time.

[5]To learn more about the First Order Decay (FOD) methodology for accounting GHG emission from Municipal solid waste (MSW) refer Section 8.3 Calculating emissions from solid waste disposal, Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. Available at:https://ghgprotocol.org/sites/default/files/ghgp/standards/GHGP_GPC_0.pdf

[6]To learn more about fuel sales approach refer GPC - https://ghgprotocol.org/ghg-protocol-cities (accessed 18 October 2023)

the number of passengers carried, and the average distance travelled by each passenger. To account for in-boundary emissions, only the length of rail track within the city boundary has been considered for the calculations.

For aviation, the Landing and Takeoff (LTO) emissions have been accounted. This approach estimates GHG emissions and fuel used for LTO phase based on statistics on the number of LTOs (aggregate or per aircraft type) and default emission factors per LTO cycle corresponding to the aircraft type.

### 6.2.2 Emission Sources Excluded and Included Elsewhere

As noted earlier, the GHG emission inventory is compliant with the requirements of the GPC BASIC reporting framework. Emission sources that are excluded from the inventory and categorized elsewhere are as follows:

- Emissions from agriculture, forestry, and other land-use (AFOLU), industrial processes and product use (IPPU), are excluded from the inventory as they fall beyond the scope of the GPC BASIC framework.
- Emissions resulting from transmission and distribution losses linked to grid-supplied electricity are excluded from the inventory as they fall beyond the scope of the GPC BASIC framework.
- Due to a lack of disaggregated data on fuel consumption for off-road transportation within the city, emissions from such sources are included in the emissions reported under on-road transportation.

### 6.2.3 Harmonized Emission Analysis Tool Plus (HEAT+)

ICLEI's HEAT+ is an online emissions accounting software package that helps local governments account for GHG emissions and develop a comprehensive energy and GHG inventory of their cities. The tool helps them make informed climate action decisions and was used to assist with the accounting of Tiruchirappalli's GHG emissions inventory. The HEAT+ tool incorporates the latest technical findings (IPCC, 2006) and incorporates international reporting requirements and standards outlined in the GPC. HEAT+ contains numerous country specific emission factors and energy densities for a wide range of fuels, combustion technologies, and waste types. HEAT+ uses these values to calculate the GHG emissions resulting from electricity use, fuel consumption, and waste decomposition. HEAT+ is GPC compliant and includes a local government module to reflect GHG emissions limited to municipal operations.

HEAT+ tool supports cities in the implementation of ICLEI's Climate Action methodologies, including the 'Net Zero ClimateResilientCities (CRC)' methodology. Through its extensive database of IPCC and country-specific emissions coefficient data sets, ability to generate analyses and various built-in reports, HEAT+ provides a robust tool to prepare city-specific GHG inventories to support comprehensive climate action plans.

### 6.2.4 Data Source and Collection

The baseline year for this study was the financial year of 2021-22 (i.e. April 2021-March 2022). Relevant data for the analysis and estimation was collected for a five-year period preceding the baseline year i.e. from 2017-18 onwards.

ICLEI South Asia and TCC officials engaged various agencies, and local and sub-national stakeholders mentioned in the table below through official letters and meetings to source the relevant energy consumption data focusing on the primary emission sources within the municipal area. Supply and demand-side data was collected and analyzed. The various sources of energy and other relevant data used in the report are elaborated in Table 6.2.

*Table 6.2: Source of energy consumption data for GHG emission estimations*

| Fuel Type | Sector | Source of Data |
|---|---|---|
| Electricity | Residential, Commercial/Institutional facilities, Manufacturing Industry and Construction, Agriculture, forestry and fishing activities (i.e., mainly agriculture) | Tamil Nadu Electricity Board is a power generation and distribution (TNEB) & Tamil Nadu Generation and Distribution Corporation (TANGEDCO) |
| | Municipal Buildings, Water Supply, Wastewater Management, Street Lights | TCC |
| Diesel and Petrol | Community Transport, Commercial/Institutional facilities, Manufacturing Industry and Construction, | IOCL, HPCL, BPCL, Shell, Essar, Reliance |
| | Municipal Vehicles | TCC |
| LPG | Residential, Commercial/Institutional Facilities, Manufacturing Industry and Construction, Auto LPG – Community Transport | IOCL, HPCL, BPCL |
| PNG | Residential, Commercial/Institutional Facilities, Manufacturing Industry and Construction | |
| Solid Waste Management | | TCC |
| Wastewater management | | TCC |
| Rail | | Tiruchirappalli's Railway Department |
| Aviation | | Tiruchirappalli Airport |

# 6.3 GHG Emissions Inventory

The following section includes inventory details on Tiruchirappalli's energy consumption and GHG emissions.

## 6.3.1 City-Scale Energy Consumption and GHG Emissions in Tiruchirappalli City (2021-22)

*Table 6.3: Key Indicators[7] - City-Scale Energy Consumption and GHG Emissions (2021-22)*

| Indicator | Value |
|---|---|
| **Total Energy Use[8]** | 1,00,56,752 GJ |
| **Total GHG Emission** | 14,25,761 $tCO_2e$ |
| **Per Capita Energy Use** | 9.30 GJ |
| **Per Capita GHG Emission** | 1.32 $tCO_2e$ |

*Table 6.4: Sector-wise energy consumption and GHG emissions (2021-22)*

| Sector | Energy Use (GJ) | GHG Emissions ($tCO_2e$) |
|---|---|---|
| **Stationery Energy** | **63,92,067** | **10,43,700** |
| Residential Buildings | 32,69,161 | 5,61,759 |
| Commercial and Institutional Buildings/ Facilities | 10,65,186 | 1,84,906 |
| Manufacturing Industry and Construction (i.e., Industrial sector) | 20,57,720 | 2,97,036 |
| **Transportation** | **36,64,685** | **3,07,262** |
| On Road Transportation | 36,64,685 | 2,63,646 |
| Rail | - | 25,224 |
| Aviation | - | 18,392 |

[7] These indicators can enable comparison with other Indian cities as well as cities around the globe. However, such comparison should be done with due caution since results may vary across cities, even amongst those located in the same country, on account of the different local contexts (in terms of socio-economic conditions and drivers), data availability and data management practices followed in the cities, and the overall methodology adopted for developing GHG inventory.

[8] Includes direct energy use (from combustion of fuels such as kerosene, LPG, petrol, diesel) and indirect energy use (due to consumption of grid electricity)

| Sector | Energy Use (GJ) | GHG Emissions ($tCO_2e$) |
|---|---|---|
| **Waste** | **-** | **74,799** |
| Solid Waste Disposal | - | 38,418 |
| Biological treatment | - | 13,523 |
| Wastewater | - | 22,859 |
| **Total** | **1,00,56,752** | **14,25,761** |

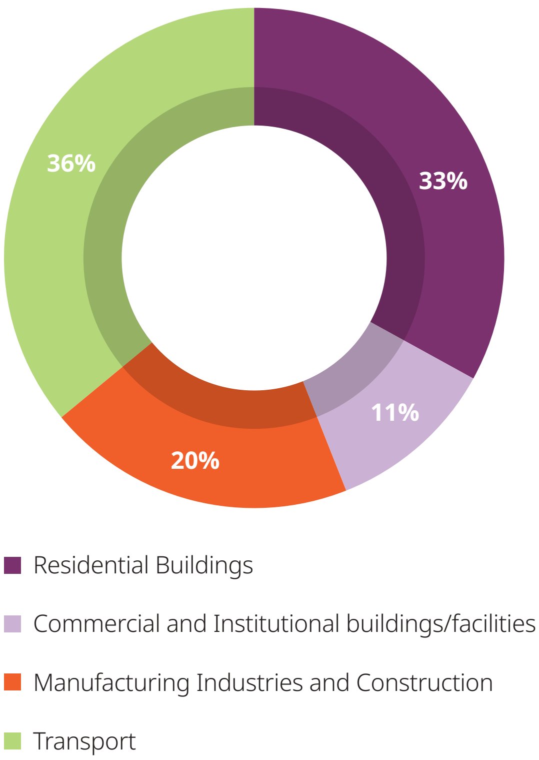



*Figure 6.1: Sector wise share of energy consumption, 2021-22*

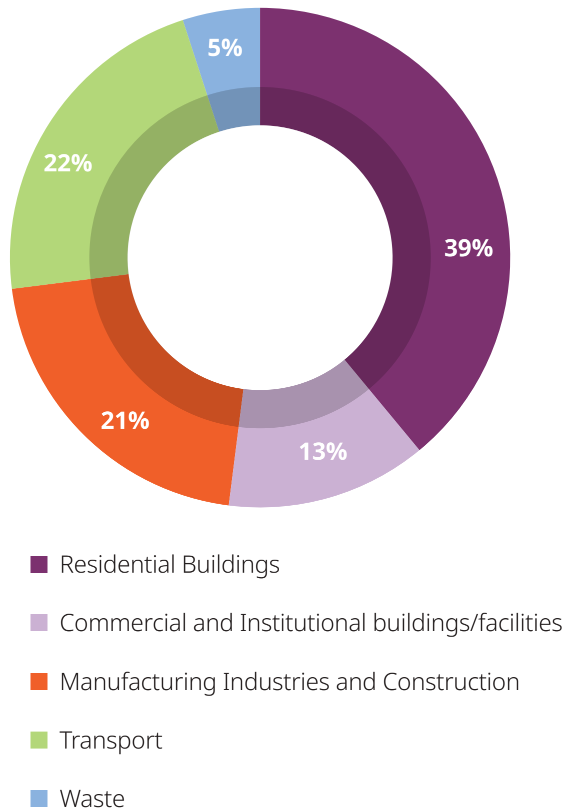



*Figure 6.2: Sector wise share of GHG Emissions, 2021-22*

## a.Trend of Community-Level Energy Consumption and GHG Emissions in Tiruchirappalli City

### Highlights

**Energy intensive sectors:**
Transportation (36.4%); Residential Buildings (32.5%); Manufacturing Industry and Construction (20.5%); and Commercial and Institutional Buildings/ Facilities (10.6%)

**Energy consumption trend (2017-18 to 2021-22)**
6.7% increase at 1.67% annually[9]

**Sectors with significant GHG emissions**
Residential Buildings (42.8%), Transportation (20.9%), Manufacturing Industry and Construction (17.1%)

**GHG emissions trend (2017-18 to 2021-22)**
9.43% increase at 2.36% annually

The overall GHG emissions and energy consumption in Tiruchirappalli has increased in FY 2021-22 as compared to FY 2017-18. However, the emissions and energy use have declined between FY 2019-20 and 2020-21, which is primarily attributed to the COVID-19 restrictions and lockdown implemented during 2020-21.

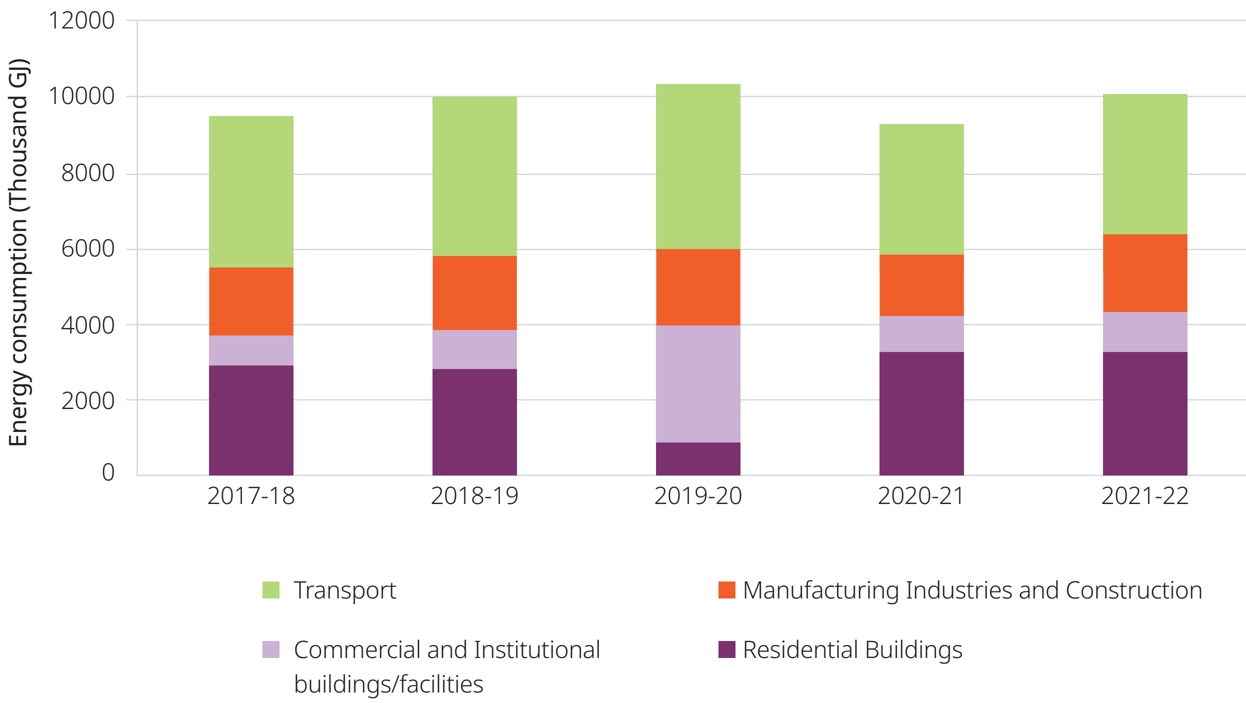



*Figure 6.3: Trend of energy consumption from 2017-18 to 2021-22*

[9]All annual growth rates are Average Annual Growth Rates (AAGR)

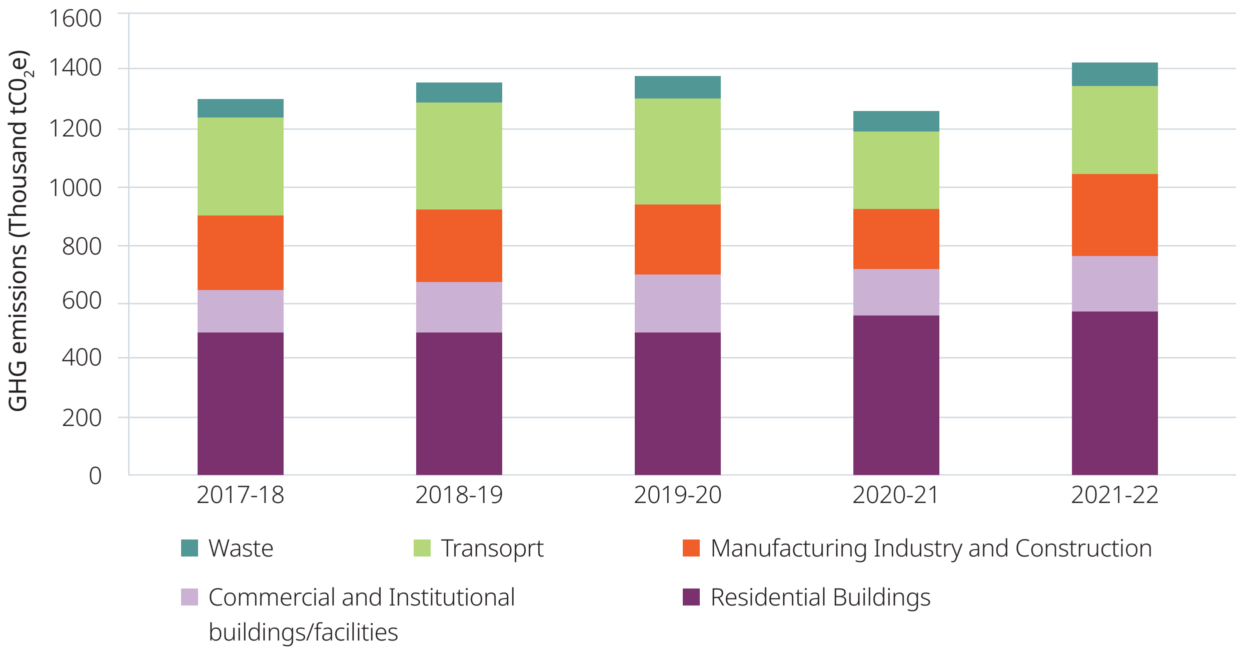



*Figure 6.4: Trend of GHG Emissions from 2017-18 to 2021-22*

### b.Energy Consumption and GHG Emissions by Energy Source

**Highlights**

**Predominant energy sources**
Indirect electricity (46.4%), Diesel (24.8%); Petrol (19.1%); LPG (9.4%)

**Energy sources with significant GHG emissions**
Indirect electricity (70.8%)[10], Diesel (14.2%); Petrol (10.2%); and LPG (4.5%)

*Table 6.5: Energy consumption and GHG emission by energy source (2021-22)*

| Fuel/Energy Source | Energy Use by Source (GJ) | GHG emission by Source ($tCO_2e$) |
|---|---|---|
| Diesel | 24,95,895 | 1,85,579 |
| Petrol | 19,22,544 | 1,33,720 |
| LPG | 9,41,089 | 59,434 |
| Kerosene | 9,41,089 | 2,458 |
| Indirect Electricity | 46,63,152 | 9,26,154 |
| Total | 1,00,56,752 | 13,07,346 |

[10]Although electricity accounts for 46.4% of the energy mix, it contributes to 70.8% of the GHG emissions in Tiruchirappalli, largely due to India's GHG intensive thermal power-based generation system.

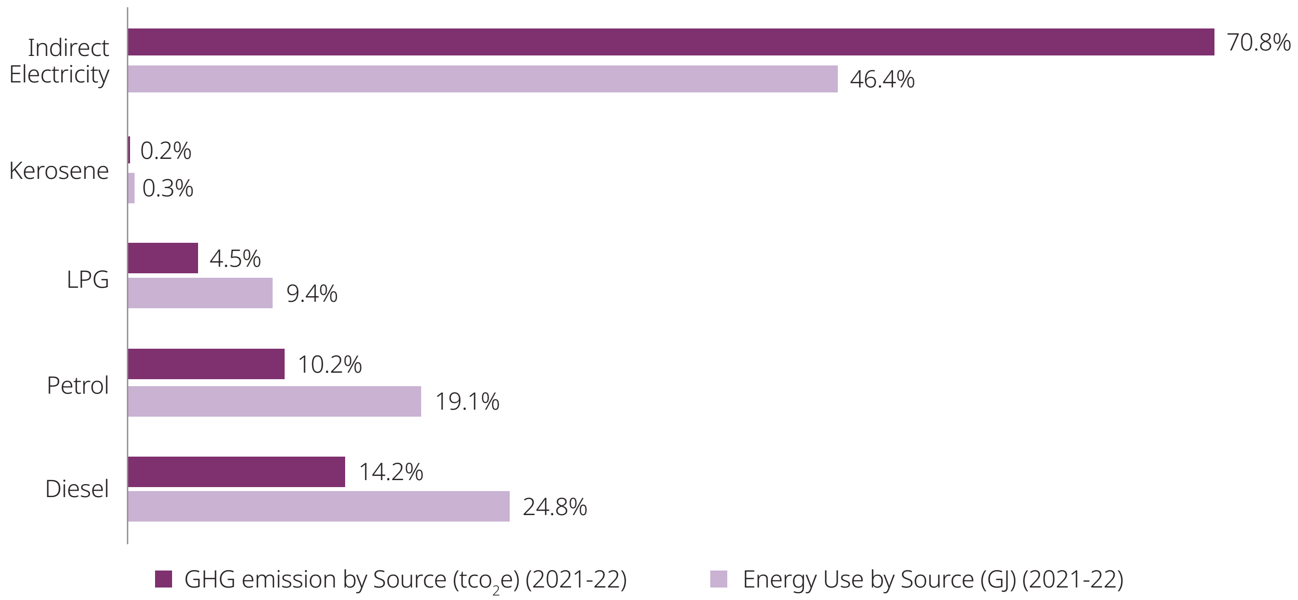



*Figure 6.5: Energy consumption and GHG emissions by energy source, 2021-22*

## 6.3.2 Sectoral Insights and Trends of Energy Consumption and GHG Emissions

### 6.3.2.1 Sectoral Electricity Consumption and GHG Emissions

**Highlights**

**Total electricity consumption in 2021-22**
1,295.3 million kWh

**Per capita electricity consumption**
1,198 kWh

**GHG emissions from electricity consumption in 2021-22**
926 thousand $tCO_2e$

**Trend of electricity consumption (2017-18 to 2021-22)**
25.4% increase at 6.34% annually

**Trend of GHG emissions (2017-18 to 2021-22)**
18.9% increase at 4.72% annually

**Sectoral electricity consumption and GHG emissions (2021-22)**
Residential Buildings (56.2%), Manufacturing Industry and Construction (25.2%) and Commercial and Institutional Buildings/Facilities (18.6%)

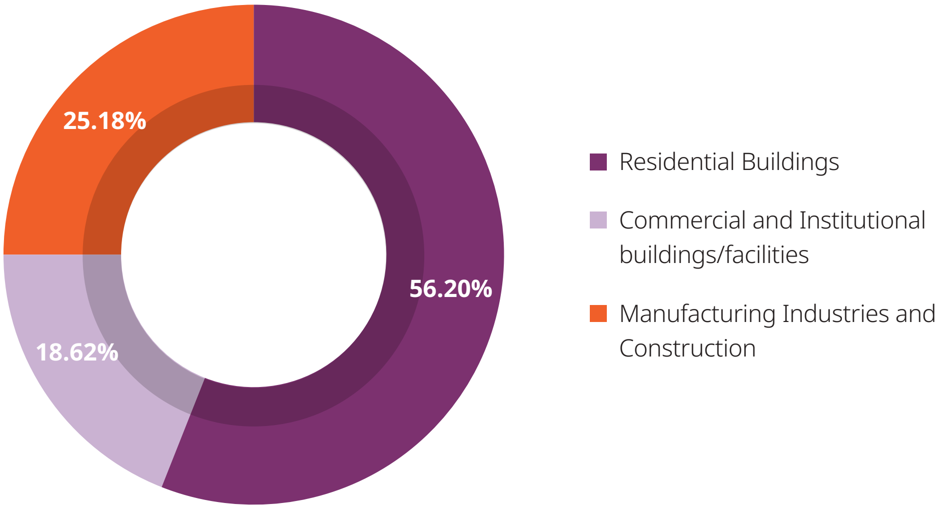



*Figure 6.6: Sector-wise GHG emissions from electricity consumption (2021-22)*

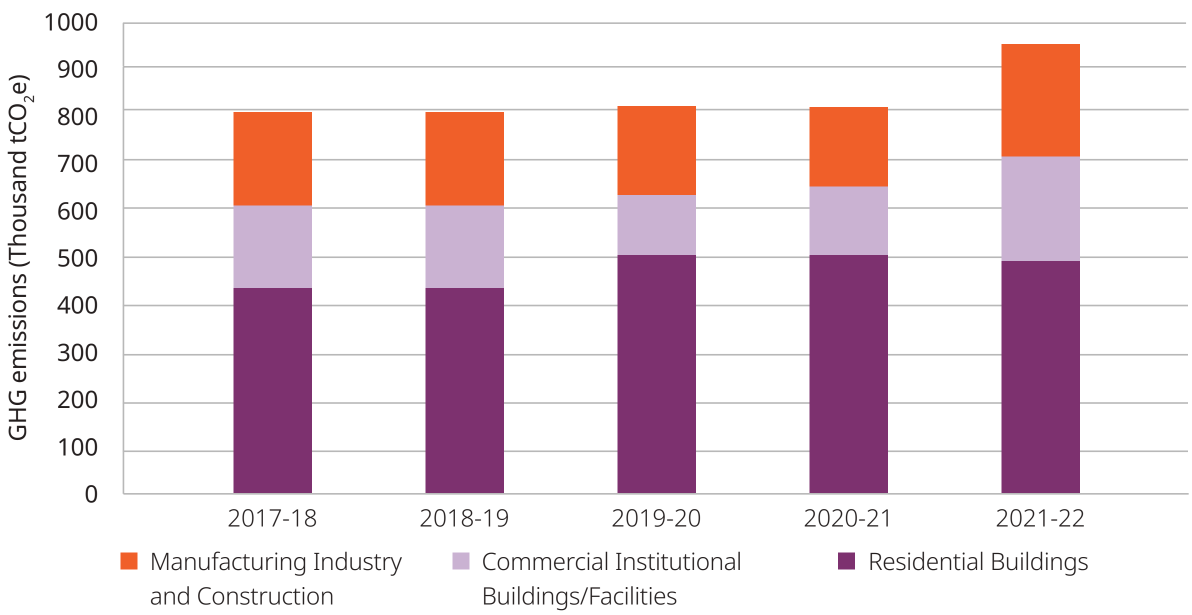



*Figure 6.7: Trend of GHG emissions from electricity consumption (2017-18 to 2021-22)*

### 6.3.2.2 GHG Emissions from Stationary Fuel Consumption[11]

**Highlights**

**Sectoral share of energy consumption**

Industrial (51%), Residential Buildings (38%), Commercial (11%)

**Trend of GHG emissions from stationary fuel consumption**

6.9% decline at 1.73% annually

**Sectors with significant GHG emissions**

Industrial (54%), Residential Buildings (35%), Commercial (11%)

[11]Stationary fuel consumption refers to the fuel used for all purposes other than transportation (e.g. LPG for residential use, furnace oil used for industrial purposes), which leads to direct emissions of GHGs.

*Table 6.6: Energy consumption and GHG emissions from stationary fuel consumption (2021-22)*

| Sector | Energy consumption (GJ) | GHG Emissions ($tCO_2e$) |
|---|---|---|
| Residential | 6,48,469 | 41,261 |
| Commercial | 1,96,758 | 12,426 |
| Manufacturing Industries and Construction | 8,83,688 | 63,860 |
| **Total** | **17,28,915** | **1,17,547** |

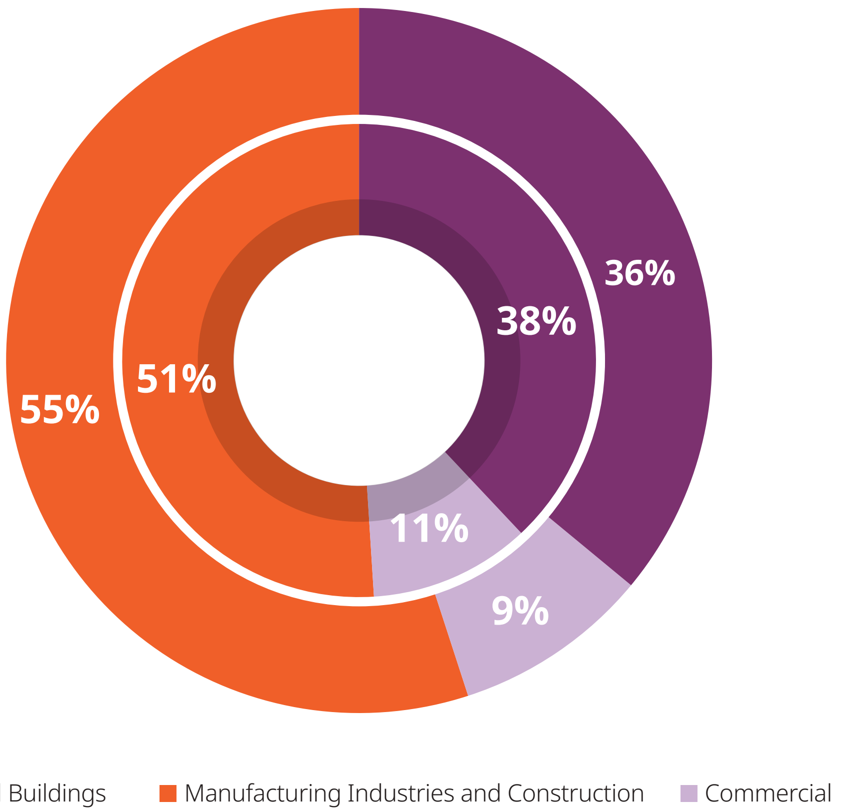



*Figure 6.8: Sector share of energy consumption (inner graph) and GHG emissions (out graph) from stationary fuel consumption (2021-22)*

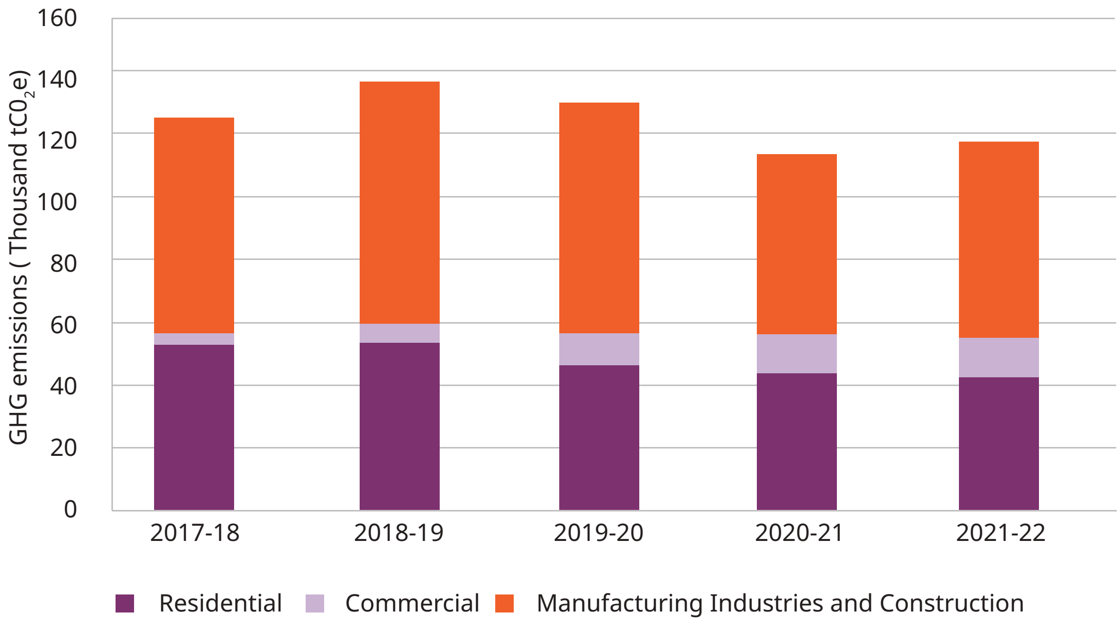



*Figure 6.9: Trend of GHG emissions from stationary fuel consumption (2017-18 to 2021-22)*

### a.Residential Buildings

**Highlights**

**Energy consumption from stationary fuel consumption (2021-22)**
6,48,469 GJ

**GHG emissions from stationary fuel consumption (2021-22)**
41,261 $tCO_2e$

**Trend of energy consumption (2017-18 to 2021-22)**
17.20% decline at 4.30% annually

**Trend of fuel consumption (2017-18 to 2021-22)**

- LPG: 18.3% increase at 4.58% annually
- Kerosene[12] 87.1% decline at 21.77% annually

**Trend of GHG emissions (2017-18 to 2021-22)**
20.40% decline at 5.10% annually[13]

[12] Kerosene in the city has decreased due to Pradhan Mantri Ujjwala Yojana introduced in 2017.
[13] The primary reason for the decline in total greenhouse gas emissions from stationary fuel consumption in the residential sector can be primarily attributed to the significant decline in kerosene usage.

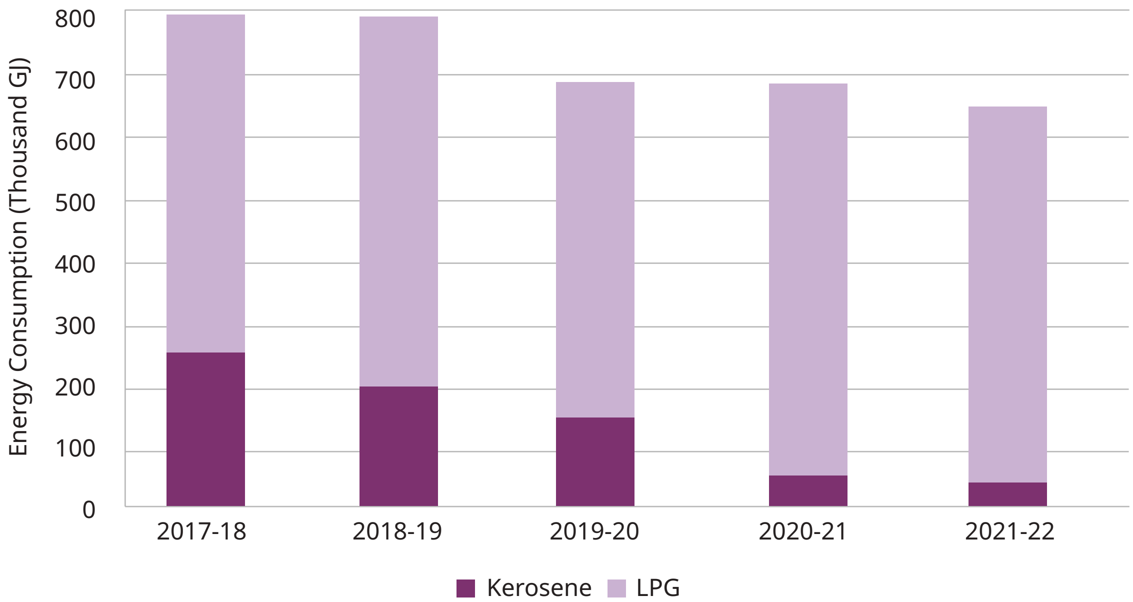



*Figure 6.10: Trend of stationary fuel energy consumption in residential buildings (2017-18 to 2021-22)*

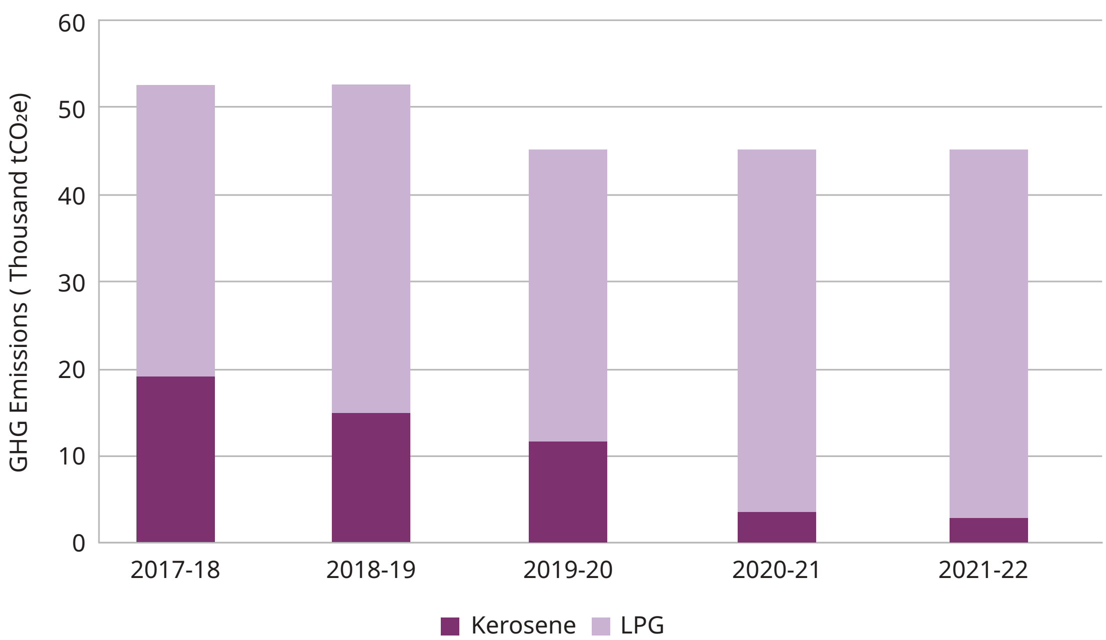



*Figure 6.11: Trend of GHG emissions from stationary fuel consumption in residential buildings (2017-18 to 2021-22)*

### b.Commercial and Institutional Buildings and Facilities

**Highlights**

**Energy consumption from stationary fuel consumption (2021-22)**
1,96,758 GJ

**GHG emissions from stationary fuel consumption (2021-22)**
12, 426 $tCO_2e$

**Trend of fuel consumption and GHG emissions (2017-18 to 2021-22)**
LPG: 200% increase at 50% annually[14]

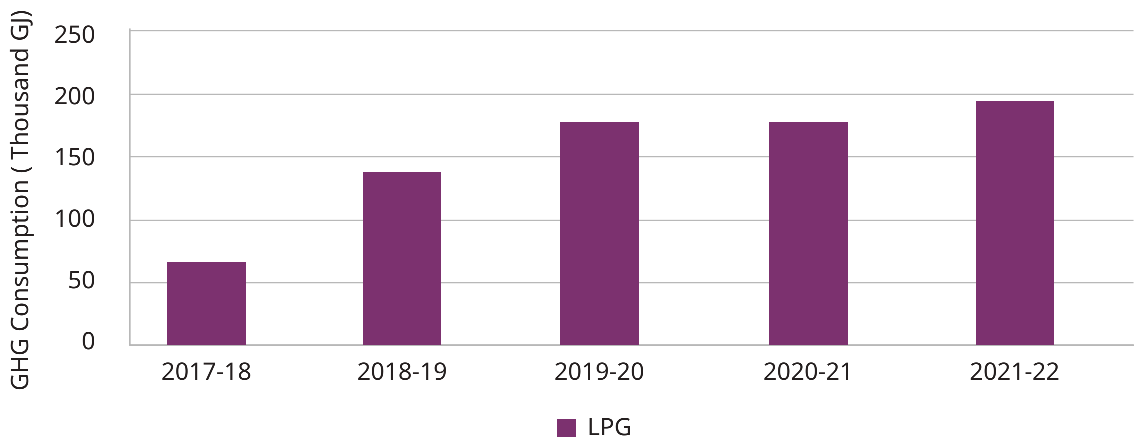



*Figure 6.12: Trend of stationary fuel energy consumption in commercial and institutional buildings/facilities, 2017-18 to 2021-22*

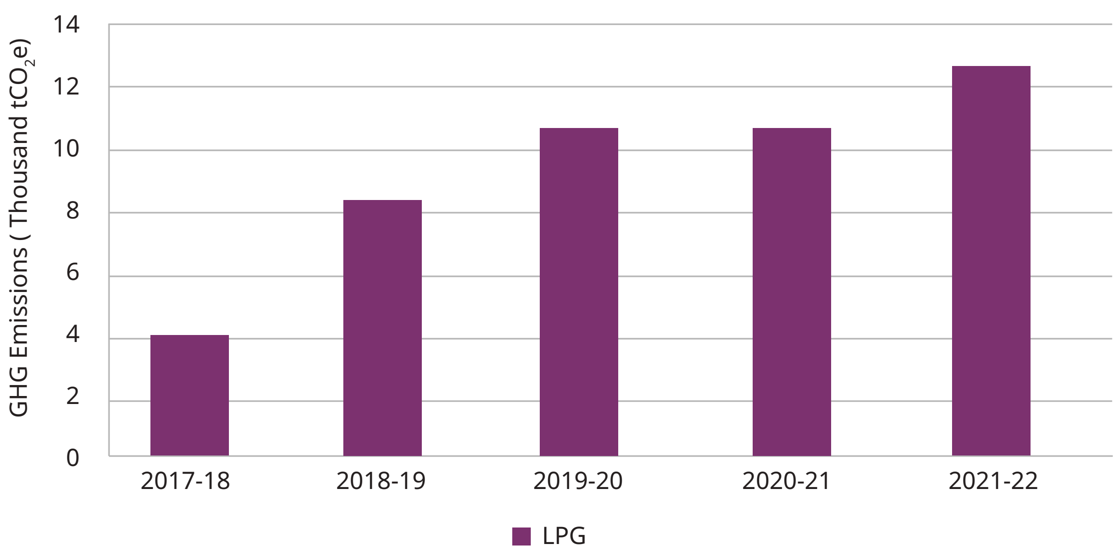



*Figure 6.13: Trend of GHG emissions from stationary fuel consumption in commercial and institutional buildings/facilities, 2017-18 to 2021-22*

[14]A combination of factors like removal of Kerosene and increased penetration of LPG has caused this rapid rise.

### c.Manufacturing Industries and Construction

**Highlights**

**Energy consumption from stationary fuel consumption (2021-22)**
8,83,688 GJ

**GHG emissions from stationary fuel consumption (2021-22)**
63,860 $tCO_2e$

**Trend of energy consumption (2017-18 to 2021-22)**
8.72% decline at 2.18% annually

**Trend of fuel consumption (2017-18 to 2021-22)**
- Diesel: 19.80% decline at 4.94% annually
- Petrol: 11.10% increases at 2.78% annually

**Trend of GHG emissions (2017-18 to 2021-22)**
9.20% decline at 2.30% annually[15]

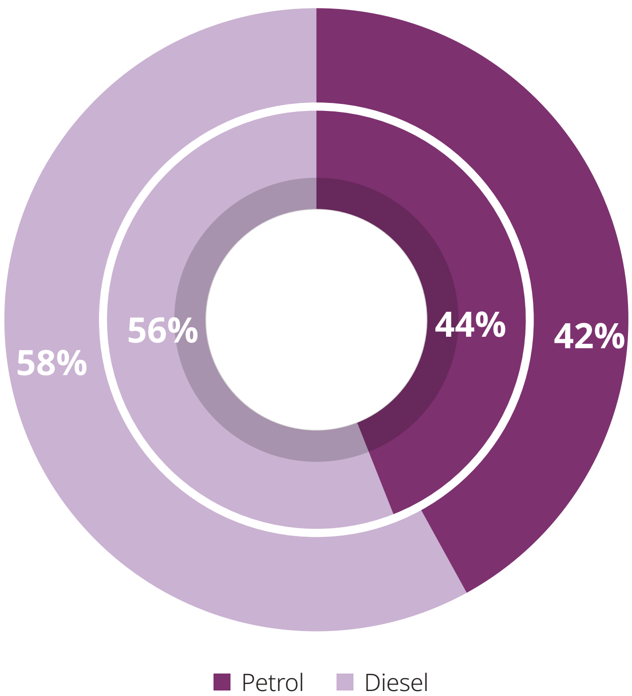



*Figure 6.14: Stationary energy consumption (inner graph) and GHG emissions (outer graph) in industries, 2017-18 to 2021-22*

[15] The observed decline in overall greenhouse gas (GHG) emissions in the industrial sector in Tiruchirappalli can primarily be attributed to the relocation of red-category industries as per the National Clean Air Program (NCAP) Action Plan, aligning with the trend observed in several cities across India.

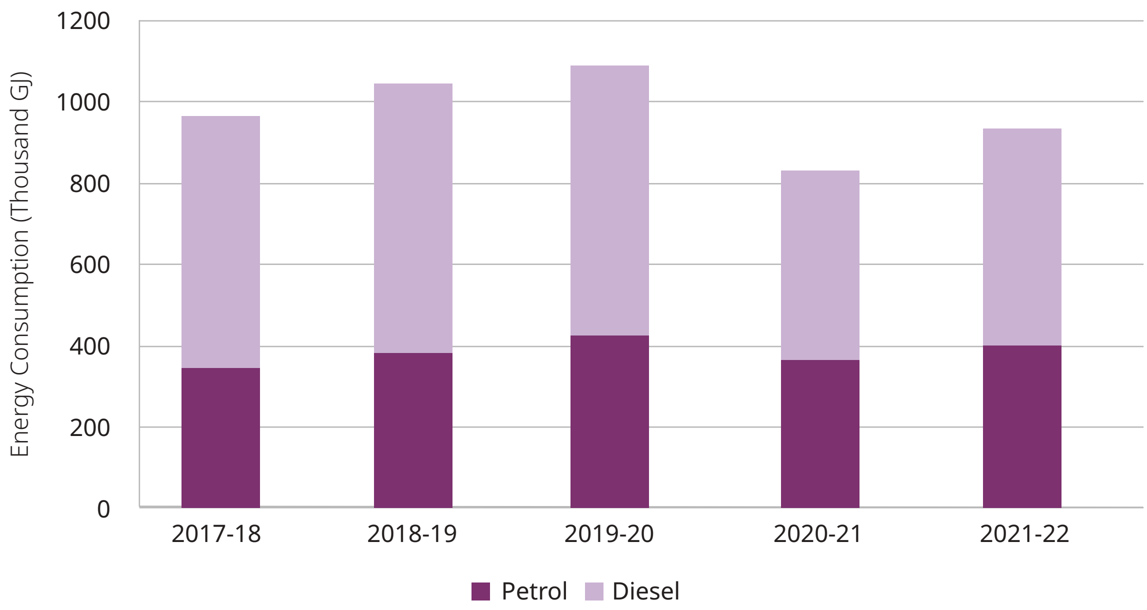



*Figure 6.15: Trend of stationary fuel energy consumption in industries, 2017-18 to 2021-22*

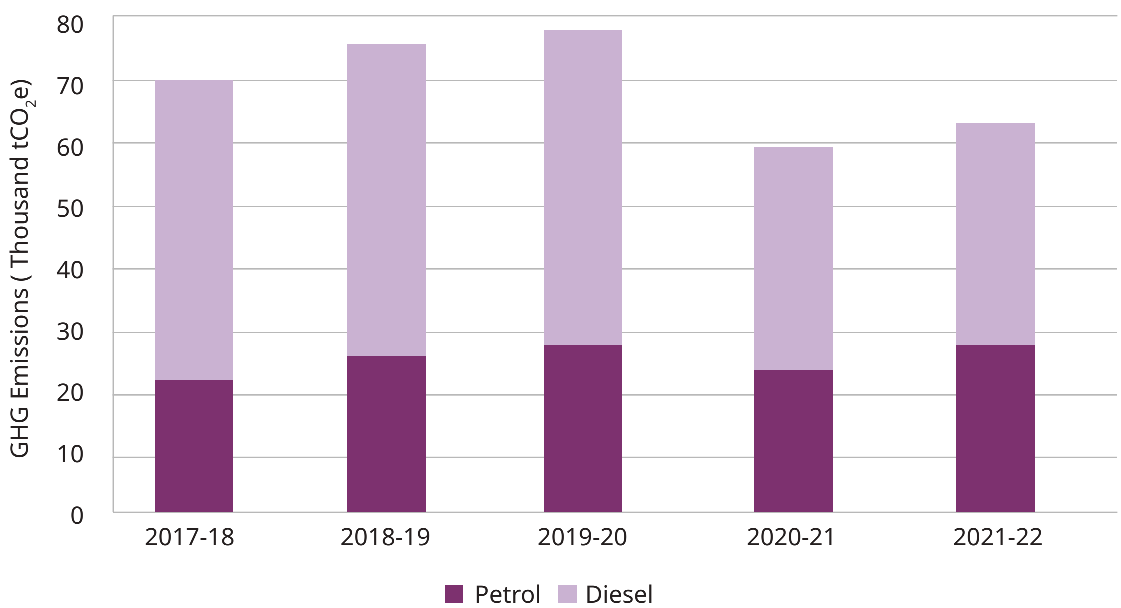



*Figure 6.16: Trend of GHG emissions from stationary fuel consumption in industries, 2017-18 to 2021-22*

### 6.3.2.3 GHG Emissions from Transportation Sector

**Highlights**

**GHG emission share by mode**
On-road Transportation (85.80%), Rail (8.20%), Aviation (6.0%)

**Trend of GHG Emissions (2017-18 to 2021-22)**
8.60% decline[16] a21,241 t 2.20% annually

*Table 6.7: GHG emissions by mode share from 2017-18 to 2021-22*

| Sector | GHG Emissions ($tCO_2e$) | | | | |
|---|---|---|---|---|---|
| | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22 |
| On-road | 2,82,482 | 3,01,752 | 3,13,076 | 2,41,901 | 2,63,646 |
| Rail | 21,241 | 21,241 | 21,241 | 10,475 | 25,224 |
| Aviation | 32,547 | 37,697 | 36,032 | 11,618 | 18,392 |
| **Total** | **3,36,271** | **3,60,691** | **3,70,349** | **2,63,994** | **3,07,262** |

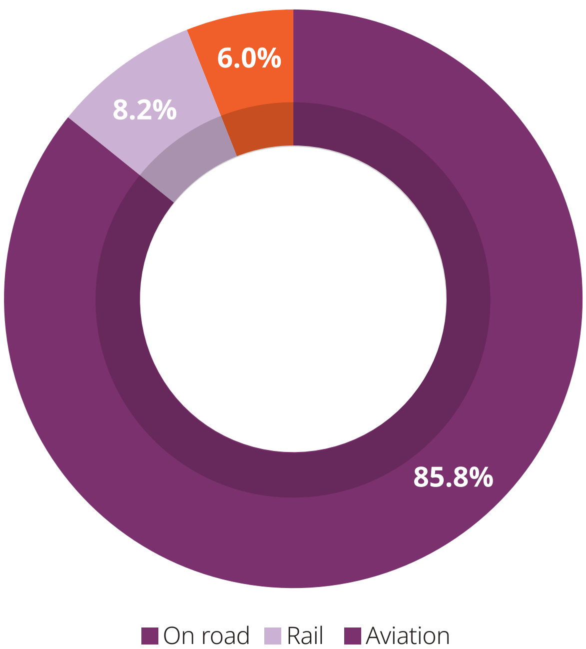



*Figure 6.17: GHG emissions by transportation modes, 2021-22*

[16]The overall reduction has been due to a sharp drop in Diesel vehicles in the city.

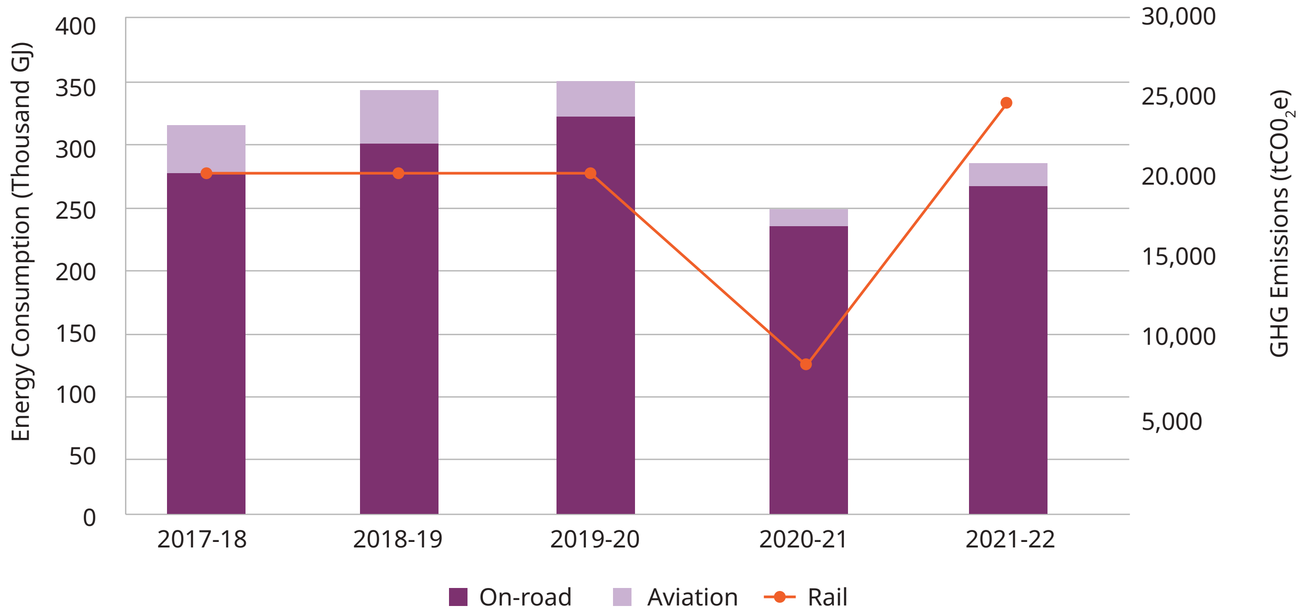



*Figure 6.18: Trend of GHG emissions from transportation sector, 2017-18 to 2021-22*

### a.GHG Emissions from Fuel Consumption in On-Road Transportation

**Highlights**

**Energy consumption (2021-22)**
36,64,685 GJ

**GHG emissions (2021-22)**
3,07,262 $tCO_2e$

**Trend of energy consumption (2017-18 and 2021-22)**
5.8% decline at 1.46% annually

**Trend of fuel consumption (2017-18 to 2021-22)**
8.72% decline at 2.18% annually

**Trend of fuel consumption (2017-18 to 2021-22)**
- Auto-LPG: 582.6% increase[17] at 145.66% annually
- Diesel: 19.8% decline[18] at 4.94% annually
- Petrol: 11.1% increase at 2.78% annually

**Trend of GHG emissions (2017-18 to 2021-22)**
6.7% decline at 1.67% annually

[17]Auto-LPG has increased due to an increase in the number of vehicle models offering Auto-LPG option and also due to GoTN

[18]Emissions from Diesel consumption declined due to reduction in heavy vehicle movement and introduction of Bharat Stage (BS) stage VI emission norms leading to OEMs dropping sales of Diesel options in their vehicle offerings.

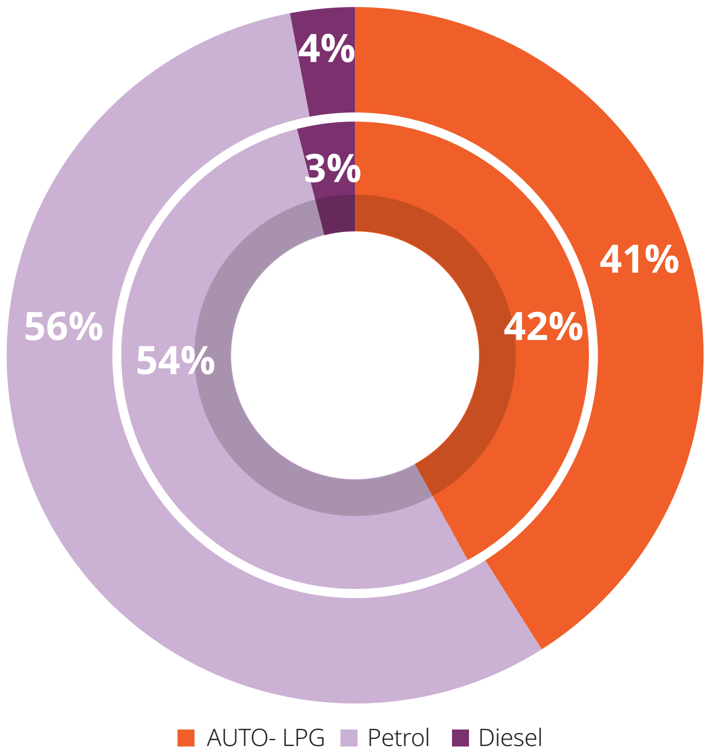



*Figure 6.19: Fuel consumption (inner) and GHG emissions (out graph) in on-road transportation, 2021-22*

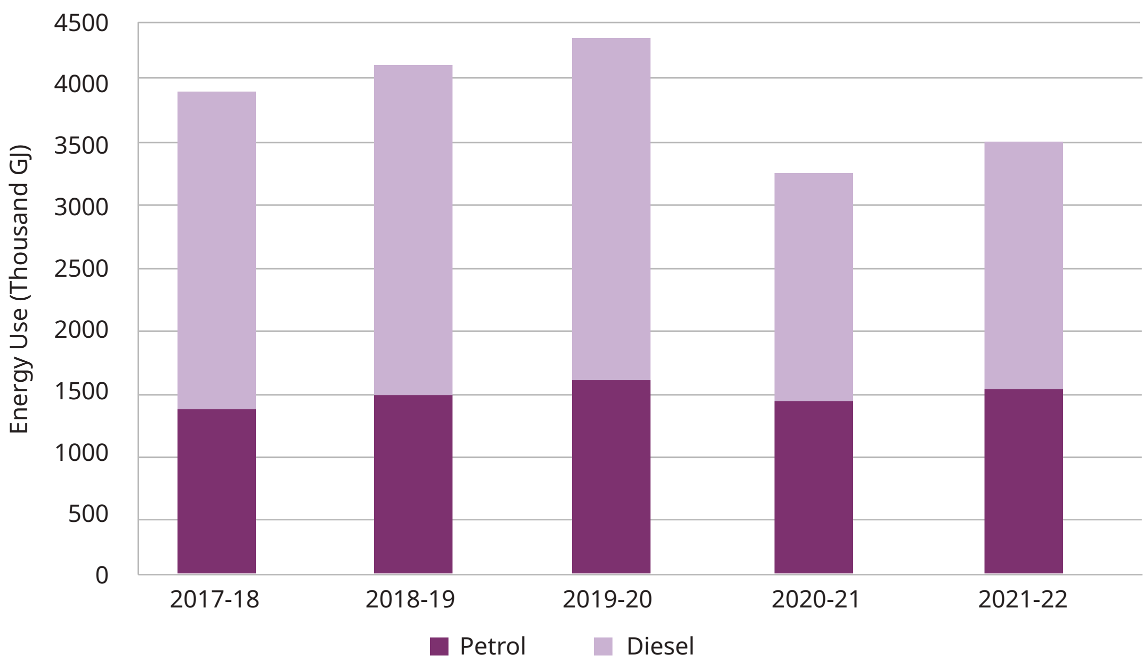



*Figure 6.20: Trend of energy use in on-road transportation, 2017-18 to 2021-22*

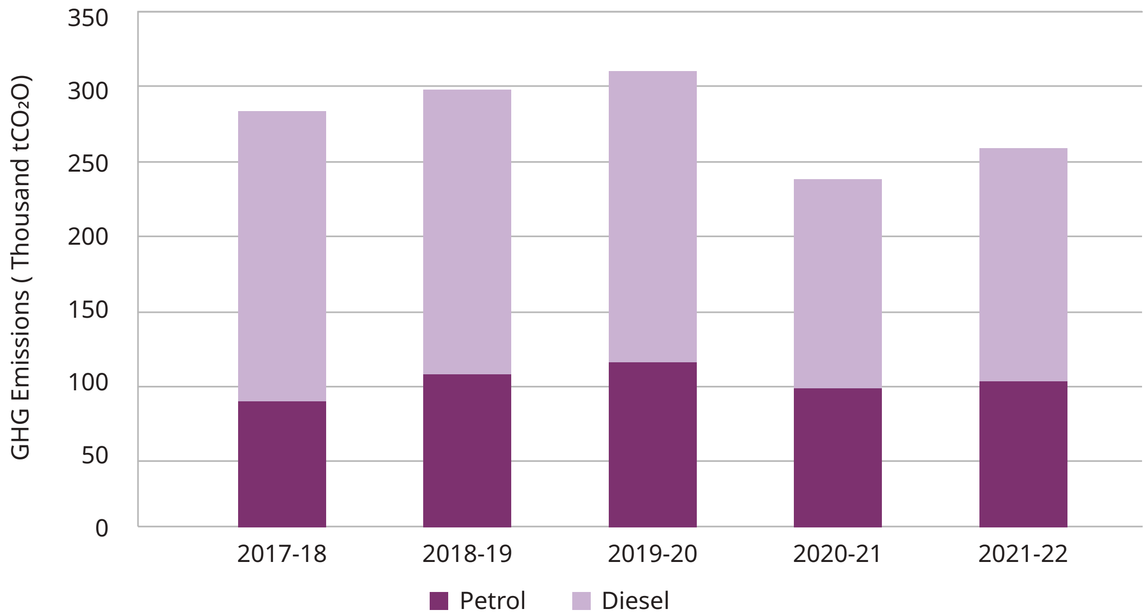



*Figure 6.21: Trend of energy use in on-road transportation, 2017-18 to 2021-22*

### 6.3.2.4 GHG Emissions from Waste Sector

**Highlights**

**GHG emissions from waste sector (2021-22)**
74,799 $tCO_2e$)

**Contribution to GHG emissions**
Wastewater (29%), Solid Waste (71%)

**Trend of GHG emissions (2017-18 to 2021-22)**
21.9% increase at 5.48% annually.

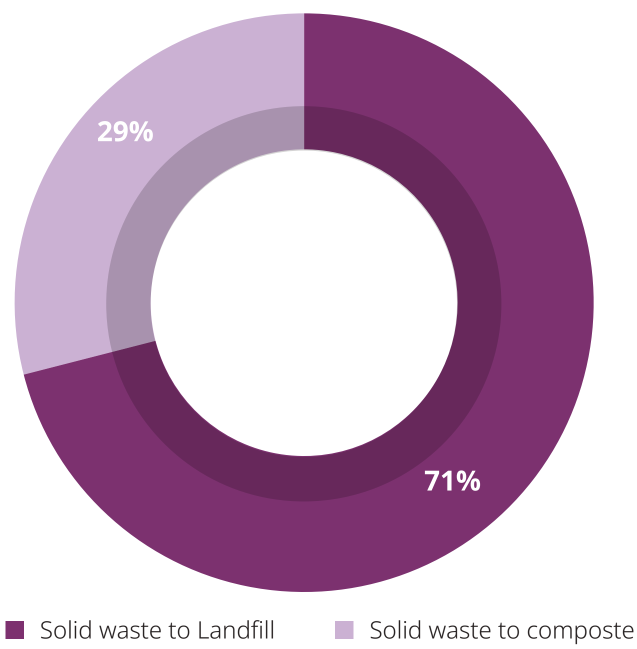



*Figure 6.22: Contribution to GHG emissions from Domestic Wastewater and Solid Waste (2021-22)*

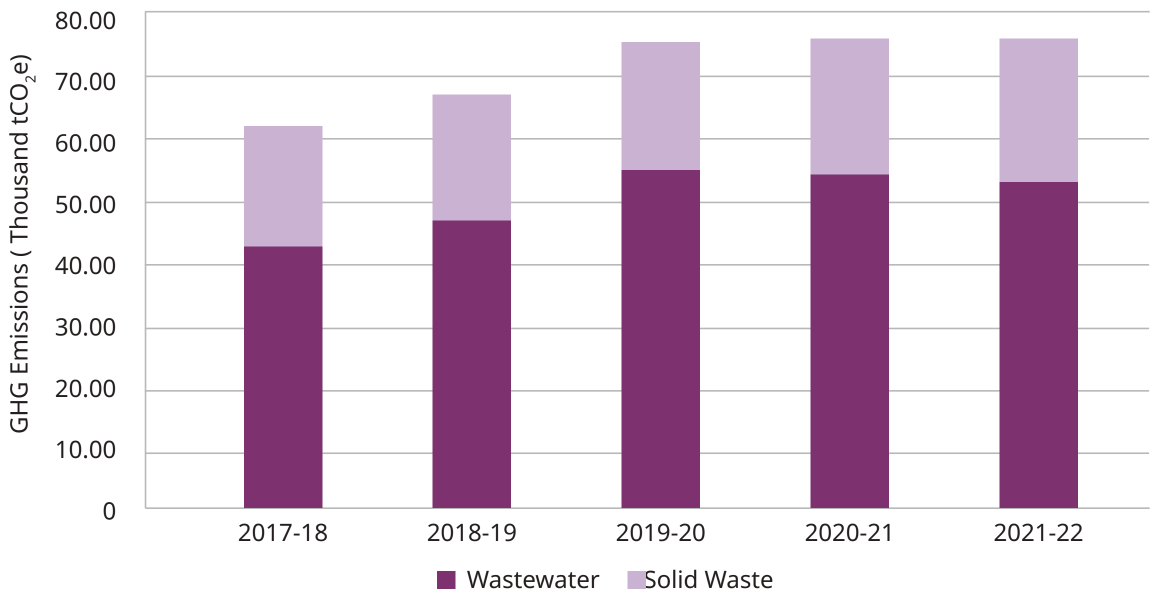



*Figure 6.23: Trend of GHG emissions from waste sector (2017-18 to 2021-22)*

### a GHG Emissions from Solid Waste

**Highlights**

**Waste generation (2021-22)**
470 TPD (90% waste collected)

**Waste disposed at dumpsite per day (2021-22)**
162 TPD (34% of the waste generated)

**Total Waste Recovered at MRF Facility and sent to RDF Facility**
20 TPD (4.2% of the waste generated)

**GHG emissions from biological treatment (2021-22)**
13,523 $tCO_2e$

**GHG emissions from dumpsite (2021-22)**
38,418 $tCO_2e$

**Trend of GHG emissions from solid waste (2017-18 to 2021-22)**
24.7% increase at 6.17% annually

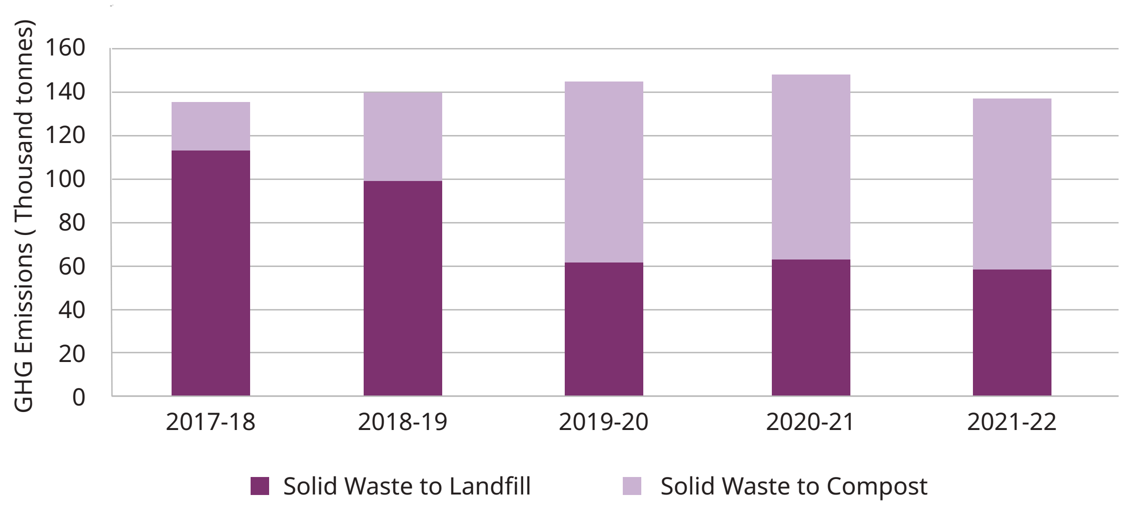



*Figure 6.24: Trend of solid waste generation and management, 2017-18 to 2021-22*

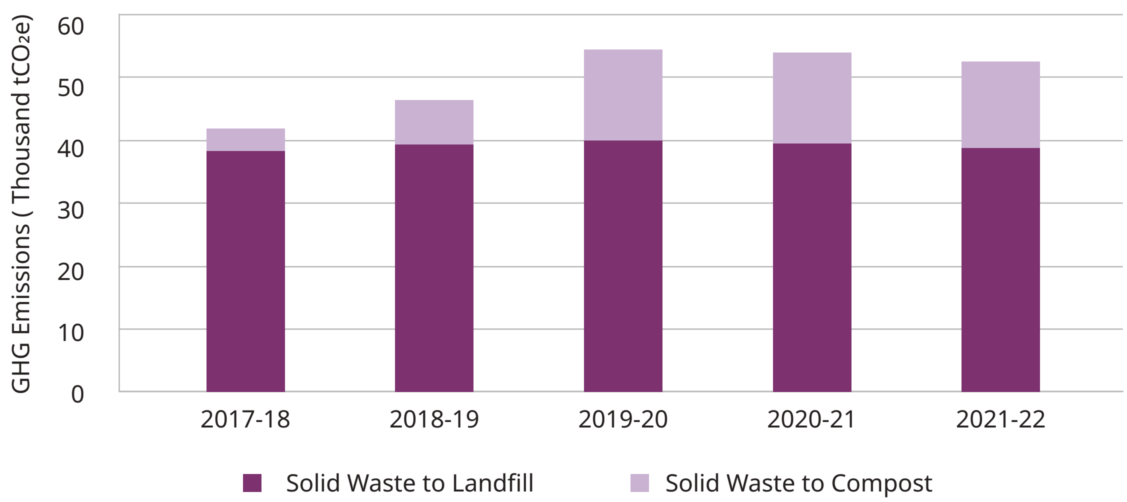



*Figure 6.25: Trend of GHG emissions from solid waste, 2017-18 to 2021-22*

### b.GHG Emissions from Domestic Wastewater Treatment and Discharge

**Highlights**

**GHG emissions from domestic wastewater (2021-22)**
0.02 million $tCO_2e$

**Trend of GHG emissions (2017-18 to 2021-22)**
16.1% increase at 4% annually

**Predominant contributors to GHG emissions**
Sewer collected and not treated (66.54%); septic system uncollected (26%) and uncollected Latrine (7.46%)

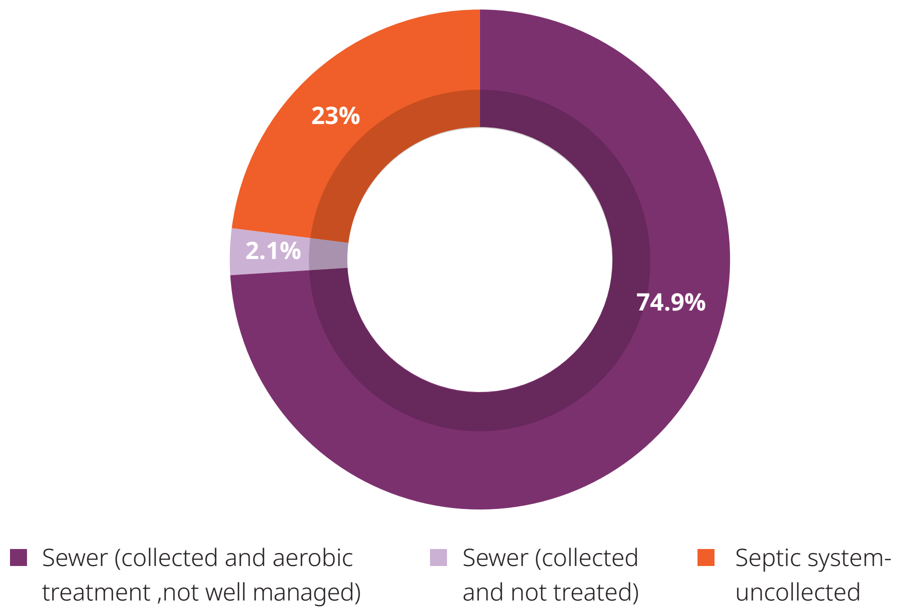



*Figure 6.26: GHG emissions by type of discharge/ treatment pathway (2021-22)*

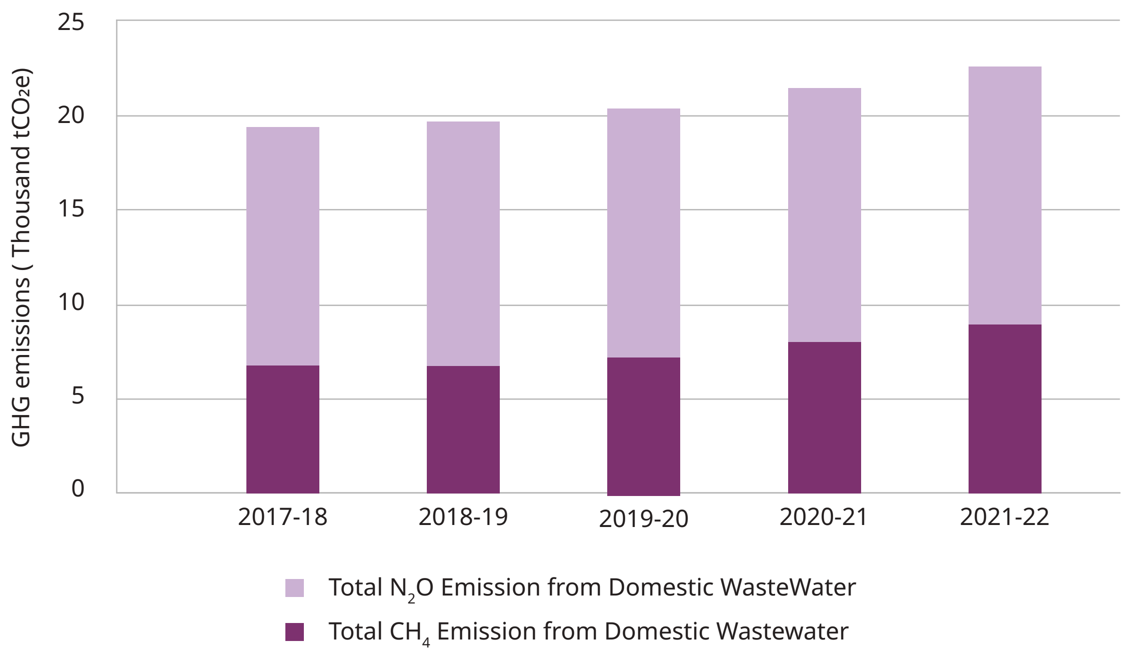



*Figure 6.27: Trend of GHG emissions from wastewater (2017-18 to 2021-22)*

### 6.3.3 Municipal Operations: Energy Consumption and GHG Emissions

**Predominant electricity consumers**
Water Supply (46.95%), Street Lighting (16.25%), Wastewater Treatment (12.44%)

**Main contributors to GHG emissions**
Water Supply (53.02%), Street Lighting (18.35%), Wastewater Treatment (14.05%), and Transportation (7.74%).

**Trend of GHG emissions (2017-18 to 2021-22)**
14.8% decline at 3.7% annually. This is due to the significant investments done by TCC in LED conversion and roof-top solar in several of its office buildings across the city.

*Table 6.8: Energy consumption and GHG emissions from municipal operations (2021-22)*

| Sector | Electricity Consumption (MU kWh) | Fuel Consumption (Kilo-Litre) | GHG Emissions ($tCO_2e$) |
|---|---|---|---|
| Buildings | 3.0 | - | 2152 |
| Wastewater Treatment | 6.2 | - | 4411 |
| Water Supply | 23.3 | - | 16,625 |
| Street Lighting | 8.1 | - | 2430 |
| Municipal vehicle fleet | - | 852 | |
| **Total** | **40.5** | **852** | **31.41** |

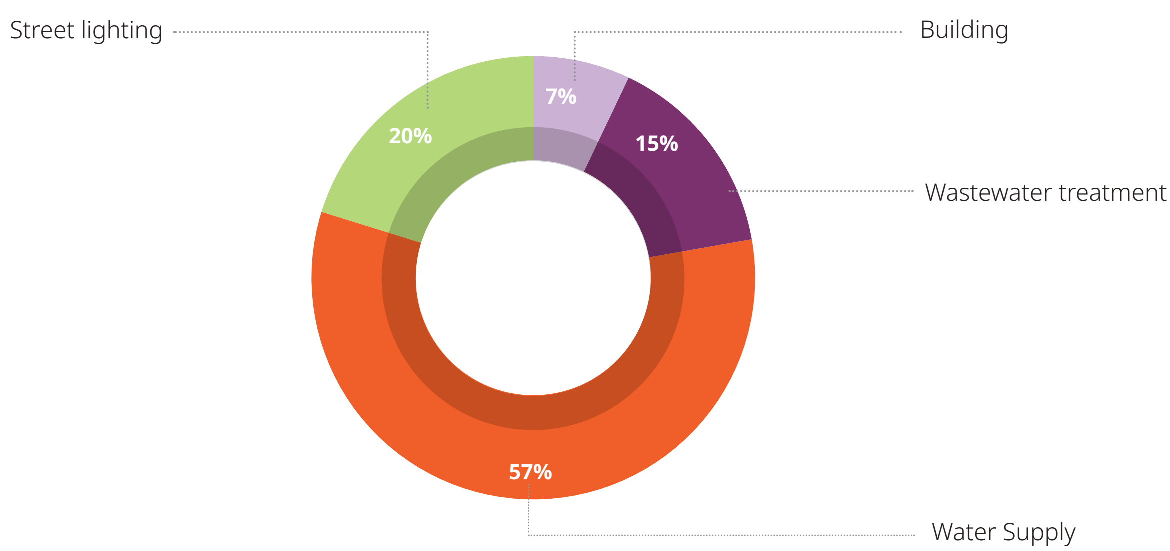



*Figure 6.28: Electricity Consumption from Municipal Operations 2021-22*

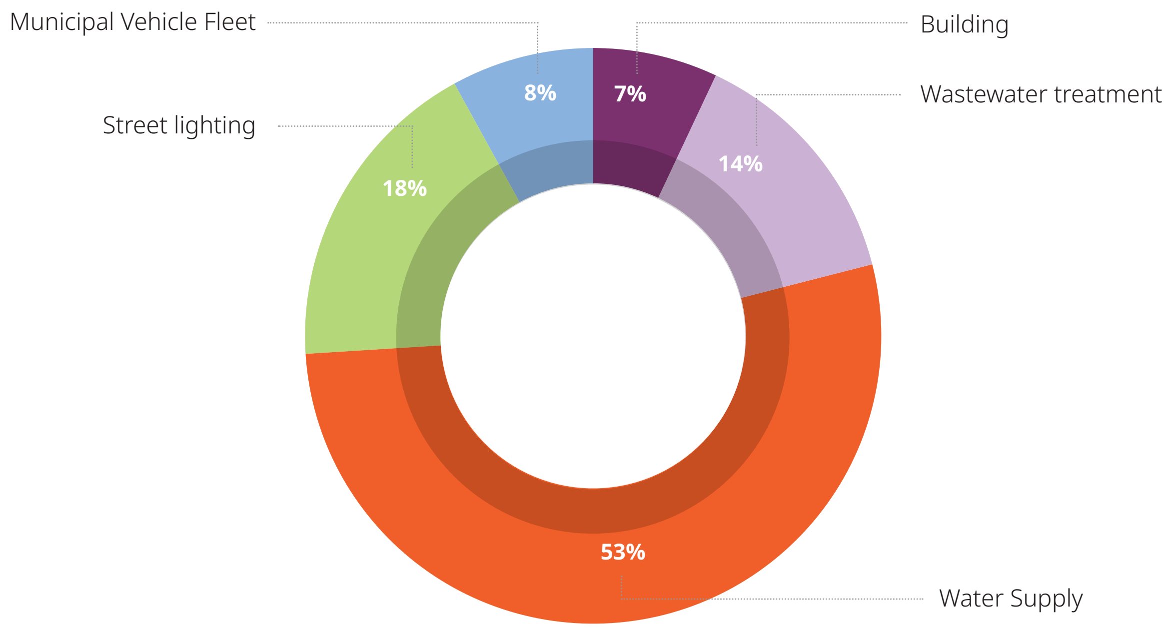



*Figure 6.29: GHG emissions from Municipal Operations 2021-22*

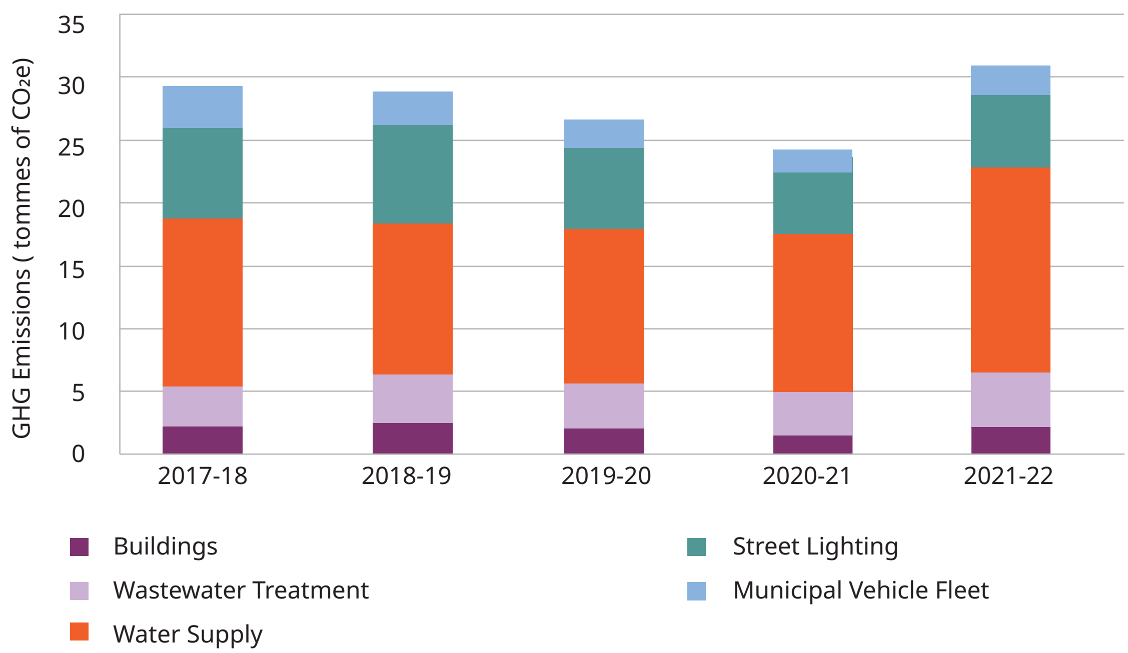



*Figure 6.30: Trend of GHG emissions from Municipal Operations, 2017-18 to 2021-22*

The Municipal emissions in Tiruchirapalli has seen a consistent reduction in all sectors except water and wastewater, due to significant investments by TCC in roof-top solar and LED conversion.

07

# SCENARIO PLANNING

07

# SCENARIO PLANNING

## Introduction

The Net-zero CRCAP aims to transform Tiruchirappalli into a climate-resilient city with a vision to achieve net-zero emissions by 2070. Central to this plan is a strategy to significantly reduce GHG emissions, aligning with the ambitious climate goals of GoI announced at COP 26[1].

An integral part of the Net-zero CRCAP is Scenario Planning, a methodological step that maps out future GHG emissions pathways. This process is crucial for establishing strategic emission reduction targets and forecasting future GHG levels. Through Scenario Planning, the Net-zero CRCAP develops a clear roadmap that outlines the ambitious climate actions and levels of commitment required to meet the net-zero emissions target, ensuring a sustainable future for Tiruchirappalli.

**Trichy's End Goal: Achieving Net Zero GHG Emissions by 2070**

The overarching objective steering Trichy's GHG emissions reduction strategy is to attain net-zero emissions by 2070. This target aligns with India's national NDC commitment and is outlined in this chapter.

The scenario planning aims to demonstrate how emission levels are expected to look like in the future in different scenarios and intends to help identify an evidence-base for the levels of ambition and climate actions to achieve net zero goals.

The methodology adopted for modelling and scenario analysis is indicated in Figure 7.1. The emissions baseline[2] is the starting point to undertake scenario planning that helps to ascertain emission reduction targets and climate actions. The next step involved developing projections of Business-as-usual emissions until 2070 based on growth factors including composite economic and population growth rates, urbanisation factor, and municipal service demand growth estimates. Thereafter, two emission reduction scenarios, comprising of a set of locally appropriate strategies and quantifiable targets, were developed to lower the BAU emissions trajectory towards net zero emissions. The first scenario (Progress action scenario) represents an interim pathway and relatively higher level of ambition for emissions reduction compared to BAU, while being reflective of on-ground efforts, context and resources. The second scenario (Net-Zero Pathway) maps out an incrementally higher and necessary level of ambition, targets and strategies required to achieve net-zero emissions.

**According to IPCC 'Net zero emissions' is "When anthropogenic $CO_2$ emissions are balanced globally by anthropogenic $CO_2$ removals over a specified period." In the case of cities this implies net-zero GHG emissions rather than net-zero $CO_2$ emissions, as the former also includes non-$CO_2$ GHG removals.**

[1]COP 26 Website. Accessed April 2024.
[2]The GHG Inventory for the baseline

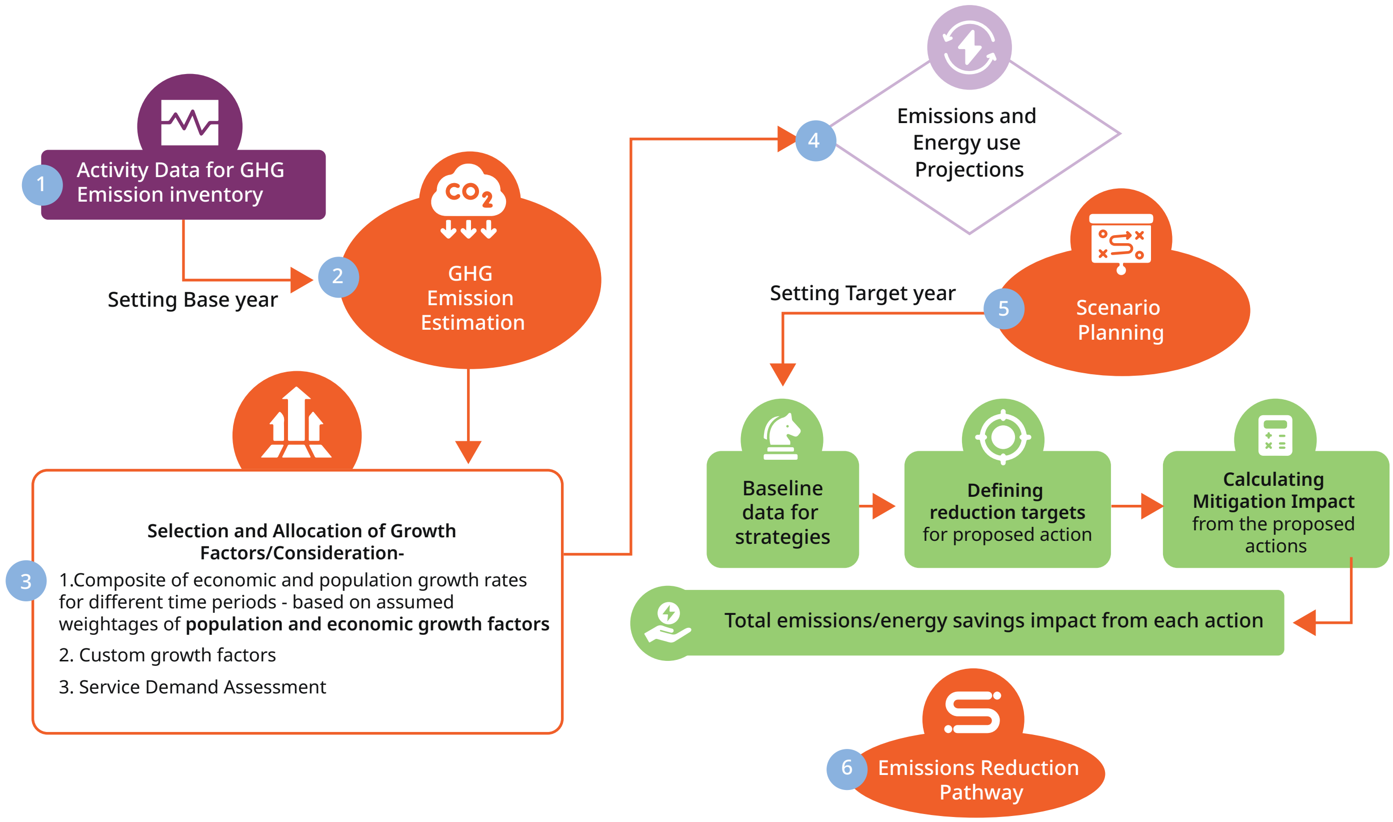



*Figure 7.1: Methodology adopted for modelling and scenario analysis*

## 7.2 Scenarios Identified for GHG Emissions Reduction

**The Comprehensive Net-zero Climate Resilient City Action Plan for Trichy outlines three distinct greenhouse gas (GHG) emission trajectories:**

### 1 BAU Projection (Business as Usual)

Anticipates GHG emissions trajectory if current climate action levels persist, serving as a baseline for assessing the impact of enhanced emissions reduction efforts.

### 2 Progressive Action Scenario

This scenario envisions GHG emissions with increased climate action at the city scale beyond the BAU scenario, in line with the various stated national and state policies & programs. It factors in local conditions, resource availability, and the current adoption status of solutions, financial commitments obtained, among other factors and incorporates them in the emission growth trajectory.

### 3 Net-zero Pathway

This pathway targets net-zero emissions by 2070, aligning with India's NDC commitment. It is defined by ambitious efforts, building upon national and state targets through relevant plans, policies, and programs, demonstrating Trichy's alignment with national policy and also reflecting the bold climate vision of the city.

These scenarios form the Net-zero CRCAP's strategic backbone, guiding Trichy in defining and executing emissions reduction strategies & actions while creating a low-carbon inclusive and sustainable growth trajectory.

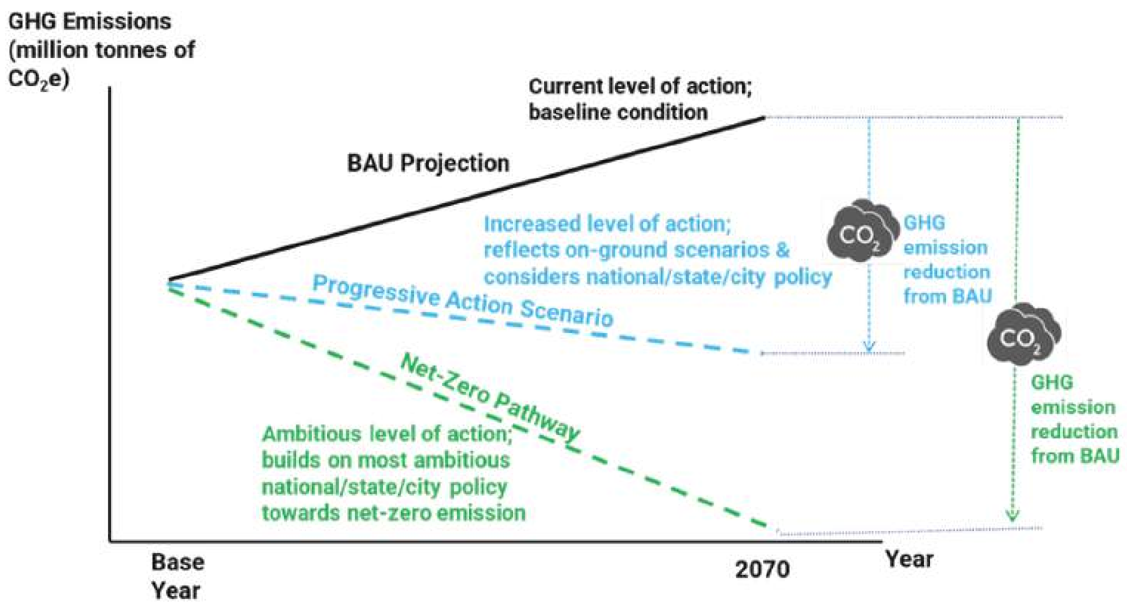



*Figure 7.2: Illustrative depiction of Progressive Action Scenario & Net-Zero Pathway compared to BAU projection*

## 7.3 Methodology for Emissions Modelling & Scenario Analysis

Trichy's Net-zero Climate Resilient City Action Plan (CRCAP) employs the Net-zero Climate Resilient Cities Action Planning Methodology for its development. This methodology includes baseline analysis, identifying and prioritising climate-resilient strategies and targets.

The specialized Net Zero GHG Emissions Tool, developed by ICLEI South Asia, is designed to estimate greenhouse gas emissions under various scenarios. By integrating local data sources, it offers the flexibility to adjust forecasts over different time frames, making it an essential resource for cities. Its primary function is to support urban planners in crafting effective strategies to reduce emissions, facilitating a more sustainable future.

The tool allows for city-level customizations like:

**GHG Inventory and Baseline**

Utilises local data for adjustments across different periods, modelling up to 2070, with key benchmarks in 2030 and 2050.

**Population Growth**

Employs ICLEI's population projection methodology which has been adapted from UNFCCC's Shared Socio-economic Pathways (SSP). It considers varying urbanisation rates, demographic trends, and regional variations, with Trichy following the slow growth rate as it aligns with the historic growth rate in population

**Economic Growth**

Projects future economic growth by analysing historical real GDP, also known as, GDP at constant prices, growth patterns.

**Sector-Specific Assumptions**

Considers the anticipated evolution of critical sectors such as energy, transportation, industry, and agriculture based on population and economic growth trends, assuming these continue unchanged.

Trichy's commitments to net-zero emissions are designed to align with India's overarching climate target of attaining net zero by 2070. The pathway to net zero in India should be effectively integrated with its existing NDC commitments, and also align with missions, schemes, programs and policies. To become a developed country by 2047[3], India should aim to reduce its absolute emissions to half by this time, a key step towards achieving net-zero emissions by 2070. From 2050 to 2070, India must decrease its emissions by 50%, advancing towards the net-zero goal at COP26. This gradual reduction highlights India's commitment to global climate objectives while advancing national development and economic prosperity.

**Guiding Assumptions for GHG Emissions Modelling in Trichy's Net-zero CRCAP**

**1 Proportional Urbanisation and Emissions**

It's assumed that emissions rise directly with urbanisation.

**2 Influences on Urbanisation Rate**

Urbanisation is driven by a mix of factors like population growth, economic development, sector growth, educational levels, demographic trends, and migration.

**3 Urbanization Defined**

Urbanisation is driven by a mix of factors like population growth, economic development, sector growth, educational levels, demographic trends, and migration.

**4 BAU Emissions Modelling Pathways**

4.BAU emissions are modelled using three scenarios-rapid, moderate, and slow urbanisation—based on various global methodologies, including those from the UN, IPCC, and the Global Cities Institute methodology.

**5 Government Policy Influence**

Trichy follows the slow growth rate for the Net-zero CRCAP as the historic trend matches the census numbers till baseline year only in this trajectory.

*Figure 7.3: Methodology adopted for modelling and scenario analysis*

[3]Viksit Bharat @2047 is the vision to make India a developed nation by 2047, the 100th year of independence. The vision encompasses various aspects of development, including economic growth, social progress, environmental sustainability, and good governance.

## 7.4 Business-as-Usual Projection of GHG Emissions

The BAU (Business as Usual) Projection outlines expected emissions for Trichy under current conditions without implementing additional mitigation strategies. It serves as a crucial baseline, illustrating the potential outcomes of persisting with existing practices and emphasising the importance of urgent action towards sustainability. This projection helps stakeholders and policymakers grasp the critical need for sustainable practices and policies to address forthcoming challenges.

Future emissions are projected using the baseline GHG inventory alongside population and economic growth data and sector-specific dynamics. The process for estimating future BAU emissions utilises GHG inventory, population, economic growth, and sectoral data to model future emissions. Some of the key considerations are:

**Sectoral Growth Rates:**

- Residential, Commercial, and Transport: Growth rates are calculated using a weighted average of population and economic data.
- Industrial Sector: Based on past energy consumption trends, aligning with environmental goals and the National Clean Air Program (NCAP).
- Urban Services and Utilities: Projects demand for services like water and waste management based on population growth.

Table 7.1 reflects the base growth rates used for population and GDP.

*Table 7.1: Population and economic growth rates used in BAU projection*

| Parameter | Annual Average Growth Rates | | | | 2061-70 |
|---|---|---|---|---|---|
| | 2022-2030 | 2031-2040 | 2041-2050 | 2051-2060 | |
| **Population Growth Rate** | 2.20% | 1.06% | 1.06% | 0.66% | 0.63% |
| **Economic Growth Rate** | 8.38% | 4.43% | 2.60% | 2.38% | 2.38% |

*Table 7.2: Sector-wise emissions in BAU for Trichy*

| Sector | GHG Emissions in Million $tCO_2e$ | | | | % Share of total in 2070 |
|---|---|---|---|---|---|
| | Baseline 2021-22 | Projected 2030 | Projected 2050 | Projected 2070 | |
| **Stationary Energy** | 1.04 | 1.66 | 2.64 | 3.62 | 80.0% |
| Residential Buildings | 0.56 | 0.78 | 1.09 | 1.35 | 29.8% |
| Commercial and Institutional Buildings | 0.18 | 0.34 | 0.59 | 0.87 | 19.2% |

| Sector | GHG Emissions in Million $tCO_2e$ | | | | % Share of total in 2070 |
|---|---|---|---|---|---|
| | Baseline 2021-22 | Projected 2030 | Projected 2050 | Projected 2070 | |
| Manufacturing Industry and Construction | 0.30 | 0.54 | 0.95 | 1.40 | 30.9% |
| **Transportation** | 0.31 | 0.43 | 0.61 | 0.74 | 16.7% |
| **Waste** | 0.07 | 0.08 | 0.11 | 0.15 | 3.3% |
| **City Total** | 1.43 | 2.17 | 3.36 | 4.53 | 100% |

If current trends persist and in the absence of any additional action, Tiruchirappalli's GHG emissions are expected to increase nearly three-fold to 4.53 million $tCO_2e$ in 2070 from 2021-22 (Detailed in Table 7.2).

**Key Findings from the BAU Projection in Trichy's Net-zero CRCAP**

- **Stationary Energy Sector Dominance**
  Stationary energy sector, are expected to significantly impact Trichy's emissions by 2070 of upto 80.0%, continuing the trend seen in the 2021-22 baseline year.

- **Manufacturing Industry and Construction as a Major Contributor**
  Emissions are set to rise, particularly from Manufacturing Industries and Construction by four times, with residential buildings and Commercial and Institutional Buildings also seeing an increase in emissions.

- **Transport and Waste Sectors**
  Although projected to rise, emissions from transport and waste will likely remain lower than those from the stationary energy sector remaining at 16.7 % & 3.3% in 2070.

- **Energy Consumption Sources**
  Building energy demand, met through grid-based electricity and fossil fuels, is poised to escalate GHG emissions under the Business as Usual (BAU) scenario.

- **On-Road Transportation Impact**
  The marginal increase in transport sector emissions is mainly attributed to high reliance on private vehicles as detailed in the City Profile chapter.

- **Opportunities for Emission Reduction in Transport**
  Enhancing public transport services, such as buses and metros, offers a viable solution for reducing reliance on private vehicles as indicated in the Urban System Gap Analysis Chapter.

- **Waste Management Infrastructure**
  Existing and planned waste management infrastructures meet current needs, but the anticipated population growth will necessitate further sustainable solutions to manage increased waste volumes.

## 7.5 Progressive Action Scenario

The Progressive Action Scenario incorporates the objectives and frameworks established by national and state government policies, programs, and missions across multiple sectors. It includes all ongoing and planned projects and policies at the city level, even those climate actions that have received administrative sanction but yet to begin operations are considered. This scenario aims for a higher level of climate action and achieves high GHG reductions than those in the BAU scenario. This scenario considers the realities on the ground, local conditions, available resources, financial allocations and existing barriers that would limit implementation of policy goals.

Several specific missions and programs are near completion, however new initiatives with similar objectives and key elements are set to launch, ensuring seamless progression in the efforts toward sustainable development.

**The key existing policies and commitments considered to build this scenario include:**

- India's Nationally Determined Contributions (NDC), CoP 26[4]
- Mission LiFE[5], India Cooling Action Plan, National Clean Air Program
- Swachh Bharat Mission
- National Action Plan for Climate Change (NAPCC), 2008 (including National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, Green India Mission, National Mission for Sustainable Agriculture[6])
- Energy Conservation Building Code, 2022[7]
- Tamil Nadu State Action Plan for Climate Change
- State policies on RE: Tamil Nadu Solar Energy Policy, 2022 (revised), and the Wind Power Policy
- Tamil Nadu Electric Vehicle Policy 2023[8]
- Tamil Nadu $ 1 trillion Vision[9]
- Trichy Annual Budget Planning[10]
- Trichy's Action Plan for SBM 2.0[11]
- Tamil Nadu State Budget
- Service Level Improvement Plan 2020-21 to 2024-25 under 15th Finance Commission
- Trichy's city's ongoing and planned initiatives for FY 2023-24, among others
- Tiruchirappalli Vision 2030[12]

When determining targets for energy efficiency measures in the progressive scenario, goals, and guidelines of initiatives under the National Mission for Enhanced Energy Efficiency[13] such as Market Transformation for Energy Efficiency[14] (MTEE), Energy Efficiency Financing Platform (EEFP), and Framework for Energy Efficient Economic Development (FEEED) have been referred for targets within the built environment the Energy Conservation Building Code, 2017 is used.

For grid level energy mix, solar and wind power, is a key focus as both in the base year and 2070 stationary energy is likely to be the highest emission contributor. It is informed by the Tamil Nadu Solar Energy Policy, 2019[15], and the Tamil Nadu Wind Energy Roadmap[16]. These policies aim to encourage the widespread use of renewable sources. These targets are also finalised

[4]India's NDC Revised in CoP 26. Accessed Dec 2023.
[5]Mission LiFE. Accessed March 2024.
[6]National Mission for Sustainable Agriculture. Accessed March 2024.
[7]Tamil Nadu Energy Conservation Building Code - 2022. Accessed 2024.
[8]Tamil Nadu E-Vehicle Policy 2023. Accessed March 2024.
[9]Tamil Nadu $ 1 trillion Vision. Accessed Jan 2024.
[10]TCC Annual Budget - 2023-24. Accessed March 2024.
[11]Trichy Action Plan for SBM 2.0. Accessed Jan 2024.
[12]Trichy Vision 2030. Accessed March 2024.
[13]NMEEE. Accessed Feb 2024.
[14]MTEE. Accessed Feb 2024.
[15]TN Solar Energy Policy, 2019. Accessed March 2024.
[16]GWEC Tamil Nadu Wind Energy Roadmap. Accessed March 2024.

based on Industry-specific commitments to renewable energy through consultations with various industry stakeholders.

The transition to electrification of transport (all modes) is informed by the goals mentioned in the Tamil Nadu Electric Vehicle Policy 2023[17]. Modal shares in various horizon years are adopted from the National Urban Transport Policy but also incorporates Trichy master Plan 2041 and City Development Plan.

The targets in the SWM sector are guided by the ambitions of the MSW 2015 and are also informed by the Action Plan submitted by Trichy to the Swachh Bharat Mission, aiming for ambitious but realistic targets in waste management. These targets are further tweaked based on expert opinions and the current capacity of waste management systems.

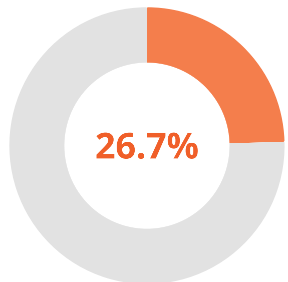
Local initiatives, including Trichy's Annual Budget Planning for FY 2023-24 and city-specific programs, are crucial in shaping the city's environmental strategies. These local plans ensure that actions are relevant and practical. Several mitigation and adaptation actions undertaken by TCC are detailed in Annexure A - Table A1. TCC has increased its dependence on energy from renewable sources by adopting Rooftop Solar 831 KWp in 206 Office Buildings and Ground Mounted Solar with the Capacity of 9.6 MWp. The total budget allocated by TCC is Rs. 39252.23 lakhs[18] in 2024-25 alone.

Lastly, the scenario is flexible, adjusting targets and strategies based on the real-world implementation of energy efficiency measures, renewable energy adoption, and the deployment of electric mobility solutions. This adaptability allows for continuous alignment with actual progress and challenges.

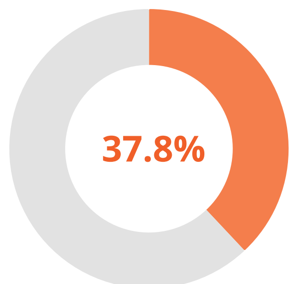
## Results & Highlights

The Progressive Action Scenario leads to a substantial reduction in greenhouse gas (GHG) emissions for Trichy. In 2070, the estimated reduction is 51.7% compared to the Business-As-Usual (BAU) scenario.

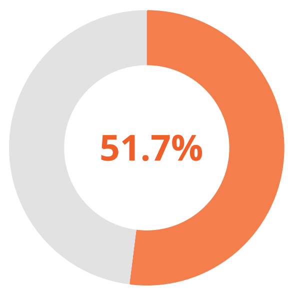
**The emissions reduction achieved in the key horizon years compared to BAU are:**




2030: 26.7% lower than BAU




2050: 37.8% lower than BAU




2070: 51.7% lower than BAU

[17] TN EV Policy 2023. Accessed Dec 2023.

[18] Note: The budget includes funding from central schemes like Swachh Bharat Mission, AMRUT, NCAP and state government schemes in addition to the Corporation Budget.

The sectoral level emission reduction achieved in Progressive Action Scenario is detailed in table 7.3.

*Table 7.3: Sector-wise emission reduction achieved in Progressive Action in Trichy*

| Sector | GHG Emissions Reduction compared to sectoral BAU Emissions | | | | | |
|---|---|---|---|---|---|---|
| | 2030 (million $tCO_2e$) | Percentage reduction (%) wrt sectoral BAU Emissions | 2050 (million $tCO_2e$) | Percentage reduction (%) wrt sectoral BAU Emissions | 2070 (million $tCO_2e$) | Percentage reduction (%) wrt sectoral BAU Emissions |
| **Residential Buildings** | 0.21 | 27% | 0.45 | 41% | 0.77 | 57% |
| Commercial and Institutional Buildings and Facilities | 0.12 | 36% | 0.32 | 54% | 0.62 | 71% |
| Manufacturing Industries and Construction | 0.07 | 13% | 0.22 | 23% | 0.53 | 38% |
| Transportation | 0.09 | 21% | 0.16 | 26% | 0.24 | 31% |
| waste[19] | 0.09 | 105% | 0.12 | 107% | 0.19 | 123% |
| **Total** | **0.58** | **26.7%** | **1.27** | **37.8%** | **2.34** | **51.7%** |

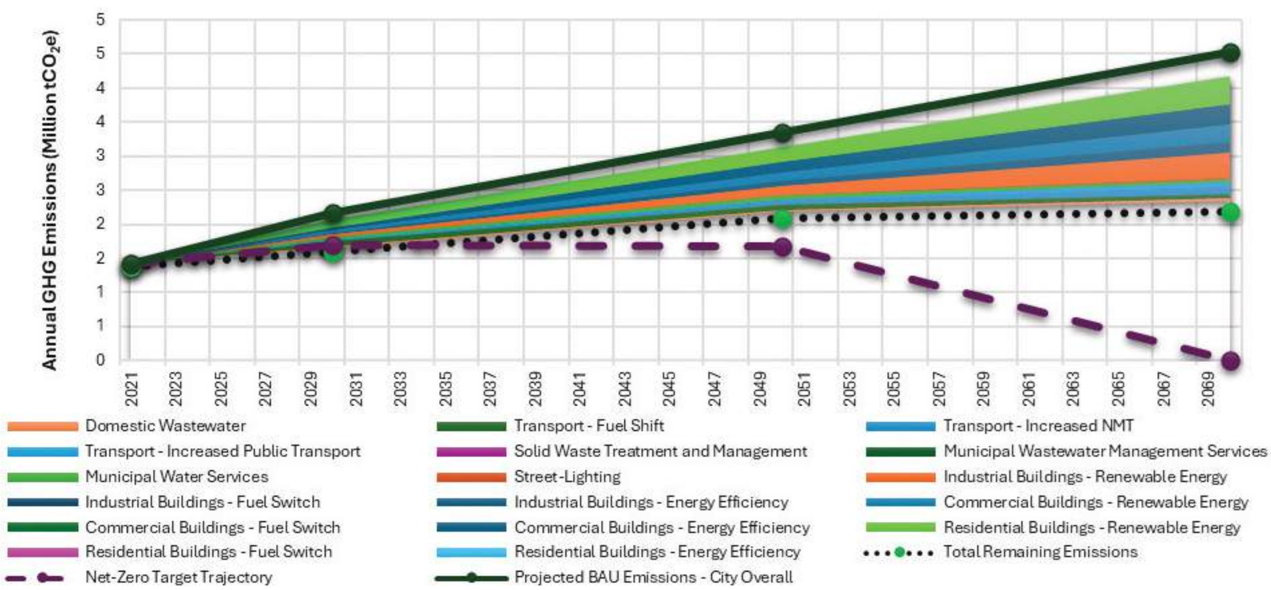



*Figure 7.4: GHG emissions mitigation trend for Progressive Action Scenario, 2021 to 2070*

[19]Note:The emissions reduction is beyond 100% due to energy generated from the waste in the form of Bio-CNG.

The emission reduction from various sectors indicated in figure 7.3. It is evident that the actions (renewable energy & energy efficiency) in the residential and commercial sector have the highest emission reduction impacts.

The sectoral contribution to the emission reduction is indicated in Figure 7.4.

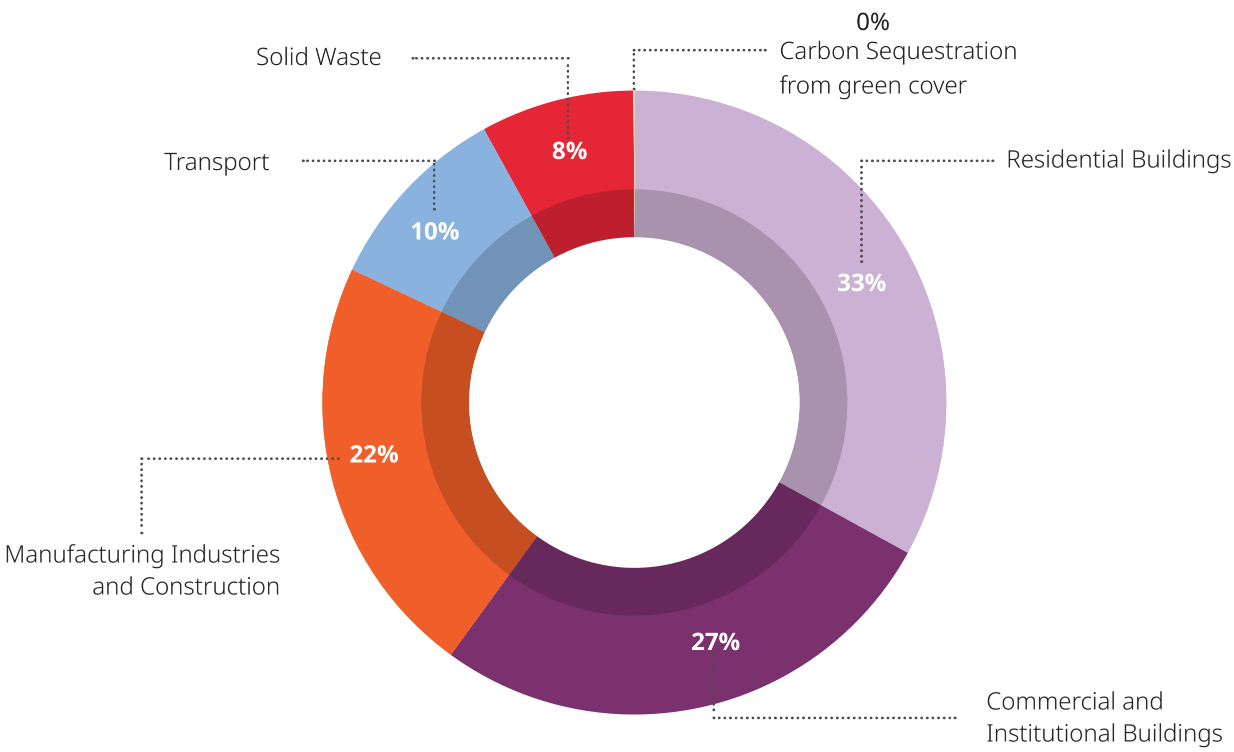



*Figure 7.5: Sectoral Contribution to emission reduction in 2070*

### Key Findings of the Progressive Action Scenario

- **Emissions Reduction**
  The progressive action scenario achieves a significant reduction in emissions by 51.7% from the Business-As-Usual (BAU) scenario by 2070.

- **Transport Sector Strategies**
  All the strategies adopted in the transport sector leads to a reduction of 0.24 million $tCO_2e$ by 2070.

- **Waste Sector Transformation**
  Actions in the waste sector leads to a reduction of 0.15 million $tCO_2e$ by 2070 or 3.28% compared to BAU.

- **Domestic Waste Water**
  All the strategies adopted in the Domestic Wastewater sector leads to reduction of 0.03 million $tCO_2e$ by 2070.

- **Net Zero Pathway Requirement**
  The progressive action scenario does not achieve the net-zero goal by 2070. Hence, a more ambitious scenario to align with GoI commitment over and above the progressive action scenario is necessary for Trichy.

## 7.6 Net-Zero Pathway

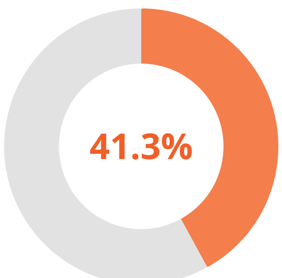
The Net Zero Pathway for Trichy delineates the comprehensive climate actions necessary to progress towards achieving net zero greenhouse gas emissions by 2070, aligning with the Government of India's commitment to a net zero future. This ambitious pathway aligns with and aims to surpass the goals and targets set by various national and Gujarat state policies, missions, and programs dedicated to climate change mitigation. Building upon the foundation laid by the Progressive Action Scenario, it utilizes the goals from schemes implemented by the Government of Tamil Nadu, informed by strategic documents like the USD $ 1 Trillion Vision - 2023 of Government of Tamil Nadu, setting even more ambitious targets. Implementing the strategies and activities outlined in this pathway is considered feasible through the combined policy and financial support from municipal, state, and national governments.

Achieving 2070 net zero target underscores the need for substantial financial investment from all levels of governance and private sector, emphasising the collaborative effort required to combat climate change effectively.

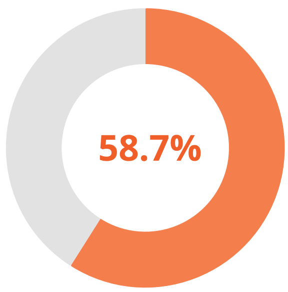
### Results & Highlights

The Net Zero Pathway achieves a remarkable reduction in GHG emissions, amounting to 87.4% by 2070 compared to the Business-As-Usual (BAU) scenario.

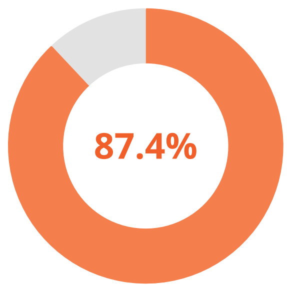
**The Net Zero Pathway results in the following levels of emission reduction compared to BAU:**




2030: Net zero GHG emissions are 41.3% lower than BAU




2050: Net zero GHG emissions are 58.7% lower than BAU




2070: Net zero GHG emissions are 87.4% lower than BAU

The sectoral level emission reduction achieved in Net-Zero Action is detailed in table 7.4.

*Table 7.4: Sector-wise emission reduction achieved in Net-Zero Action Scenario in Trichy*

| Sector | GHG Emissions Reduction compared to sectoral BAU Emissions | | | | | |
|---|---|---|---|---|---|---|
| | 2030 (million $tCO_2e$) | Percentage reduction (%) wrt sectoral BAU Emissions | 2050 (million $tCO_2e$) | %Percentage reduction wrt sectoral BAU Emissions | 2070 (million $tCO_2e$) | %Percentage reduction wrt sectoral BAU Emissions |
| Residential Buildings | 0.31 | 40% | 0.70 | 64% | 1.26 | 93% |
| Commercial and Institutional Buildings and Facilities | 0.17 | 49% | 0.69 | 77% | 1.21 | 99% |
| Manufacturing Industries and Construction | 0.12 | 23% | 0.37 | 38% | 0.92 | 66% |
| Transportation | 0.20 | 47% | 0.32 | 53% | 0.72 | 95% |
| waste | 0.09 | 108% | 0.13 | 113% | 0.20 | 132%[20] |
| **Total** | **0.90** | **41.3** | **1.97** | **58.7** | **3.96** | **87.4%** |

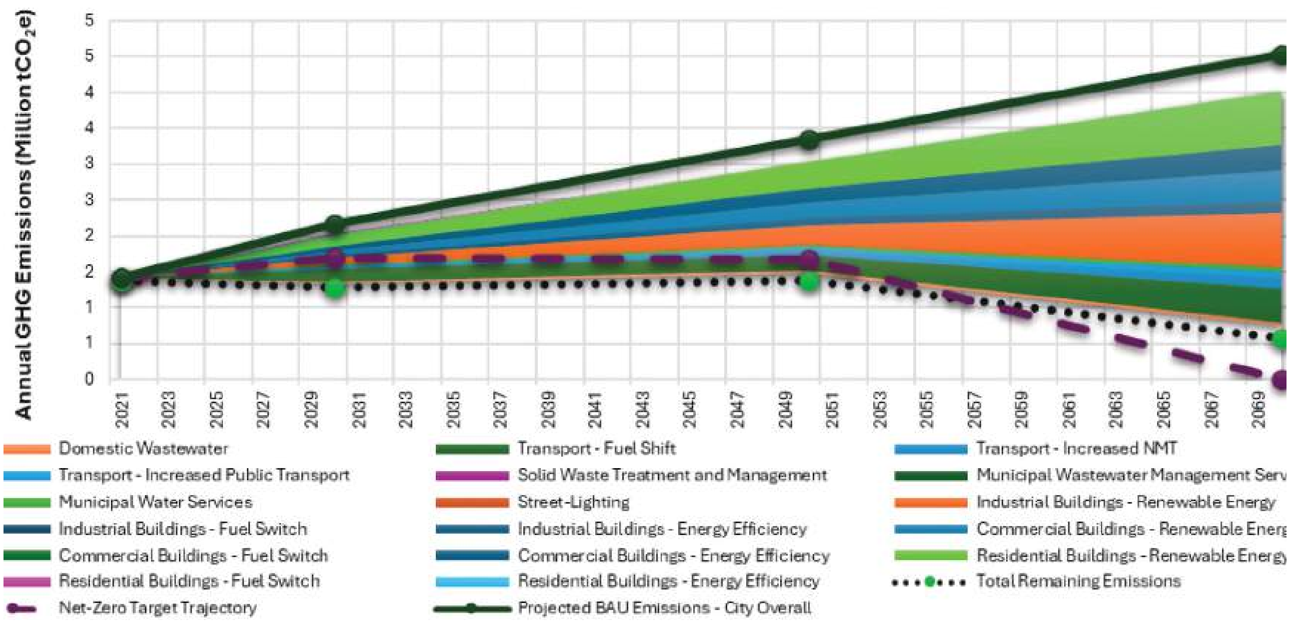



*Figure 7.6: GHG emissions mitigation trend for Net-Zero Action Scenario, 2021 to 2070*

[20]Note: The percentage reduction in the waste sector is so high because of energy generation from the solid waste.

In the Net Zero Pathway, the ambitious level of actions and targets proposed for different sectors helps Trichy reach a GHG emissions reduction of 87.4% from its city-scale projected BAU emissions.

## Key Findings of the Net-Zero Scenario

### Building Sector

The pathway emphasizes the importance of energy efficiency and renewable energy in reducing the emissions from the stationary sector leading to an avoided emission to 3.04 million $tCO_2e$ by 2070.

### Transport Sector

A key action in the transport sector is the electrification of the various modes. It must be noted that significant investments are required in the energy sector to manage this additional demand. This action has the strong policy backing of TN State EV Policy and several programs of GoI like FAME 2 and FAME 2 for electric charging infrastructure.

### Solid Waste Management (SWM)

Bio-CNG and waste composting are key strategies to reduce emission from the SWM sector. This leads to mitigation emissions levels of 0.17 million $tCO_2e$ by 2070.

### Domestic Waste Water (DWW)

Increase efficiency of pumping and treatment infrastructure are strategies to reduce emission from the DWW sector. This leads to emission levels of 0.04 million $tCO_2e$ by 2070.

### Green Cover Enhancement

Trichy already has 10.57 sq.m of green cover per person which is greater than the WHO recommended minimum of 9 sq.m per person[21]. However, considering the high temperatures in the city compared to the state average, the city must increase its green cover to better adapt to heat stress. Additionally, this will increase carbon sequestration with a long-term goal of enhancing carbon sequestration potential by 2070.

[21]WHO Recommendation for Minimum Green Space indicated by NIUA. Accessed April 2024.

Recognising the need for substantial financial investment and policy support, the success of the Net Zero Pathway depends on collaboration across city, state, and national levels, underscoring the importance of collective efforts in achieving net-zero emissions. Beyond emissions reduction, the pathway's proposed actions aim to yield co-benefits such as improved public health, enhanced liveability, and biodiversity conservation, illustrating the multi-faceted benefits of pursuing a net-zero future.

### Residual Emissions in Net-Zero Pathway

Despite the ambitious targets set forth in Tiruchirappalli Net-zero Pathway leading to an 87.4% reduction in GHG emissions from BAU levels in 2070, residual emissions of 12.6% of 2070 BAU levels (0.57 million $tCO_2e$) remain to be addressed. Reducing these residual emissions is crucial for Tiruchirappalli to achieve net-zero by 2070.

Further reductions in residual emissions can be achieved through interventions such as full grid decarbonisation, natural climate solutions, and resource circularity, and utilising local carbon sinks.

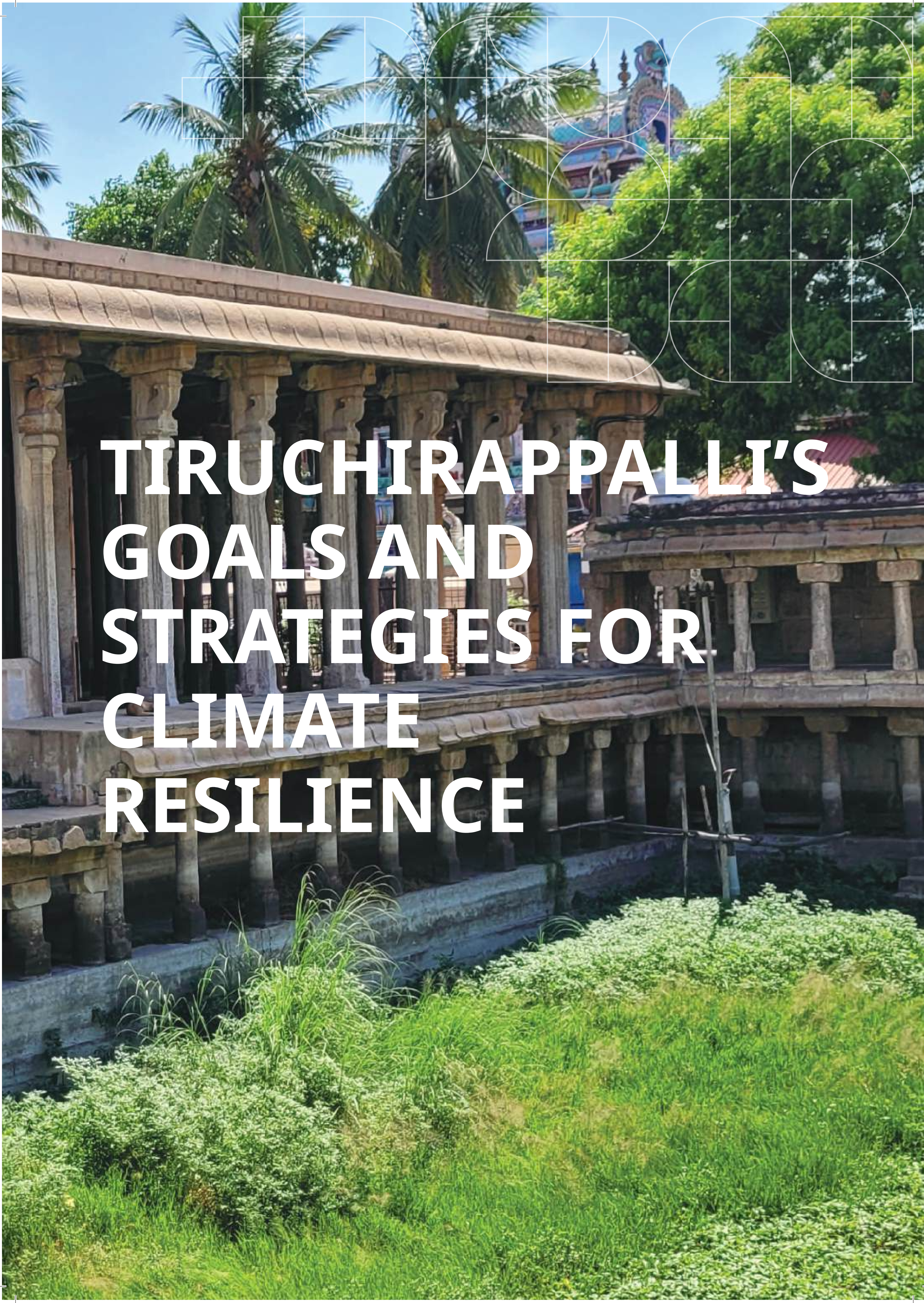
For instance, the city's green cover can offer significant potential to sequester carbon. Green areas currently have a 56% share in Tiruchirappalli's land use (93. 56 sq. km), which translates to a per capita green cover of 10.6 sq. m per person against the WHO-recommended standard of 9 sq. m per person[22]. While the city has adequate green spaces at present, possible future changes in land allocation for urban development requirements may alter this dynamic. If Tiruchirappalli retains its current extent of green cover, it can potentially sequester emissions by up to 0.93 million $tCO_2e$[23] . Thereby maintaining its present green infrastructure and using appropriate native tree species can help the city leverage its carbon sequestration potential and support in advancing further towards net-zero targets.

Implementing the strategies outlined in this Climate Action Plan and meeting net-zero targets requires substantial policy support, enabling frameworks, barrier addressing, capacity building, and financial support from state and national governments, and the international community. Periodic reviews of the Net-Zero CRCAP are necessary to ensure ongoing support and updates across policy, capacity building, finance, and other aspects until 100% reduction of BAU GHG emissions is achieved. Tiruchirappalli City Corporation Corporation commits to work with other key departments and stakeholders to achieve their net zero vision ahead of time.

[22]WHO Recommendation for minimum green space. Accessed April 2024.

[23]This estimate is based on preliminary analysis and further detailed scientific studies and surveys are needed to accurately determine the carbon sequestration potential. Carbon sequestered per hectare is approximately 307.31 tonne of $CO_2$

# 08



# TIRUCHIRAPPALLI'S GOALS AND STRATEGIES FOR CLIMATE RESILIENCE

# 08

# TIRUCHIRAPPALLI's GOALS AND STRATEGIES FOR CLIMATE RESILIENCE

Trichy has embarked on a bold climate journey by creating an action plan document that aligns with the goals of the Government of Tamil Nadu to achieve net zero before 2070. The groundwork for this climate journey began with Trichy's participation in the CapaCITIES 2 project in 2019, a collaborative effort involving ICLEI South Asia, South Pole, and eConcept. This project laid the foundation for developing the Net-zero Climate Resilient City Action Plan, an action plan and roadmap designed to mitigate climate risks, reduce greenhouse gas (GHG) emissions, and chart a course towards future net-zero emissions.

The Net-zero CRCAP plan was led by the Climate Core Committee within TCC. Further, the Stakeholder Committee of TCC, consisting of a diverse array of stakeholders, including government bodies, research institutions, non-governmental organisations (NGOs), and community representatives, actively contributed to the plan. This collaborative approach ensured that the Net-zero CRCAP captured a wider perspective and created an inclusive climate action strategy contextualized to Trichy.

This climate action plan will assist TCC in data-driven decision-making. Recognising the indispensable role of accurate information, the city conducted a comprehensive vulnerability assessment across urban sectors such as water resources, stormwater management, waste management, urban greening and biodiversity, and air quality. This assessment provided finer insights into Trichy's vulnerabilities, enabling the prioritisation of efforts and the efficient allocation of resources.

Parallel to the vulnerability assessment, Trichy used the Net-Zero GHG emissions scenario planning tool of ICLEI SA, that analysed future emissions scenarios and their implications across diverse urban sectors. The insights have helped in formulating evidence-based decision-making processes and strategies as detailed in this chapter.

The vulnerability assessment and GHG emission modelling outcomes have assisted TCC to evaluate a spectrum of mitigation and adaptation strategies. This evidence-driven approach allowed Trichy to establish ambitious goals and targets for the various urban sectors, providing a guiding framework for its climate action planning and preparing the city to confront and overcome multifaceted challenges posed due to climate change effectively. **The Net-zero CRCAP is not just a strategic document but a bold commitment and testimony of TCC's unwavering commitment to a sustainable and climate-resilient future.**

## 8.1 Vision, Sectoral Goals & Targets

TCC is committed to leading Trichy towards a net-zero emissions future, enhancing resilience against urban challenges like heat waves, flooding, and resource scarcity while addressing equality and gender concerns. TCC envisions creating a sustainable city that prioritizes citizen welfare and ecosystem protection, integrating blue-green spaces and infrastructure to ensure public safety, enhance life quality, and promote clean air through equitable and climate-resilient municipal services.

TCC aims to construct more environmentally friendly, energy-efficient, and thermally comfortable buildings powered entirely by renewable energy that align with net-zero emission goals as already demonstrated by its IGBC Gold certified knowledge centre buildings. TCC plans to minimize its environmental footprint and maximize resource efficiency by embracing zero-waste wards building on its bin-free city initiative by using a circular economy approach. The commitment extends to advancing zero-emission mobility, offering cleaner, greener transportation options for all residents.

TCC is determined to foster a community that is adaptive to climate change through collaboration and innovation. **The objective is to establish Trichy as a model city that demonstrates the importance of sustainable practices and inspires other cities to collaboratively achieve net-zero well ahead of 2070.**

The net zero CRCAP provides 22 strategies across 8 sectors to achieve Tiruchirappalli's vision of transitioning towards a net-zero emissions future and strengthening the climate resilience of the city's urban systems, actors, stakeholders, and communities. These strategies chart out a roadmap for driving towards sustainable urbanisation in an environmentally responsible, socially equitable and economically prosperous manner. Trichy's Net-zero Climate Resilient City Action Plan (Net-Zero CRCAP) aligns with Tamil Nadu's State Action Plan on Climate Change (SAPCC) and global initiatives like the Paris Agreement and Sustainable Development Goals (SDGs). It sets a benchmark in TN's journey towards net-zero emissions. The plan significantly reduces greenhouse gas emissions and enhances urban climate resilience, aiming for net-zero emissions by 2070. It promotes climate-resilient urban planning and infrastructure development, emphasising the necessity of sustainable practices across all urban development sectors.

## Tiruchirappalli's Vision for a Net-Zero Climate Resilient Future:

Trichy is embarking on a visionary course toward environmental sustainability, aiming for net-zero emissions by 2070, committing to significant reductions in greenhouse gasses, strengthening urban resilience, and focusing on integrating sustainable practices across all development sectors to achieve a transformative climate future.

**Adaptation Goals**

To reduce the impact of heat stress and urban flooding on urban infrastructure and citizens, particularly vulnerable communities, by enhancing their capacities, build climate resilient infrastructure and respond successfully to climate change.

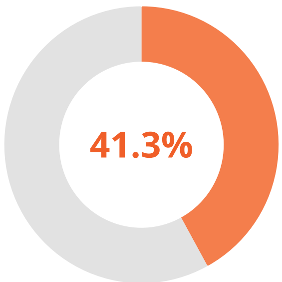
Thematic goals, targets and strategies identified to help realize Trichy's vision and its overarching adaptation goal and GHG emissions reduction target are summarised below.

*Figure 8.1: Snapshot of sectoral goals, targets, and strategies*

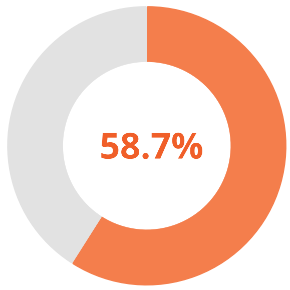
| Sector | Built Environment & Energy | Transport | Water Sector | Wastewater |
|---|---|---|---|---|
| 1 Goal | Trichy is committed to becoming a heat-resilient city, and adopting and implementing a sustainable energy transition. | Advocate for and implement clean, zero-emission transportation systems. | Increase water resilience and foster a circular economy via complete wastewater treatment and reuse. | |

**Mitigation Targets**

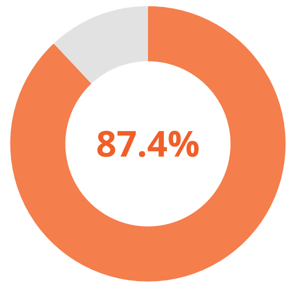
**The Net Zero Pathway aims to reduce the emissions in the horizon years compared to BAU by:**




2030: Net zero GHG emissions are 41.3% lower than BAU




2050: Net zero GHG emissions are 58.7% lower than BAU




2070: Net zero GHG emissions are 87.4% lower than BAU

| Stormwater | Solid Waste | Urban Greening & Biodiversity | Air Quality |
|---|---|---|---|
| Make the city resilient to urban flooding | Advance towards a zero-waste urban environment. | Increase Blue-Green Infrastructure to improve climate resilience.<br><br>Reduce heat stress through enhanced adaptive measures.<br><br>Enhance the green cover to improve the potential of carbon sequestration. | Adopt a comprehensive strategy to ensure cleaner air and a healthier environment, in alignment with the National Clean Air Program objectives by 2025. |

| 2 Targets | | | | |
|---|---|---|---|---|
| Targets | 60% (Residential) & 80% (Commercial & Institutional) adoption of green building principles in new constructions by 2070.<br><br>94%[1] utilisation of energy-efficient appliances in both new and existing buildings in Commercial and Institutional Buildings by 2070. 70%[2] of energy demand is met by renewable energy[3] in Industries by 2070. | Shift 10% of motorized trips to non-motorized transport (NMT) and 8% to public transit by 2070.<br><br>Ensure 90% cars, 90% commercial vehicles, 90% two & three wheelers are electric by 2070 with 70% powered by renewables. | 80% adoption of energy-efficient motors for water pumping by 2070 and use up to 60% renewable energy facilities for powering water supply operations.<br><br>Achieve non-revenue water (NRW) of 20% by 2024-25 and 10% by 2070. | 80% adoption of energy-efficient motors for water pumping by 2070 and use up to 60% renewable energy facilities for powering water supply operations. 50% utilization of anaerobic treatment with 100% methane gas capture and reuse in new plants. |

[1] Average of Energy Efficient Lighting, Energy Efficient Fans, Energy Efficient AC and Refrigerators.
[2] Average of Energy Efficient Lighting, Energy Efficient Fans, Energy Efficient AC and Refrigerators.
[3] Total of Rooftop Solar PV, Captive Solar PV & green power purchase from DISCOM.

| | | | |
|---|---|---|---|
| Achieve 100% storm water drain coverage network as per CPHEEO guidelines by 2030. | 75% of energy used in SWM to be powered by RE by 2070.<br><br>100% scientific waste processing, treatment, and disposal by 2030. | Double the current green cover from the current 10.6 sq.m per person. | Achieve PM10 of <60 μg/$m^3$ in areas where higher concentration is observed. |

| | | | | | |
|---|---|---|---|---|---|
| 3<br>Strategies | Integrate advanced green building designs to significantly reduce urban heat effects.<br><br>Mandate comprehensive energy-saving and sustainable building standards.<br><br>Achieve a full transition to sustainable energy systems for all city energy needs. | Expand infrastructure for NMT (biking and walking), and increase the capacity and efficiency of public transit.<br><br>Mandate electric transition of transport systems and develop renewable energy powered charging stations.<br><br>Implement smart traffic management systems and create more pedestrian zones to ensure smoother traffic flow and reduced congestion. | Establish governance models, policy & regulatory framework for water conservation improve water resilience.<br><br>Universal access to high-quality 24/7 water through distribution networks with reduced NRW.<br><br>Launch comprehensive lake restoration projects to restore ecological balance and recreational value.<br><br>Implement a large-scale riverfront recovery program to enhance biodiversity and community engagement.<br><br>Upgrade all water supply systems to be powered exclusively by renewable energy with enhanced efficiency measures. | Optimize sewage processing facilities with the latest technology to ensure maximum efficiency and minimum environmental impact and increase the coverage to 100% and use RE powered pumping and lifting equipment.<br><br>Implement state-of-the-art sludge treatment and recycling techniques to minimize waste and environmental hazards.<br><br>Transition to low-carbon technologies in all wastewater treatment processes. |

Implement sustainable urban planning practices to reduce runoff and prevent urban flooding.

Achieve 100% SWD coverage and construct stormwater systems to manage projected cloud-bursts and fully restore historic natural drainage paths.

Achieve near-zero waste by drastically reducing waste generation and enhancing recycling programs and adopt the principles of 3R's (Reduce, Reuse and Recycle)

Achieve 100% source segregation and 100% waste collection system with minimal emissions footprint.

Develop facilities for environmentally friendly and scientific waste processing and disposal.

Transform the cityscape with extensive native green spaces that have native species to ensure sustainability and improve ecosystems.

Establish diverse microhabitats across the city to promote and preserve rich biodiversity.

Maximize carbon absorption (carbon sink) by expanding urban forests and creating green corridors.

Implement strict emissions standards and promote zero-emission vehicles city-wide.

Enforce rigorous pollution control measures in all construction projects to minimize dust and debris.

Require industries to adopt advanced pollution control technologies and switch to cleaner production methods.

### 8.1.1 Built Environment & Energy

**Goal:** Trichy is committed to becoming a heat-resilient city, and adopting and implementing a sustainable energy transition.

**Mitigation Targets:**

- 60% (Residential) & 80% (Commercial & Institutional) adoption of green building principles in new constructions by 2070.
- 94%[4] utilisation of energy-efficient appliances in both new and existing buildings in Commercial and Institutional Buildings by 2070.
- Upto 70% of energy demand is met by renewable energy[5] in Industries by 2070.

Tiruchirappalli recognises the potential for energy conservation and renewable integration, prioritising energy-efficient and thermally comfortable design and green building practices to optimise deployment and investment in renewable energy. Trichy is already implementing 2 knowledge centres totalling about 28000 sq.ft across two sites in the city. TCC aims to capture the learnings and implement the same across other municipal buildings in TCC. This would significantly reduce the energy footprint from the municipal building stock. For the municipal buildings, TCC will improve on the provisions for renewable energy as mentioned in the Tamil Nadu Combined Development Building Rules (TNCDBR 2019) to provide more space to install roof-top solar panels.

**Strategies:**

1. Integrate advanced green building designs to significantly reduce urban heat effects.
2. Mandate comprehensive energy-saving and sustainable building standards.
3. Achieve a full transition to sustainable energy systems for all city energy needs.

[4]Average of Energy Efficient Lighting, Energy Efficient Fans, Energy Efficient AC and Refrigerators.
[5]Average of Rooftop Solar PV, Captive Solar PV & green power purchase from DISCOM.

## 8.1.2 Transport

**Goal:** Advocate for and implement clean, zero-emission transportation systems.

**Mitigation Targets:**

- Shift 10% of private motorised trips to non-motorised transport (NMT) and 8% to public transit by 2070.
- Ensure 90% cars, 90% commercial vehicles, 90% two & three wheelers are electric by 2070 with 70% powered by renewables.

Trichy prioritises infrastructure development and programs to promote zero-emission modes of mobility, aiming to reduce private vehicle usage, lower emissions, and improve air quality. Trichy will aim to build on the Tamil Nadu State EV Policy.

**Strategies:**

1. Expand infrastructure for NMT (biking and walking), and increase the capacity and efficiency of public transit.
2. Mandate electric transition of transport systems and develop renewable energy powered charging stations.
3. Implement smart traffic management systems and create more pedestrian zones to ensure smoother traffic flow and reduced congestion.

## 8.1.3 Water and Wastewater

**Goal:** Increase water resilience and foster a circular economy via complete wastewater treatment and reuse.

**Mitigation Targets:**

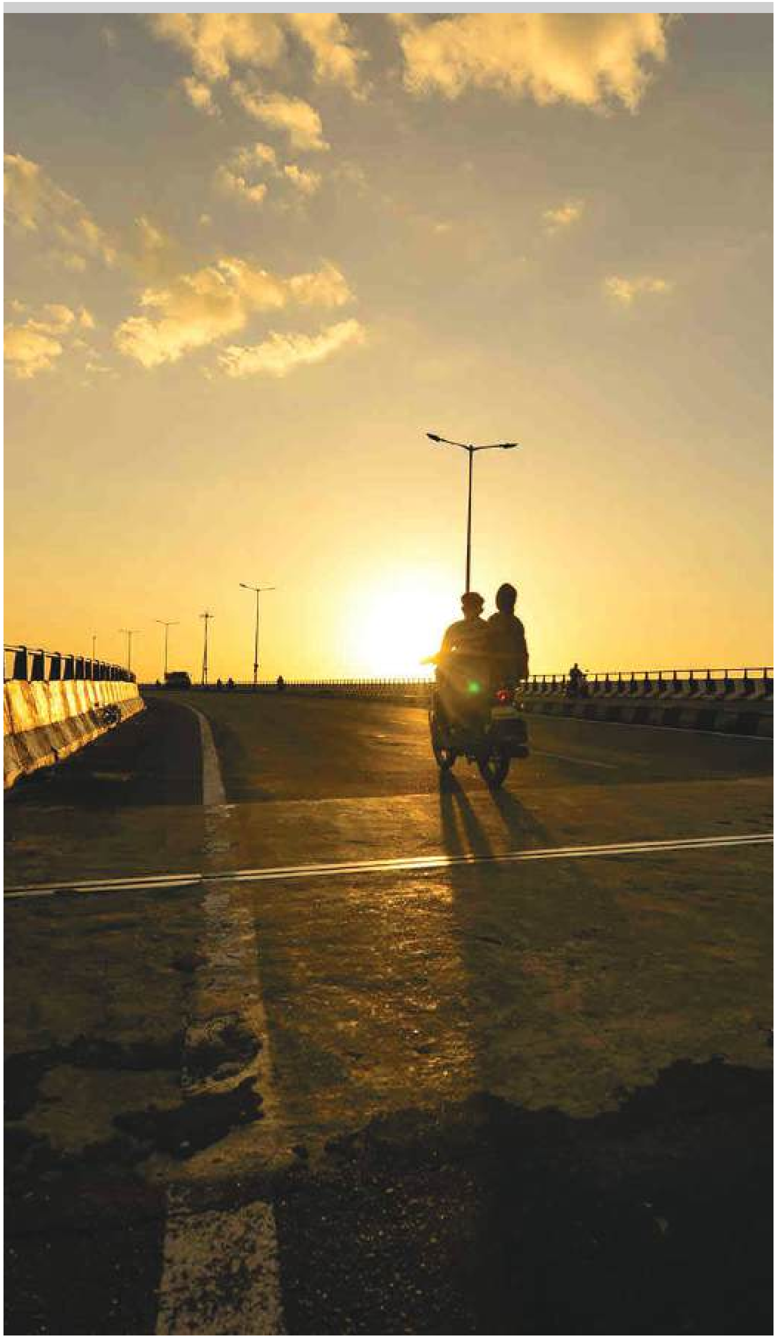
Water

- 80% adoption of energy-efficient motors for water pumping by 2070 and use up to 60% renewable energy facilities for powering water supply operations.
- Achieve NRW of 20% by 2024-25 from the current baseline of 31% and achieve 10% by 2070.

Wastewater

- 80% adoption of energy-efficient motors for water pumping by 2070 and use up to 60% renewable energy facilities for powering water supply operations by 2070.
- 50% utilisation of anaerobic treatment with 100% methane gas capture and reuse in new plants by 2070.

Tiruchirappalli focuses on sustainable urban water management, integrating renewable energy into municipal infrastructure and adopting strategies for water resilience and a circular economy.



**Strategies:**

Water

1.Establish governance models, policy & regulatory framework for water conservation improve water resilience.

2.Universal access to high-quality 24/7 water through distribution networks with reduced NRW.

3.Launch comprehensive lake restoration projects to restore ecological balance and recreational value.

4.Implement a large-scale riverfront recovery program to enhance biodiversity and community engagement.

5.Upgrade all water supply systems to be powered exclusively by renewable energy with enhanced efficiency measures.

## 8.1.4 Wastewater

**Goal:** Increase water resilience and foster a circular economy via complete wastewater treatment and reuse.

**Mitigation Targets:**

Wastewater

- 80% adoption of energy-efficient motors for water pumping by 2070 and use up to 60% renewable energy facilities for powering water supply operations by 2070.
- 50% utilization of anaerobic treatment with 100% methane gas capture and reuse in new plants by 2070.

Tiruchirappalli focuses on sustainable urban water management, integrating renewable energy into municipal infrastructure and adopting strategies for water resilience and a circular economy.

**Strategies:**

Wastewater

1.Optimise sewage processing facilities with the latest technology to ensure maximum efficiency and minimum environmental impact and increase the coverage to 100% and use RE powered pumping and lifting equipment.

2.Implement state-of-the-art sludge treatment and recycling techniques to minimise waste and environmental hazards.

3.Transition to zero-carbon technologies in all wastewater treatment processes.

### 8.1.5 Stormwater

**Goal:** Make the city resilient to urban flooding

Trichy adopts a comprehensive approach, focusing on effective stormwater management and natural-based solutions to minimise runoff and urban flooding.

**Strategies:**

1. Implement sustainable urban planning practices to reduce runoff and prevent urban flooding.

2. Achieve 100% SWD coverage and construct stormwater systems to manage projected cloud-bursts and fully restore historic natural drainage paths.

**Adaptation Targets**

- Achieve 100% storm water drain coverage network as per CPHEEO guidelines by 2030.

### 8.1.6 Solid Waste

**Goal:** Advance towards a zero-waste urban environment.

**Mitigation Targets:**

- 75% of energy used in SWM to be powered by RE by 2070.

- 100% scientific waste processing, treatment, and disposal by 2030.

Trichy adopts a holistic approach to waste management, promoting a circular economy and aiming to become a zero-waste city by 2030.

**Strategies:**

1. Achieve near-zero waste by drastically reducing waste generation and enhancing recycling programs and adopt the principles of 3R's (Reduce, Reuse and Recycle)

2. Achieve 100% source segregation and 100% waste collection system with minimal emissions footprint.

3. Develop facilities for environmentally friendly waste processing and disposal.

### 8.1.7 Urban Green Space and Biodiversity

**Goal:**

- Increase Blue-Green Infrastructure to improving climate resilience,

- Reduce heat stress through enhanced adaptive measures,

- Enhance the green cover to improve the potential of carbon sequestration.

**Mitigation Target:**

- Substantially increase the current green cover from the current 10.6 sq.m per person.

Tiruchirappalli recognises the significance of healthy natural ecosystems to improve climate resilience, with strategies focusing on native plantations, developing microhabitats, and increasing carbon sinks through urban greening. This will improve the adaptation to the heat stress and also improve the carbon sequestration potential and air quality.

**Strategies:**

1. Transform the cityscape with extensive native green spaces that have native species to ensure sustainability and improve ecosystems (including river/lake & ponds).

2. Establish diverse microhabitats across the city to promote and preserve rich biodiversity (including river/lake & ponds).

3. Maximise carbon absorption (carbon sink) by expanding urban forests and creating green corridors.

### 8.1.8 Air Quality

**Goal:** Adopt a comprehensive strategy to ensure cleaner air and a healthier environment, in alignment with the National Clean Air Program objectives by 2025.

**Strategies:**

1. Implement strict emissions standards and promote zero-emission vehicles city-wide.

2.Enforce rigorous pollution control measures in all construction projects to minimise dust and debris.

3.Require industries to adopt advanced pollution control technologies and switch to cleaner production methods.

**Targets**

1.Achieve PM10 of <60 μg/m³ in areas where higher concentrations are observed and actively maintain or reduce other emissions within safe limits.

Trichy's proactive climate action planning focuses on sustainable and climate-resilient development, aiming for a cleaner and healthier future.

## 8.2 Advancing towards Net-Zero Emissions through Strategies in the Net Zero Pathway

Tiruchirappalli echoes the commitment of Government of Tamil Nadu to achieving net-zero emissions well before 2070, by creating this roadmap Net-zero CRCAP that will guide the city's actions and initiatives, ensuring a systematic approach to achieving the ambitious net-zero emissions target by 2070.

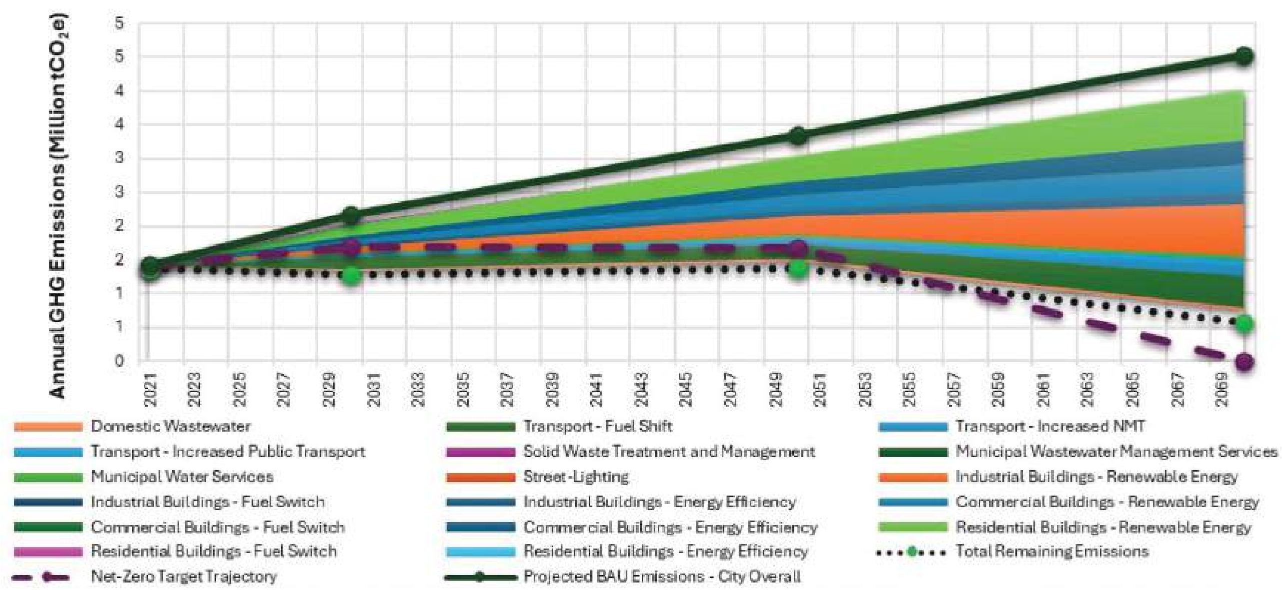
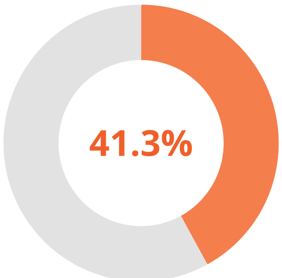



*Figure 8.2: GHG emissions mitigation trend for Net Zero Pathway, 2021 to 2070*

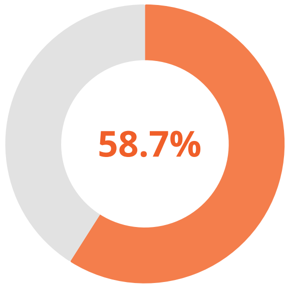
**Tiruchirappalli's Vision for a Net-Zero Climate Resilient Future:**

Trichy's Net-Zero Climate Resilient City Action Plan (Net-Zero CRCAP) sets a visionary course toward environmental sustainability, aiming for net-zero emissions by 2070. The plan commits to significant reductions in greenhouse gasses and strengthens urban resilience, focusing on integrating sustainable practices across all development sectors to achieve a transformative climate future. By implementing the comprehensive strategies and actions outlined in the Net-zero Pathway, Trichy positions itself to make significant strides toward its net-zero emissions goal. This approach reflects Trichy's commitment to sustainable and resilient development, contributing substantially to the overarching climate goals set at the national level. The city's meticulous planning ensures that each step aligns with the broader vision of a greener and more sustainable future for Trichy and the nation.

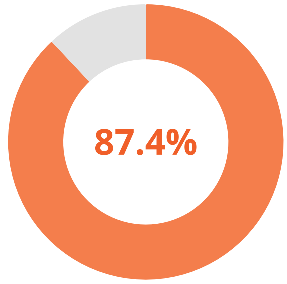
Tiruchirappalli's unwavering commitment to sustainability is exemplified in its Net Zero Pathway, targeting an impressive 87.4% reduction in greenhouse gas (GHG) emissions by 2070 compared to the Business-As-Usual (BAU) scenario. This ambitious journey includes:




2030: Net zero GHG emissions are 41.3% lower than BAU




2050: Net zero GHG emissions are 58.7% lower than BAU




2070: Net zero GHG emissions are 87.4% lower than BAU

Detailed in section 8.3, Tiruchirappalli's Net Zero Pathway signifies its dedication to surpassing national and global climate goals. Positioned as a model for sustainable urban development, Trichy envisions a resilient and eco-conscious future.

The Built Environment and Energy sector is the primary driver of emissions reduction, closely followed by the Transport sector. Strategies and actions to reduce conventional fossil fuel-based energy demand and accelerated integration of renewable energy will help achieve deep emission cuts in these sectors (see Table 8.1). Implementing renewable energy measures in TCC's infrastructure such as administrative buildings, water supply and streetlight reduces municipal carbon footprint significantly. The decrease in emissions in Transport is spurred by large-scale shifts from private vehicles to non-motorised transit and public transport along with electrification of vehicles powered by zero-emission renewable energy. Adopting resource efficiency and circularity principles, deploying sustainable waste management infrastructure, along with the additional emissions reduction due to energy generation from waste and wastewater.

Trichy's ambitious goals and targets in the Net Zero Pathway will lead to a total reduction in emissions of 87.4% of BAU by 2070, leaving behind residual emissions of 12.6% of BAU levels in 2070 which need to be addressed, in order to achieve net-zero emissions. This can be achieved through sequestration of $CO_2$ by increasing the green cover in the city. TCC can undertake this action in conjunction to the periodic review of this CRCAP. Although the current per capita green cover is adequate in the city, a burgeoning population in the future will alter the present dynamics. Thus, it is essential that the area under urban greens be increased as the population of the city increases. Reductions for the remaining residual emissions could be possible through forward-looking interventions such as full decarbonisation of electricity supply to achieve 100% green energy for buildings and electric mobility the grid and while tapping into the potential of advanced solutions such as green hydrogen, carbon capture, usage and storage (CCUS), natural climate solutions[6] and material resource circularity[7,8] among others. It should be noted that the level of efforts set out through the strategies and actions in the Net-zero Pathway will need significant policy support, enabling frameworks, addressal of barriers, capacity building, and financial impetus from city, state and national governments and from the international community.

[6] The World Economic Forum defines Natural climate solutions are actions that avoid greenhouse gas emissions and increase carbon storage in forests, grassland and wetlands. Well-known examples include forest conservation, restoration and management aimed at carbon sequestration and improvements in biodiversity, soil quality and water quality. (Source: https://www.weforum.org/agenda/2021/09/what-are-natural-climate-solutions-ncs-alliance/)

[7] The United Nations Economist Network defines resource circularity implies to models in which products and materials are designed in such a way that they can be reused, remanufactured, recycled or recovered (4-R) and thus maintained in the economy for as long as possible, along with the resources of which they are made, and the generation of waste, especially hazardous waste, is avoided or minimized, and greenhouse gas emissions are prevented or reduced. (Source: https://www.un.org/sites/un2.un.org/files/circular_economy_14_march.pdf)

[8] https://www.mckinsey.com/capabilities/sustainability/our-insights/decarbonising-india-charting-a-pathway-for-sustainable-growth

*Table 8.1: GHG Emissions reduction by sector for Net Zero Pathway*

| Sector | GHG Emissions Reduction compared to sectoral BAU Emissions | | | | | |
|---|---|---|---|---|---|---|
| | 2030 | | 2050 | | 2070 | |
| | Total Emissions Reduced (Thousand $tCO_2e$) | Emissions Reduction from Sectoral BAU Emissions (%) | Total Emissions Reduced (Thousand $tCO_2e$) | Emissions Reduction from Sectoral BAU Emissions (%) | Total Emissions Reduced (Thousand $tCO_2e$) | Emissions Reduction from Sectoral BAU Emissions (%) |
| Residential Buildings | 313.0 | 40% | 699.6 | 64% | 1257.3 | 93% |
| Commercial and Institutional Buildings and Facilities | 165.9 | 49% | 457.8 | 77% | 860.0 | 99%[9] |
| Manufacturing Industries and Construction | 123.7 | 23% | 365.2 | 38% | 924.8 | 66% |
| Transport | 203 | 47% | 319.8 | 53% | 718.9 | 95% |
| Waste | 90.20 | 108% | 126.8 | 113% | 200.8 | 132%[10] |
| **Total** | **895.8** | **41.3** | **1,969.2** | **58.7** | **3961.9** | **87.4%** |

Note: Additionally, carbon sequestration potential of increased green cover could also be assessed.

[9] Note: The percentage reduction in the 'Commercial and Institutional Buildings and Facilities' is so high because of the bold investments done by TCC already like Roof Top Solar and significant investments in the area of energy efficient appliances. Additionally, based on discussion with TANGEDCO, the transition to non-renewable sources is projected to be very high in the progressive action scenario.

[10] Note: The percentage reduction in the waste sector is so high because of energy generation from the solid waste.

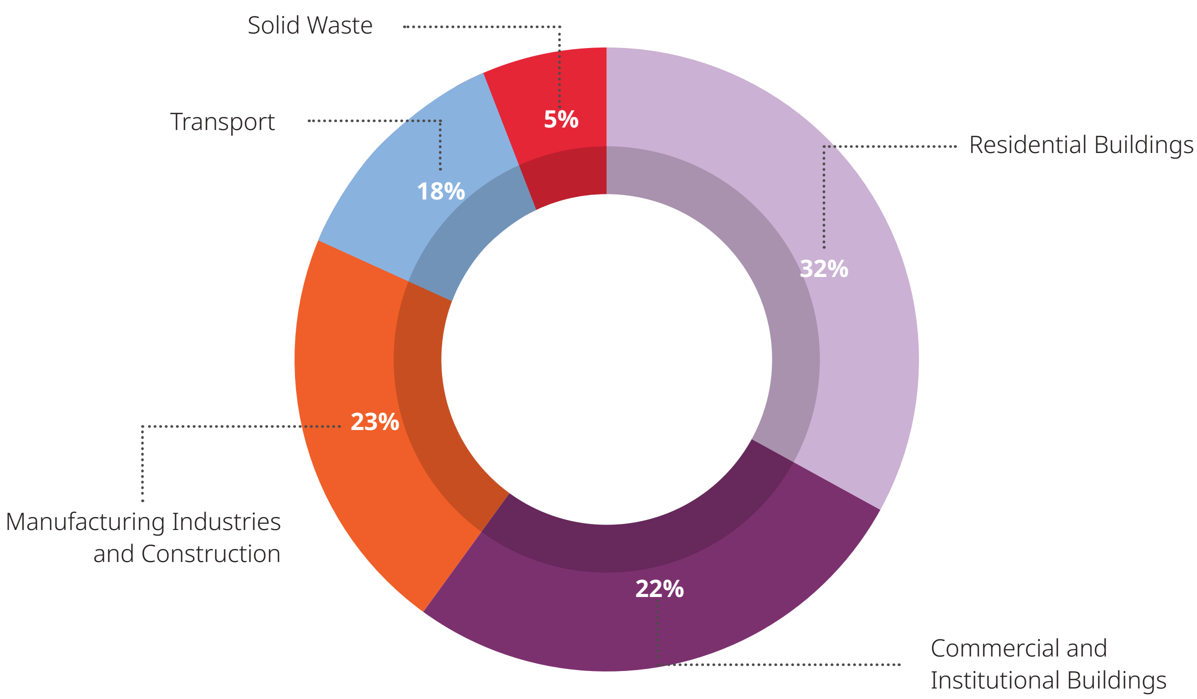



*Figure 8.3: Sectoral contribution to GHG emissions reduction in Net Zero Pathway, 2070*

**Residual Emissions in Net-Zero Pathway**

Despite the ambitious targets set forth in Tiruchirappalli Net-zero Pathway leading to an 87.4% reduction in GHG emissions from BAU levels in 2070, residual emissions of 12.6 of 2070 BAU levels (0.22 million $tCO_2e$) remain to be addressed. Reducing these residual emissions is crucial for Tiruchirappalli to achieve net-zero by 2070.

Further reductions in residual emissions can be achieved through interventions such as full grid decarbonisation, natural climate solutions, and resource circularity, and utilising local carbon sinks.

For instance, the city's green cover can offer significant potential to sequester carbon. Green areas currently have a 56% share in Tiruchirappalli's land use (93. 56 sq. km), which translates to a per capita green cover of 10.6 sq. m per person against the WHO-recommended standard of 9 sq. m per person[11]. While the city has adequate green spaces at present, possible future changes in land allocation for urban development requirements may alter this dynamic. If Tiruchirappalli retains its current extent of green cover, it can potentially sequester emissions by up to 0.93 million $tCO_2e$[12] Thereby maintaining its present green infrastructure and using appropriate native tree species can help the city leverage its carbon sequestration potential and support in advancing further towards net-zero targets.

Implementing the strategies outlined in this Climate Action Plan and meeting net-zero targets requires substantial policy support, enabling frameworks, barrier addressing, capacity building, and financial support from state and national governments, and the international community. Periodic reviews of the Net-Zero CRCAP are necessary to ensure ongoing support and updates across policy, capacity building, finance, and other aspects until 100% reduction of BAU GHG emissions is achieved. Tiruchirappalli City Corporation commits to work with other key departments and stakeholders to achieve their net zero vision ahead of time.

[11]WHO Recommendation for minimum green space. Accessed April 2024.

[12]This estimate is based on preliminary analysis and further detailed scientific studies and surveys are needed to accurately determine the carbon sequestration potential. Carbon sequestered per hectare is approximately 307.31 tonne of $CO_2$

Diving into the subsequent sections unveil Trichy's tailored climate action strategies, detailed implementation plans, and estimated budgetary needs. This in-depth exploration illuminates the city's proactive stance and underscores the transformative impact achievable through inclusive climate action planning.

## 8.3 Sectoral Actions & Implementations

The net zero CRCAP provides 25 strategies across 8 sectors to achieve Tiruchirappalli's vision of transitioning towards a net-zero emissions future and strengthening the climate resilience of the city's urban systems, actors, stakeholders, and communities. These strategies chart out a roadmap for driving towards sustainable urbanisation in an environmentally responsible, socially equitable and economically prosperous manner. Aligned with Tamil Nadu's SAPCC and India's NDCs, the strategies ensure climate risk and vulnerabilities of communities and infrastructure are reduced and net-zero GHG emissions at city scale are achieved by 2070. Implementation of the sectoral actions will result in resilience to climate risks, conservation of resources and natural ecosystems, energy and water security, lower GHG emissions, lower municipal expenditure on energy, and improved public health. The sectoral strategies and targets have been linked to existing plans and schemes to ensure integration and institutionalisation of climate action planning in urban governance. The strategies of each sector are accompanied by a set of enabling actions which

- Provides necessary policy and planning recommendation, and
- Informs the design and implementation of the climate actions.

The different **climate actions can be prioritised for implementation based on their resilience potential, feasibility, and period of impact realisation.** The resilience potential of the climate actions has been analysed along the lines of five parameters:

i. **Redundancy:** Actions able to cope with contingency situations in case existing pathways fail

ii. **Flexibility:** Actions can be implemented under a variety of conditions

iii. **Responsiveness:** Actions can respond to meet unexpected shocks

iv. **Access to information:** Actions have mechanisms to learn from and build on experience

v. **Energy saving and GHG emissions mitigation potential:** Actions contribute to GHG emissions.

Each of these parameters have been allocated a score of one, thus, each action can score a maximum of five points and a minimum of one. The scores have been defined as low, average, medium, high and very high in the order of one to five. The feasibility of climate actions is based on three parameters, viz, **technical, political, and financial feasibility (Annexure H: Table H1)**. The feasibility score of the actions have been defined as low, medium, and high depending on the number of feasibility parameters the actions fulfil. The time required for the impact of these actions to be realised, i.e., **the period of impact realisation can be short term (by 2030), medium term (by 2050) and long term (by 2070).** TCC and other stakeholders can choose to undertake the implementation of the climate actions depending on the prioritisation score, feasibility score and period of impact realisation. For example, TCC can undertake 100% of solid waste segregation, transfer and processing as a prioritised climate action which has a 'high' resilience potential and 'feasibility score' and its impact can be realised in the short term.
The prioritization has been indicated in **Annexure H: Table H2.**

## 8.3.1 Built Environment & Strategy

**Baseline status (2021) Built Environment and Energy**

**Energy consumption (GJ):** 6.39 million GJ (63.9% of total energy consumption)
**GHG emissions:** 1.04 million $tCO_2e$ (70.50% of total GHG emissions)

Key statistics:

| Sector | Share in Buildings Energy Use (Baseline) | Share in Buildings GHG Emissions (Baseline) |
|---|---|---|
| **Residential Buildings** | 51.0% | 54% |
| **Commercial and Institutional Buildings** | 17.0% | 18% |
| **Manufacturing Industries and Construction** | 32% | 28% |

Opportunities and challenges/gaps:

- UJALA Scheme[13],ESEAP Scheme[14], BEE star labelling program and awareness supporting penetration for EE appliances.
- Tamil Nadu Solar Power Policy (2019)[15] and Tamil Nadu Wind Energy Roadmap[16] (GWEC), supported by GOI, penetrating RE installations.
- Pradhan Mantri UJJWALA scheme[17] supporting cleaner fuel adoption.
- Lack of master plans and Development Control rules mandating implementation and enforcement of Green Buildings. Lack of incentives to builders for adopting green building principles and lack of enforcement of ECBC.
- Government housing divisions/departments are adopting green principles, but this can be more full fledged adoption aligned to ECBC.
- Lack of net metering facility for roof top solar less than 151 Kwp leads to lack of adoption for medium enterprises as the cost of the the transformers can be prohibitive.

**Building Policy and Ongoing Initiatives**

**National Policy/ Programs/ Targets:**

- Nationally Determined Contribution (NDC), India: 50 percent of electric power installed capacity from renewable sources by 2030.
- Ministry of Power's target to all DISCOMs to achieve 43.3% Renewable Purchase Obligation[18] by 2030.

[13]Unnat Jyoti by Affordable LED for All. Accessed Dec 2023.
[14]EESL's Super-Efficient AC Program. Accessed Dec 2023.
[15]Tamil Nadu Solar Power Policy 2019. Accessed Dec 2023.
[16]Tamil Nadu Wind Energy Roadmap. Accessed Dec 2023.
[17]Pradhan Mantri Ujjwala Scheme. Accessed Dec 2023.
[18]Ministry of Power Notification F.No. 09/13/2021-RCM. Accessed Dec 2023.

Baseline status (2021)
Built Environment and Energy

- India Cooling Action Plan[19] intends to reduce cooling demand by 20 to 25% (focusing on building envelope design) and cooling energy demand by 25% to 40% by 2038.
- Mission Life[20] promoting an environmentally conscious lifestyle.
- National Clean Air Program supporting air quality improvement measures, including adoption of cleaner fuel, use of RE, increase in green cover etc.

**State and City Level Policy/ Programs/ Targets**

- The Government of Tamil Nadu intends to meet 40% of the consumer category of the total target of 900 MW solar energy target of 2023[21]
- Tamil Nadu Combined Development & Building Rules - 2019 (TNCDBR)[22] promotes solar PV installation, solar water heater, green cover, etc.

Climate Risk and BAU GHG emissions scenario

**BAU GHG Emissions:**

| Sector | BAU GHG Emissions (Million $tCO_2e$) | | | Share in overall BAU GHG Emissions (%) | | |
|---|---|---|---|---|---|---|
| | 2030 | 2050 | 2070 | 2030 | 2050 | 2070 |
| **Residential Buildings** | 0.78 | 1.09 | 1.35 | 36% | 32% | 30% |
| **Commercial and Institutional Buildings** | 0.34 | 0.59 | 0.87 | 15% | 18% | 19% |
| **Manufacturing Industries and Construction** | 0.54 | 0.95 | 1.40 | 25% | 28% | 31% |
| **Total GHG Emissions from Buildings** | 1.66 | 2.64 | 3.62 | 76% | 79% | 80% |

**Note:** The projected emissions for commercial and institutional buildings sector includes emissions from municipal service facilities such as water supply, wastewater and street-lighting in addition to commercial/private/public buildings.

**Climate Risk Status: Medium to High**

- Increased surface and air temperature, and related impacts on health
- Increased water logging areas due to impermeable surface areas
- Increased demand for water and cooling

[19]Indian Cooling Action Plan. Accessed Jan 2024.
[20]Mission LiFE. Accessed Mar 2024.
[21]TN Solar Energy Targets - Section 6.0. Accessed Jan 2024.
[22]TNCDBR 2019 - Accessed March 2024.

| | |
|---|---|
| Potential climate resilience impact from identified interventions (Net Zero Scenario) | **GHG mitigation potential and indicative cost of interventions:** (see table below) Climate Resilience Impact: • Reduced grid dependency • Improved indoor thermal comfort • Improved green cover |
| SDGs | **GOAL 3:** Good Health and Well-being, **GOAL 7:** Affordable and Clean Energy, **GOAL 8:** Decent Work and Economic Growth, **GOAL 11:** Sustainable Cities and Communities, **GOAL 12:** Responsible Consumption and Production, **GOAL 13:** Climate Action; **GOAL 15:** Life on Land |

| Parameters | Net-Zero Scenario | | |
|---|---|---|---|
| | 2030 | 2050 | 2070 |
| GHG Emissions Reduction from BAU (%) | 34% | 56% | 82% |
| Total cost of mitigation actions (Million INR) | 21,498 | 56,300 | 1,16,410 |
| Total cost of adaptation actions (Million INR) | | | |
| Not Estimated | | | |

### 8.3.1.1 Adaptation Strategies for Built Environment and Energy

**Goal:** Trichy is committed to becoming a heat-resilient city, and adopting and implementing a sustainable energy transition.

In response to the urgent need for sustainable urban development, especially the built environment, this section outlines proactive adaptation strategies for enhancing the built environment and transitioning to renewable energy sources. These strategies are designed to improve energy efficiency, reduce environmental impact, and create a resilient urban infrastructure in the face of urban heat and urban flooding.

**Strategy 1: Promote green construction concepts to reduce the risk of urban heat**

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1<br>Develop an Urban Cool Roof program for Trichy, and implement especially in areas that have high temperatures; focusing on slum settlements | **Proposed Actions:**<br>• Cool roofing material & AAC blocks proposed in several TNUHDB project in Trichy region<br>• High SR paints used in 2 knowledge centres of TCC.<br>• AAC Blocks used in various TCC buildings<br>• Heat alerts being provided on digital screens connected to the ICCC | • Slums, vendors, and traffic junctions impacted by extreme heat risks.<br>• Potential beneficiaries: All citizens of Trichy especially, 130997[23] people living in slum areas |
| 2<br>**Promote adoption of sustainable architecture especially the principles indicated in ECBC, 2017 (including for affordable housing)**<br><br>**Sub-Action:** Enable mass training on green building principles, especially for relevant professionals and artisans by leveraging academic institutions, state training institutions, and builders associations. | **Current Status:**<br>• Two Knowledge cum Library buildings are IGBC Gold certified.<br>• 4 Private buildings are LEEDS certified[24]<br><br>**Proposed Actions:**<br>• Increase the numbers of buildings under green certification and undertake improvement plans to increase certification grade.<br>• Introduce law to make it mandatory for all new public buildings to be green building certified.<br>Raise awareness for green building certification in private buildings and offer incentives | • Priority areas with high construction activities (developing areas)<br>• All public buildings<br>• All buildings being developed/built by TNUHDB & TNHB<br>• Potential beneficiaries: Incremental increase of 3216 people / year[25] |

[23] This is estimation based on 2018 population of slums in Trichy
[24] LEEDS buildings in Trichy. Accessed March 2024.
[25] Computed based on the annual growth rate of built-up area in LULC by 0.2975%.

| Implementation Entities and FinancingMode | Total Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| • Engineering Department, Health Department of TCC<br>• Department of Public Health, Government of Tamil Nadu<br>• Industry Bodies to tap into CSR funds | Not estimated.<br><br>CSR funds to be sought to implement this intervention | High impact, short term |
| • Planning Department TCC, Engineering Department, TCC<br>• Tamil Nadu Urban Habitat Development Board (TNUHDB)<br>• Tamil Nadu Housing Board (TNHB)<br>• Department of Town & Country Planning.<br>• Accrediting Institutions like GBCI, IGBC etc.<br>• Builders and industry associations like CREDAI and CII | Not estimated | High impact, Medium to Long term |

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1<br>**Develop strategies and roadmap for cooling of streets and vending zones and integrate the same into local area street vending plans.** | **Proposed Actions:**<br>• Preparation of Street Vending Management Plan<br>• Strategic locations may be identified for street vending (hawkers) zone and vegetable market spaces, incorporation of implementable cooling strategies to mitigate vulnerability | • Key market zones like Gandhi market, Woraiyur market, Thennur market, Integrated Market (under construction in Panjapur),<br>• Vendors impacted by extreme heat risks in the areas indicated in Figure 5.8 in the CRVA Chapter.<br>• Potential beneficiaries: ~ 5231 street vendors[26] |
| 2<br>**Support vertical gardening and roof-top gardening to reduce heat stress on built environment .** | **Proposed Actions:**<br>Provide incentives in property tax and undertake maximum promotion of this initiative may be carried out in areas with extreme heat risk, with some additional benefits | • Residential and commercial properties especially in high built-up areas in wards 9, 20, 29, 23, 22, 21, 51, 32, 33, 50, 34<br>• All public buildings and flyovers across the city<br>• Potential beneficiaries: ~ 12526 people in based year[27] |

*Note: The enabling actions for this strategy is similar to the mitigation strategies for Built Environment and Energy and is detailed in 8.3.1.2*

[26]Based on GPS survey done by TCC in 2023-24.
[27]Estimated that 5% of the built-up area of 23.17% in LULC classification is a viable area.

| Implementation Entities and FinancingMode | Total Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| • Engineering and Planning Departments of TCC<br>• Civil Society Organizations | Not estimated. | Medium impact, Short to Medium term |
| TCC, Horticulture Department, Forest Department, Finance Department, TCC | CSR and PPP may be promoted | High impact, Short term |

### 8.3.1.2 Mitigation Strategies for Built Environment and Energy

**Target:**

- 60% (Residential) & 80% (Commercial & Institutional) adoption of green building principles in new constructions by 2070.
- 94%[28] utilisation of energy-efficient appliances in both new and existing buildings in Commercial and Institutional Buildings by 2070.
- Up to 70% of energy demand is met by renewable energy[29] in Industries by 2070.

**Strategy 1: Integrate advanced green building designs to significantly reduce urban heat effects.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1 **Develop and enforce a green building regulation specific to Trichy's context and climate addressing emissions across the entire lifecycle of a building.** | Develop a Green Building policy specific to the city's building stock, climate, and local construction trends. Policy to holistically address sustainable design, construction, operations, and end-of-life measures for different types of buildings. This plan will be developed for the metropolitan planning area to account for future expansion of the city limit. | • Planning Department of TCC<br>• Directorate of Town & Country Planning (DTCP)<br>• Architect and Building developers associations like CREDAI and CII.<br>• Accrediting agencies like GRIHA, IGBC, GBCI |
| 2 **Adopt Green Building policies and concepts in new building design and construction in line with ECBC and Eco Niwas Samhita** | Percentage of new buildings to implement green building principles:<br>**Residential:**<br>**2030:** 15% of new buildings<br>**2050:** 35% of new buildings<br>**2070:** 60% of new buildings<br>**Commercial & Institutional:**<br>**2030:** 50% of new buildings<br>**2050:** 60% of new buildings<br>**2070:** 80% of new buildings | • Planning Department of TCC<br>• Directorate of Town & Country Planning (DTCP)[30]<br>• Architect and Building developers associations like CREDAI and CII.<br>• Accrediting agencies like GRIHA, IGBC, GBCI<br>**Financing mode:**<br>Incentives by TCC & DTCP, Green Building certification costs borne by building developers or the concerned departments. |

[28]Average of Energy Efficient Lighting, Energy Efficient Fans, Energy Efficient AC and Refrigerators.
[29]Average of Rooftop Solar PV, Captive Solar PV & green power purchase from DISCOM.
[30]Note: Approving authority for all buildings greater than 2000 sq.ft is DTCP.

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| Not Estimated | Very High; Short term |
| Not Estimated | Very High; Short to mid-term |

## Enabling Actions:

### Financial and Regulatory Measures

- **Incentives:** TCC will consider offering benefits and incentives to green buildings, to make it more appealing for developers to embrace sustainable practices. This will lead to lesser consumption of resources and the supply benefits can be transferred to the developer. TCC will undertake this activity jointly with other agencies and departments like TANGEDCO & Energy Department to provide incentives to developers/end consumers.
- **Mandating ECBC 2017 for Larger Buildings:** TCC will work with DTCP and Government of Tamil Nadu to make commercial buildings with significant energy use to strictly adhere to the Energy Conservation Building Code (ECBC) 2017. This will also reduce a lot of resource demand like water, sewage systems among others. TCC along with DTCP shall consider creating a task force to enforce and periodically check the compliance of these green provisions.

### Support and Guidance

- **Easy-to-Use Online Platform:** TCC will consider creating an online portal for builders to apply for green building incentives and find resources to comply efficiently with green standards. TCC will create knowledge partnerships with accrediting agencies like IGBC, GBCI etc. to help develop and build these online channels.
- **City-Specific Green Building Policy:** TCC will develop policies tailored to the city's unique local needs, promoting energy-efficient buildings utilising local materials to reduce the lifecycle emissions of material used in constructions.

### Education and Promotion

- **Learning Through Pilots and Studies:** TCC will conduct energy use studies and pilot projects to understand effective energy-saving practices better and demonstrate their benefits. TCC will lead this activity by conducting these pilots on its own building stock and then scale the same to other public buildings in the city.

**Collaboration, Awareness, Efficiency & Innovation**

- **Facilitating Better Financing Options:** TCC will work with financial institutions for attracting finances for investment in innovative energy efficiency. Where possible TCC will leverage funding from external MDBs like World Bank and ADB via its various programs like TNCRUDP.
- **Raising Community Awareness:** TCC will take efforts to educate communities about the benefits of energy-efficient design and appliances, emphasizing cost savings and improved comfort. TCC will leverage the reach of educational institutions like National Institute of Technology, Trichy and Bharathidasan University to help communicate this to a wider audience.
- **Providing Guidelines for Efficiency:** TCC will create easy-to-follow, cost-effective guidelines for constructing new energy-efficient buildings and retrofitting existing ones along with the support of DTCP.
- **Promoting Energy Audits:** TCC will encourage energy audits for its own buildings to identify ways to reduce energy consumption and save on costs. To achieve this baselining activity will be conducted to benchmark future improvements.

**Strategy 2: Mandate comprehensive energy-saving and sustainable building standards.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1 **Promote and mandate high-energy efficiency appliances – LED Lighting** | Extent of efficient LED lights by sector:<br>**Residential:**<br>**2030:** 80%<br>**2050:** 90%<br>**2070:** 100%<br>**Commercial & Institutional:**<br>**2030:** 90%<br>**2050:** 100%<br>**2070:** 100%<br>**Industrial:**<br>**2030:** 90%<br>**2050:** 100%<br>**2070:** 100% | • EESL, Tamil Nadu Green Energy Corporation Limited (TNGECL)[31] Property Developers, Industry Bodies, TANGEDCO, TNGCC<br>**Financing mode:**<br>• Purchase by consumers from market<br>• Financial incentives availed through UJALA scheme<br>• ESCO business model with 3rd party investments for aggregated procurement<br>TCC will undertake discussions with TNGECL, and the Energy department to provide subsidized energy tariff for a limited period to incentivize adoption. |
| 2 **Promote high-energy efficiency appliances – Ceiling Fans** | Extent of energy efficient BLDC fans by sector:<br>**Residential:**<br>**2030:** 45%<br>**2050:** 75%<br>**2070:** 100%<br>**Commercial & Institutional:**<br>**2030:** 55%<br>**2050:** 100%<br>**2070:** 100% | • TANGEDCO, (TNGECL), EESL, Property Developers, Industry Bodies, TANGEDCO, TNGCC<br>**Financing mode**:<br>• Purchase of BLDC fans by consumers from market<br>• Financial incentives availed through UJALA scheme<br>• National Energy Efficient Fan Program; ESCO business model with 3rd party investments for aggregated procurement |

[31] The Non Conventional Sources (NCS) department of TANGEDCO and TEDA have been merged to form Tamil Nadu Green Energy Corporation Limited. TNGECL

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| **Residential:**<br>2**030:** INR 777 million<br>**2050:** INR 1,219 million<br>**2070:** INR 1,678 million<br>**Commercial & Institutional:**<br>**2030:** INR 93 million<br>**2050:** INR 186 million<br>**2070:** INR 276 million<br>**Industrial:**<br>**2030:** INR 120 million<br>**2050:** INR 235 million<br>**2070:** INR 346 million | High:Short-term |
| **Residential:**<br>**2030:** INR 2,070 million<br>**2050:** INR 4,809 million<br>**2070:** INR 7,944 million<br>**Commercial & Institutional:**<br>**2030:** INR 245 million<br>**2050:** INR 804 million<br>**2070:** INR 1,194 million<br>**Industrial:**<br>**2030:** INR 613 million<br>**2050:** INR 1,973 million<br>**2070:** INR 2,901 million | High:Short-term |

| | | |
|---|---|---|
| | **Industrial:**<br>**2030:** 55%<br>**2050:** 100%<br>**2070:** 100% | TCC will undertake discussions with TNGECL and the Energy department to provide subsidized energy tariff for a limited period to incentivize adoption. |
| 3 **Promote high-energy efficiency appliances – Refrigerators** | Extent of efficient refrigerators by sector:<br><br>**Residential**:<br>**2030:** 35%<br>**2050:** 45%<br>**2070:** 80%<br><br>**Commercial & Institutional:**<br>**2030:** 35%<br>**2050**: 65%<br>**2070:** 85% | • (TNGECL), BEE, TCC, EESL, Citizens, Business owners, Commercial Associations<br>• **Financing mode:** Purchase by consumers directly from market; ESCO model for EE retrofitting with 3rd party investments for aggregated procurement<br><br>TCC will undertake discussions with TNGECL, and the Energy department to provide subsidised energy tariff for a limited period to incentivize adoption. |
| 4 **Promote high-energy efficiency appliances – HVAC** | Extent of efficient air conditioning by sector:<br><br>**Residential:**<br>**2030:** 40%<br>**2050:** 60%<br>**2070:** 85% | • TANGEDCO, Tamil Nadu Energy Development Agency (TEDA), EESL, Property Developers, Industry Bodies, TANGEDCO, TNGCC |

| | |
|---|---|
| | High:Short-term |
| **Residential:**<br>**2030:** INR 2,998 million<br>**2050:** INR 5,372 million<br>**2070:** INR 11,833 million<br><br>**Commercial & Institutional:**<br>**2030:** 1,448 million<br>**2050:** 4,849 million<br>**2070:** 9,418 million | Medium; Short to mid-term |
| **Residential:**<br>**2030:** INR 935 million<br>**2050:** INR 1,956 million<br>**2070:** INR 3,433 million | Medium; Short to mid-term |

| | | |
|---|---|---|
| | **Commercial & Institutional:**<br>**2030:** 35%<br>**2050:** 70%<br>**2070:** 90%<br><br>**Industrial:**<br>**2030:** 35%<br>**2050:** 70%<br>**2070:** 100% | **Financing mode:**<br>• Purchase by consumers directly from market;<br>• ESCO model for EE retrofitting with 3rd party investments for aggregated procurement;<br>• financial support under EESL's Super-Efficient AC Program<br>TCC will undertake discussions with TNGECL, and the Energy department to provide subsidised energy tariff for a limited period to incentivize adoption. |
| 5<br>**Promote high-energy efficiency appliances – Energy Efficient Water Pumps in large apartments and residential societies** | Extent of BLDC/VFD pumps:<br>Residential:<br>2030: 40% of pumps<br>2050: 60% of pumps<br>2070: 75% of pumps | • TCC, EESL, TNGECL, BEE, Citizens<br>Implementation mode:<br>• Purchase by consumers directly from market;<br>ESCO model for EE retrofitting with 3rd part investments for bulk procurement |

| | |
|---|---|
| **Commercial & Institutional:**<br>**2030: I**NR 1,804 million<br>**2050:** INR 6,504 million<br>**2070:** INR 12,420 million<br><br>**Industrial:**<br>**2030:** INR 341 million<br>**2050:** INR 1,208 million<br>**2070:** INR 2,537 million | |
| **Residential:**<br>**2030: INR 311 million**<br>**2050: INR 650 million**<br>**2070: INR 1,007 million** | High; Short-term |

## Enabling Actions:

- TCC will Partner with EESL and TANGEDCO (TNGECL) under the UJALA Scheme to Bring LED Lighting and Super-Efficient Fans to All Income Groups, expanding access to energy-saving technologies across the community.
- Through Targeted IEC Campaigns, TCC will aim to Broaden Public Understanding of Building and Appliance Energy Efficiency, making energy conservation a community-wide initiative.
- Prioritise Mid and Low-Income Households, plan to Upgrade Residential Utilities to Include Energy-Efficient Appliances, directly contributing to reduced energy consumption and costs for those who need it most.
- Collaborating with Banks, Facilitate Access to Affordable Loans for Purchasing Energy-Efficient Appliances, ensuring all citizens can afford to participate in energy conservation.
- TCC will initiate Pilot Projects, Conduct Energy Audits and Implement Efficiency Measures in Public Buildings and Infrastructure, setting a standard for energy savings in the public sector.

**Strategy 3: Achieve a full transition to sustainable energy systems for all city energy needs.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1<br>**Encourage hotels and hospitals with roof space to install solar water heaters**. | **Number of hospital and hotels targeted:**<br>**2030:** 0.3% (2,616)<br>**2050:** 0.4% (4,043)<br>**2070:** 0.5% (6,247) | • TCC, TNGECL, Consumers, Dealers and Service providers, TANGEDCO, DTCP<br>**Financing mode**:<br>• Investment by consumers (hospital & hoteldevelopers);<br>• Demand Aggregation of multiple projects facilitated by TNGECL and TCC |

- Developing a Green Public Procurement Policy, Ensure All Public Buildings and Facilities Adopt Energy-Efficient Practices, leading by example in sustainable development.
- Engage educational Institutions, Collaborate to Upgrade Appliances and Foster Awareness of Energy Efficiency, leveraging their influence to educate the next generation.
- Incorporate Energy-Efficient Equipment Requirements into the Building Approval Process for New Commercial and Industrial Constructions, TCC will make energy savings a foundational aspect of development.
- Assess and Implement District Cooling Systems for Large Buildings with High Cooling Demands, Pilot Projects in Smart City Areas, exploring innovative cooling solutions to enhance energy efficiency.
- Promote the Adoption of Building Energy Management Systems (BEMS) in Large Buildings, Optimize Energy Use and Achieve Significant Savings, harnessing technology to reduce our carbon footprint.

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| Not estimated | Very High; Short-term |

2

**Scale up use of renewable energy through:**

- Solar energy through decentralised and grid-connected deployment
- Captive Solar
- Utilisation of wind-based power
- Purchase of green power from DISCOM

Share of building electricity consumption[32] to be met by renewable energy:

**Residential:**
**2030:** 20% (2,94,110)
**2050:** 35% (3,63,385)
**2070:** 55% (4,16,023)

**Commercial & Institutional:**
**2030:** 20% (82,050)
**2050:** 40% (1,26,783)
**2070:** 55% (1,95,905)

**Industrial:**
**2030:** 20% (22,958)
**2050:** 35% (34,712)
**2070:** 70% (53,637)

- TNGECL, TNERC, Consumers, Service providers, RWA's, Renewable Industry Associations

**Financing mode:**

- Investment by consumers;
- Demand Aggregation of multiple projects facilitated by TNGECL;
- Sale of carbon credits in voluntary carbon markets (in selected registries)
- TCC will work with TNERC to increase the RPO obligations at the consumer level depending on future generation capacity to facilitate faster scale-up.

## Enabling Actions:

- Assist in the mapping of Map Rooftop Spaces for Solar PV Potential to maximise sustainable energy production.
- Assist in revising Net-Metering and Feed-in Tariffs to attract small solar energy producers.
- DTCP to mandate Rooftop Solar PV on Large Buildings to incorporate renewable energy into urban design.
- TNGECL and the Energy department, to introduce More Incentives for Renewable Energy to accelerate the shift to greener sources.
- Assist in the aggregation of demand with TNGECL Support to lower the costs of Solar PV and Wind installations for smaller consumers.

[32]Includes Roof-top solar, captive solar & green purchase from DISCOM

| | |
|---|---|
| **Residential:**<br>**2030:** INR 4,843 million<br>**2050:** INR 11,102 million<br>**2070:** INR 21,860 million<br><br>**Commercial & Institutional:**<br>**2030:** INR 1,820 million<br>**2050:** INR 6,560 million<br>**2070:** INR 14,612 million<br><br>**Industrial:**<br>**2030:** INR 2,680 million<br>**2050:** INR 7,909 million<br>**2070:** INR 23,252 million | Very High; Mid-term |

- Leverage Cluster Development for Renewable Energy Integration to offset energy consumption in SMEs.
- TNGECL/TANGEDCO to enable Open Access for Green Power Purchases for businesses to meet Net-Zero targets when in-house RE is not feasible.
- Facilitate Partnerships Between Large Entities and DISCOMs for Renewable Energy plants with BESS, aiding Net-zero goals and RPO compliance.
- Identify and Register Carbon Credit Projects to explore additional environmental benefits and incentives by Trichy Smart City Limited & TCC.

## 8.3.2 Transport

| | |
|---|---|
| **Baseline status (2021) Transport** | **Energy consumption (GJ):** 36,64,685 GJ (36% of total energy consumption)<br><br>**GHG emissions:** 0.31 million $tCO_2e$ (22% of total GHG emissions)<br><br>**Key statistics:**<br><br>• On Road Transportation: 18%[33] of total GHG emissions<br><br>**Opportunities and Gaps:**<br><br>• Public Transport: TN aims to phase out all diesel buses by 2030<br><br>• According to the urban fleet specification of 50 buses per lakh (100,000) population, the city's bus fleet is deficient by 145 buses.<br><br>• Lack of integration between public transport modes<br><br>• Lack of NMT infrastructure<br><br>• Significant increase in private vehicles<br><br>• Lack of on and off-street parking facilities and encroachment of roads leading to traffic congestion. |
| **Existing Policy and ongoing initiatives** | **National Policy/ Program/ Targets:**<br><br>• Government of India intends for electric vehicle (EV) sales penetration of 30% for private cars, 70% for commercial vehicles and 80% for two and three-wheelers.<br><br>• National Electric Mobility Mission Plan - Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME II)[34] TN has applied for charging infrastructure under the FAME II program and is awaiting sanction.<br><br>• Voluntary Vehicle-Fleet Modernization Program (V-VMP)[35] A guide towards setting up a vehicle scrappage ecosystem.<br><br>**State Policy/ Program/ Targets:**<br><br>Tamil Nadu State EV Policy 2023[36]<br><br>**City Policy/ Program/ Targets:**<br><br>• Shift towards clean fuel vehicles for Municipal Fleets<br><br>• Convert SWM collection vehicles into EV vehicles |

[33]Considers only On-Road Transportation Emissions excludes aviation and rail emissions
[34]FAME II. Accessed March 2024.
[35]V-VMP. Accessed March 2024.
[36]TN State EV Policy. Accessed Dec 2023.

**Climate Risk and BAU GHG emissions scenario**

**BAU GHG Emission:**

| Sector | BAU GHG Emissions (Million $tCO_2e$) | | | Share in overall BAU GHG Emissions | | |
|---|---|---|---|---|---|---|
| | 2030 | 2050 | 2070 | 2030 | 2050 | 2070 |
| **Transport** | 0.43 | 0.61 | 0.76 | 20% | 18% | 17% |

**Climate Risk Status:** High risk during high temperature and high intensity rainfall

- Increased use of private vehicles, increase in traffic congestion and air pollution.
- Extreme Heat: Pedestrians, cyclists, and people using two wheelers are most vulnerable, particularly at major traffic junctions.
- Urban Flood: Road infrastructure is impacted due to extreme rainfall events.
- Improved air quality

**Potential climate resilience impact from identified interventions (Net Zero Scenario)**

**GHG mitigation potential and indicative cost of interventions:**

| Parameters | Net-Zero Scenario | | |
|---|---|---|---|
| | 2030 | 2050 | 2070 |
| **GHG Emissions Reduction from BAU (%)** | 47 | 52 | 95 |
| **Total cost of Adaptation actions (Million INR/ year)** | NA | | |
| **Total cost of Mitigation actions (Million INR/ year)** | INR 2,439 million by 2070 | | |

**Climate Resilience Impact:**

- Improved public transport services and decreasing use of private vehicles.
- Integrated mobility and accessibility
- Reduced traffic congestion and improved air quality

**SDGs**

**GOAL 3:** Good Health and Well-being, **GOAL 7:** Affordable and Clean Energy, **GOAL 8:** Decent Work and Economic Growth, **GOAL 11: Su**stainable Cities and Communities, **GOAL 12:** Responsible Consumption and Production, **GOAL 13:** Climate Action; **GOAL 15:** Life on Land

### 8.3.2.1 Mitigation Strategies for Transport

**Goal:** Advocate for and implement clean, zero-emission transportation systems.

**Target:**

- Shift 10% of motorized trips to non-motorised transport (NMT) and 8% to public transit by 2070.
- Ensure 90% cars, 90% commercial vehicles, 90% two & three wheelers are electric by 2070 with 70% powered by renewables.

**Strategy 1: Expand infrastructure for NMT (biking and walking), and increase the capacity and efficiency of public transit.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1<br><br>**Adopt a non-motorised transit Policy and implement strategies to promote use of non-motorised mobility especially for shorter trips.** | Shift in passengers from private transport to non-motorised mobility such as walk and bicycles:<br>**2030:** 5%<br>**2050:** 8%<br>**2070:** 10% | Traffic Police Department, Transport Department, Trichy Smart City, TCC, SETC, DTCP, Trichy Collectorate, Transport Commissionerate, Private service providers for NMT solutions<br>**Financing Mode:**<br>• TCC municipal budget for NMT infrastructure development<br>• National and state schemes on climate friendly infrastructure<br>• National Clean Air ProgramI<br>• Private Builders for proving NMT within the vicinity of their projects<br>• CSR fundings |

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| Not estimated | High; Short-term |

## Enabling Actions:

- Adopt Safe Street Designs for biking and walking, laying the groundwork for a pedestrian-friendly infrastructure.
- Build more projects/programs like 'Happy Streets' implemented near Trichy District Court.
- Create an NMT sub-committee with cross-department stakeholders (including NGO's and Academia) to provide seamless NMT experience across urban infrastructure managed by other departments.
- Integrate Walkability Early On in planning projects and transit areas, prioritising pedestrian access from the start.

| | Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|---|
| 2 | **Promote public transport by providing high quality buses with information systems and BRT** | Shift in passengers from private transport to public transport:<br>**2030:** 3%<br>**2050:** 5%<br>**2070:** 8% | SETC, Transport Department, Traffic Police, Trichy Smart City, Highways Department, TCC, Private service providers for NMT solutions<br><br>**Financing Mode:**<br>Transport Department, DTCP, TNGCC, Transport Department, Trichy Smart City, NCAP<br><br>TCC will also explore increasing the private operator numbers to increase the number of public transport vehicles. |

- Remove Barriers in Public Spaces, making them walkable and accessible to everyone.
- Provide supporting and conducive infrastructure like trees and other canopy and water fountains to reduce the heat.
- Designate Non-Motorised Zones to encourage walking and cycling, creating safer, cleaner community spaces.
- Launch a Public Bicycle Sharing Scheme to link key city spots, offering a green alternative for short commutes.
- Boost Bicycling Through Facilities and Awareness, ensuring infrastructure use is matched by community engagement.

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
| --- | --- |
| Not Estimated | High mid- term |

## Enabling Actions:

- Implement IoT and Smart Measures to boost public transit ridership by making services more efficient and user-friendly.
- Enhance Integration with Intermediate Transport for seamless last-mile connectivity, bridging the gap between transit stops and final destinations.
- Improve Public Bus Service Frequency, Coverage, and Connectivity to attract more riders by offering more reliable and accessible options.

**Strategy 2: Mandate electric transition of transport systems and develop renewable energy powered charging stations.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1<br>**Electrification of public and private vehicles** | Share of EVs and electricity demand for EV charging met by renewables:<br><br>**2030:** 30% cars, 80% commercial vehicles, 80% two & three wheelers with 30% RE<br><br>**2050:** 50% cars, 80% commercial vehicles, 80% two & three wheelers with 50% RE<br><br>**2070:** 90% cars, 90% commercial vehicles, 90% two & three wheelers with 70% RE | TANGEDCO, TNGECL, Transport Department, Industries Department, TIDCO, TIIC, Taxi service providers; , Technology/ service providers for EV charging and renewable energy<br><br>**Financing mode:**<br>• Aggregated EV procurement for fleet operators from market;<br>• Tamil Nadu State EV policy for subsidies;<br>• FAME II scheme;<br>• PPP mode with private investment for charging infrastructure<br>• Direct consumer financing |

- Identify and Prioritise Routes Needing Service Improvements to target enhancements where needed most, ensuring efficient use of resources.
- Adopt IoT Systems for Monitoring Ridership and Performance, using data to refine services and respond to real-time demand.
- Introduce User-Friendly Ticketing and Improved Ride Facilities to simplify access to public transit, making it a more attractive option for all.

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| Not estimated | High; Short to mid-term |

| | | | |
|---|---|---|---|
| 2 | **100% electrification of SETC, Trichy's Region public bus fleet and RE integration in E-bus charging** | Number of new E-buses required to cater to public transit demand:<br><br>No specific target as GoTN has indicated 100% procurement from 2030 to be Electric starting with 1000 buses YoY to be electric starting 2023-24. | SETC, TANGEDCO, Transport Department, Finance Department, Planning Department, Technology/service providers for EV charging and renewable energy<br><br>**Financing mode:**<br><br>• Aggregated procurement of EVs for public transport fleet in collaboration with state government;<br><br>• FAME II scheme; VGF from state government for operation of e-buses,<br><br>• Sale of carbon credits in voluntary carbon markets; PPP mode with private investment for charging infrastructure |
| 3 | **Encourage the electrification of E-commerce delivery vehicles and goods.** | Share of EVs and electricity demand for charging met by renewables:<br><br>**2030:** 80% light freight vehicles; 40% medium and heavy freight vehicles (30% RE powered)<br><br>**2050:** 90% light freight vehicles; 60% medium and heavy freight vehicles (50% RE powered)<br><br>**2030:** 90% light freight vehicles; 80% medium and heavy freight vehicles (70% RE powered) | • Transport Department, Industries Department, Freight/goods associations and business owners, Last mile goods delivery operators; technology/ service providers for EV charging and renewable energy<br><br>**Financing mode:**<br><br>• Policy interventions from state government especially Transport |

| | |
|---|---|
| Not estimated | Very High; Short-term |
| Not estimated | High; |

**Commissionerate**

- Direct procurement by good carriage business owners and delivery operators
- Financial support under GOI's Voluntary Vehicle Fleet Modernization Program (V-VMP)
- PPP mode with private investment for charging infrastructure

## Enabling Actions:

- Develop an EV Charging Infrastructure Plan that includes fast-charging stations, residential and workplace options, and more public access points.
- TCC will explore the possibility of creating low emissions areas where only electric vehicles are permitted to increase adoption.
- CC will work with institutions like IIT Madras and Centre for Battery Research (CBR) to promote innovation in battery chemistry and range.
- Enhance Public and Private EV Charging Infrastructure, supported by frameworks that facilitate expansion and integration.
- Adopt Renewable Energy for EV Charging to ensure emission-free mobility, focusing on public buses and commercial fleets before expanding to all charging facilities.
- Incentivize EV Adoption and Disincentivize Conventional Vehicles to shift consumer and business behaviour towards greener alternatives.

- Create Green Mobility Zones for E-mobility and cycling, enhancing sustainable transport options in targeted areas.
- Develop an E-mobility Framework with policies, norms, and guidelines that support electric mobility and its infrastructure.
- Integrate EV Infrastructure Planning like battery swapping and opportunity charging infrastructure mentioned in the draft battery swapping policy framework[37] with transport corridors, road networks, and specific zones to ensure comprehensive coverage.
- Amend the Building Codes (TNCDBR 2019) to make new buildings EV-ready, focusing on residential and commercial developments.
- Assess Feasibility for Carbon Credits in E-mobility transitions to leverage financial benefits and support sustainable initiatives. TCC will explore undertaking this at a larger cluster level in the state.

[37]Draft Batter Swapping Framework for 2/3 Wheelers. Accessed. April 2024.

**Strategy 3: Implement smart traffic management systems and create more pedestrian zones to ensure smoother traffic flow and reduced congestion.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 3<br><br>**Improve road infrastructure and implement traffic control measures.** | Adopt intelligent traffic management system, parking management actions, streamline freight movement,<br><br>pothole free roads, safe pedestrian friendly roads | Traffic Police, Transport Department, Trichy Smart City, TCC<br><br>**Financing Mode:**<br><br>• TCC city budget for roads and NMT infrastructure development<br><br>• National and state schemes on climate friendly infrastructure; National Clean Air Program |

**Enabling Actions:**

- Develop a Comprehensive Parking and Vendor Policy to tackle congestion caused by unauthorised encroachments, ensuring clear regulations and designated spaces.
- Deploy Intelligent Traffic Management Systems to optimise flow and enhance mobility, leveraging technology for smarter traffic solutions.
- Implement Parking Management Measures to create off-street parking, improve infrastructure for Intermediate Public Transport (IPT), and tailor parking regulations to specific roads and areas.

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| Not estimated | High; Short to mid-term |

- Streamline and Regulate Freight Movement with strategies that minimize congestion and improve efficiency, addressing the unique needs of urban freight.
- Incorporate Urban Freight into Transport and Land-Use Planning to ensure cohesive integration of freight logistics with the city's broader mobility and development strategies.

## 8.3.3 Water

**Baseline status (2021)**
**Water Supply**

**GHG emissions: 16,652** $tCO_2e$ (57.46% of total GHG municipal emissions)

**Key statistics:**

- 97%[38] water network coverage, 100% chlorination of water supply, 31%[39] NRW and 134.77 MLD supplied with ~124 lpcd[40]

**Opportunities and gaps:**

- Severe dependence on groundwater for water supply.
- High level of NRW reducing efficiency.
- Lack of upgradation and maintenance of water bodies in the city.
- No regulation or monitoring of ground water extraction from private wells and borewells.
- Complaints related to inadequate water pressure, illegal connections, leakage in pipelines, and limited/no water supply are being received in some of the wards.

**Ongoing plans and actions**

- Strong enforcement of rain water harvesting in the city as a prerequisite for giving building completion certificates. Defaulting properties are fined for non-compliance.
- Revamping of water supply in ABD area taken up at the cost of Rs 54.37 crores under the smart cities mission.
- Restoration of several lakes in the city like Chettikulam (under CapaCITIES II) and other water bodies in the city for improving storage and also improving of the inter-linkages
- Tapping into the AMRUT scheme for water body restoration in the city.
- Repair of water supply lines to reduce NRW to achieve 20% NRW by 2024-25.

**Climate Risk and BAU GHG emissions scenario**

BAU GHG Emission:

| BAU GHG Emissions (Million $tCO_2e$) | | | Share in overall BAU GHG Emissions | | |
|---|---|---|---|---|---|
| 2030 | 2050 | 2070 | 2030 | 2050 | 2070 |
| 0.015 | 0.019 | 0.021 | 0.7% | 0.6% | 0.5% |

**Climate Risk Status: High** | High risk from high temperature and intense rainfall

- Increase in water demand during extreme heat events and reduced flow of water in river Cauvery
- High intensity rain could cause blocks in the flow in sections of the network. This could also lead to public health issues.

[38] Explained in detail in Section 4.2
[39] NRW for in some of the wards as per estimates is up to 31%
[40] To reach 135 lpcd in added areas after KfW implementation.

**Potential climate resilience impact from identified interventions (Net Zero Scenario)**

**GHG mitigation potential and indicative cost of interventions:**

| Parameters | Net-Zero Scenario | | |
|---|---|---|---|
| | 2030 | 2050 | 2070 |
| GHG Emissions Reduction from BAU (%) | 27% | 49% | 68% |
| Total cost of Adaptation actions by 2070 (Million INR) | NA | | |
| Total cost of Mitigation actions by 2070 | INR 28,771 million | | |

**Climate Resilience Impact:**

- Prioritize Access to Clean Energy for operating water supply infrastructure to lower operation and maintenance costs, aligning with sustainability goals in water supply pumping infrastructure
- Ensure equitable and safe water access for everyone, highlighting the essential nature of water security.
- Revitalise water resources to counteract urban heat island effects, mitigate flooding, and replenish groundwater, enhancing ecosystem health.
- Adopt data-driven decision-making, ensuring policies and initiatives are guided by accurate insights for improved urban management.

**SDGs**

**GOAL 3:** Good Health and Well-being, **GOAL 6:** Clean Water and Sanitation, **GOAL 7:** Affordable and Clean Energy, **GOAL 9:** Industry, Innovation and Infrastructure, **GOAL 10:** Reduced Inequality, **GOAL 11:** Sustainable Cities and Communities, **GOAL 12:** Responsible Consumption and Production, **GOAL 13**: Climate Action, **GOAL 14**: Life under Water, **GOAL 15:** Life on Land

## 8.3.3.1 Adaptation Strategies for Water Sector

**Goal:** Increase water resilience and foster a circular economy via complete wastewater treatment and reuse

**Strategy 1: Establish governance models, policy & regulatory framework for water conservation improve water resilience.**

**Strategy 1: Establish governance models, policy & regulatory framework for water conservation improve water resilience.**

| Actions | Status and Ongoing/Planned Initiatives | Potential Locations for Implementation and Beneficiaries |
|---|---|---|
| 1 **Create an Action Plan for sustainable water balance that will maximise water recharge and help achieve self-sufficiency.** | • Service Level Benchmark done for base year 2020-21 and targets set till 2024-25.<br>• Revamping of water supply network in the ABD area at an estimated cost of Rs 54.37 under smart cities mission.<br>• Restoration of Panjapoor aquifer under SuWaSeM scheme<br>• Restoration of Chettikulam lake (under CapaCITIES II), Theppakulam, Thamaraikulam (under Namakku Naame Scheme)<br>• Restoration of Manja Thidal lake under capital budget for 2024-25 | Entire city |

| Implementation Entities and Financing Mode | Total Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| • Engineering Department, TCC<br>• TWAD<br>• PWD<br>• Agriculture Department<br>SuWaSeM[41] scheme, 15th Finance Commission, TCC Budget, AMRUT 2.0, Jal Shakti Grants, GEF, KfW, Nammaku Namme Scheme | **Budget Requirement:** INR 5 million | High impact, Short term |

[41] SuWaSeM is a Government of Tamil Nadu scheme that aims to progressively move towards a water security in a sustainable manner through water harvesting, waste water recycling, loss reduction and demand management.

| | | |
|---|---|---|
| 2 **24X7 water supply with Water metering policy (Target to reduce 20% NRW by 2024-25 and reach 10% by 2070)** | • **Proposed projects:**<br>24X7 water supply in eastern zone with funding from KfW to achieve a minimum 135 lpcd.<br>• Some of the proposed areas are also vulnerable to extreme heat and water supply related issues.<br>• Rs 540 million INR already allocated for the ABD area under Smart City Scheme.<br>• Will be considered for implementation under the TNCRUDP project funded jointly by the Government of Tamil Nadu & World Bank. | **Potential wards for pilot implem-entation:** Across the city.<br>However, focus on all the wards/regions not covered under piped supply and also regions that have very low pressure. |
| 3 **Implement regulations that encourage the reuse of treated wastewater by restricting ground water extraction and rationalising water tariffs for industrial and commercial customers.** | • Ground water is currently used by industries and the commercial sector including supply by water tankers.<br>MAWS/TWAD/TCC can make it mandatory for reuse | **Potential areas for implementation:**<br>Industrial & Commercial establishments especially in the areas of Chatram bus stand, Central Bus stand, Shastri Nagar, Gandhi Market Area, Thennur and Thillay Nagar. |

| | | |
|---|---|---|
| Engineering department,<br><br>Revision of water charges and enforcement<br><br>TCC Capital Budget<br><br>External funding agencies like KfW, ADB, JICA & World Bank<br><br>GoI schemes like AMRUT, Jal Jeevan | Not estimated. | Very high impact, short to medium term |
| TWAD Board, MAWS Department, Government of Tamil Nadu, Public Works Department | MAWS/TWAD in consultation with Water Resources Department of GoTN and PWD may create regulator to periodically monitor ground water levels, and enforce new wells or restrictions including set charges for drawing of water. | Medium impact, short to medium term |

**Strategy 2: Universal access to high-quality 24/7 water through distribution networks with reduced NRW.**

| | Actions | Status and Ongoing/ Planned Initiatives | Potential Locations for Implementation and Beneficiaries |
|---|---|---|---|
| 1 | **Increase water treatment capacity to satisfy rising demand from new growth regions.** | **Proposed projects by TCC:** Additional 112.88 MLD[42] water treatment[43] capacity required by 2070 | Supply efficient water in current water scarce areas and upcoming developing areas, particularly in wards 1-60 where 102 lpcd, and wards 61-65 where 70 lpcd is supplied excluding NRW Newly added areas with high population growth. |
| 2 | **Conduct a robust NRW study** | • **Project under implementation:** KfW water supply scheme in added areas to also reduce NRW in the east region. | Newly added areas with high population growth. Piped network region of the city (including all the areas from the headworks and downstream) |
| 3 | **Improve the water delivery systems through SCADA and smart meter-based monitoring** | SCADA installed at water distribution stations, Monitored centrally through Integrated Command and Control Centre (ICCC). Increasing SCADA coverage to all the OHTs from the current 97 to the total of 137. | City wide initiative |

[42] Note: This is calculated based on 150 lpcd supply as per CPHEEO norms and 10% NRW to be achieved by 2070.
[43] Chlorination as ground water already meets CPCB and IS norms

| Implementation Entities and Financing Mode | Total Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| Engineering Department, TCC | Not estimated | Medium impact, Short to medium term |
| Engineering Department, TCC, Trichy Smart City Limited | **Budget Requirement:** INR 5 million | Very high impact, Short to medium term |
| Engineering Department, TCC, Trichy Smart City Limited | Not estimated | high impact, Short term |

| | | | |
|---|---|---|---|
| 4 | **Promote rainwater harvesting and ground water recharge.**<br><br>**Sub-actions:**<br>• Awareness generation on benefits<br>• Approach organizations to implement such initiatives under CSR/CER | **Ongoing Initiatives:**<br><br>TCC is installing shallow recharge structures in more than 200 locations in the city.<br><br>TCC will install more recharge structures that have been identified as heat stressed based on the study. Public parks may be suitably modified to achieve better outcomes. | Across City, especially in:<br>• Open grounds<br>• Playgrounds<br>• Under flyovers<br>• Banks of the river<br>• Under flyovers<br>• OSR land |
| 5 | **Monitoring of RWH structures implemented by builders as per TNCDBR - 2019.** | **Current Status:**<br><br>All new properties in the city have rainwater harvesting structures implement ed as per clause under TNCDBR 2019. Impact of these structures not known<br><br>**Potential Actions:**<br>Effective monitoring and periodic maintenance through mandate to install water sensor installation for rainwater harvesting structures linked with Integrated Command and Control Centre of TCC before providing Building Completion certification and for ensuring proper maintenance checking the same before property tax renewal. | Entire city |

| | | |
|---|---|---|
| Engineering Department, TCC CSR Funds<br><br>**ClimateFinance Sources accessible through MoEF&CC:**<br><br>Adaptation Fund; Green Climate Fund and Global Environment Facilities (GEF) | INR 28,348 million by 2070 | High impact, Short term |
| Engineering Department, TCC<br><br>Builder Association<br><br>RWA's | Investment to be made by builders or contractors | High impact, Short to medium term |

**Strategy 3: Launch comprehensive lake restoration projects to restore ecological balance and recreational value.**

| Actions | Status and Ongoing/ Planned Initiatives | Potential Locations for Implementation and Beneficiaries |
|---|---|---|
| 1<br>**Rejuvenation and ecological restoration of lakes**<br>**Sub Actions:**<br>• Build STP before lakes entry points or DEWATS systems<br>• Removing encroachments.<br>• Desilting of lakes.<br>• Establishment of bird islands.<br>• Developing constructed/ floating wetlands to treat water | **Current Status:**<br>Some of the lakes in the city have sewage inflow and are not potable.<br>No lake in the city is used as a water supply source.<br>**Proposed projects:**<br>• Kulamkulam is being rejuvenated at the cost of 48 crores.<br>• Better outflow management of all the water bodies with funds from TCC capital budget. | **Potential beneficiaries:**<br>Entire city but most importantly population within 500m of these lakes across the city. |

### 8.3.3.2 Mitigation Strategies for Water Sector

**Target:**

- 80% of water supply facilities adopt energy efficiency and renewable energy by 2070.
- 20% NRW levels by 2024-25 and 10% by 2070.

| Implementation Entities and Financing Mode | Total Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| Engineering Department, TCC<br><br>CSR Funds\<br><br>**Climate Finance Sources accessible through MoEF&CC:**<br>Adaptation Fund; Green Climate Fund and Global Environment Facilities (GEF) | **Allocated Budget for Lake Rejuvenation:**<br>INR 480<br>million for Kulam Kulam | High impact, Short term |

**Strategy 1: Upgrade all water supply systems to be powered exclusively by renewable energy with enhanced efficiency measures.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1 **Implement energy efficiency in water pumping** | **2030:** 35% of existing pumps<br>**2050:** 50% of existing pumps<br>**2070:** 80% of existing pumps | Engineering Department, TCC<br>**Financing mode:** Municipal budget; ESCO model with private sector investment |
| 2 **Utilize solar and wind power in water supply facilities with electricity connections** | **Estimated capacity/size:**<br>**Solar:**<br>2030: 20% of total demand<br>2050: 40% of total demand<br>2070: 60% of total demand | Engineering Department, TCC, TNGECL, TNERC, TANGEDCO, Technology providers<br>**Financing mode:** Municipal budget; RESCO model with private sector investment; Issuance of Green Bonds; 15th Finance Commission |
| 3 **Reduce non-revenue water and leakages to reduce energy usage in water networks.** | **20% reduction in NRW levels by 2024-25** | Engineering Department, TCC<br>**Financing mode:** Municipal budget, AMRUT 2.0, Development Bank funding |

**Enabling Actions:**

- Adopt financing mechanisms such as Energy Performance Contracting for pump replacement through agencies such as EESL.
- Assess LT/HT load in water facilities for assessing the scale of net metering and captive RE power plants.

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
| --- | --- |
| Not estimated | Very High; Short-term |
| INR 537 million | Very High;<br>Short to mid-term |
| Not estimated. Will be considered for implementation under the TNCRUDP[44] project funded jointly by the Government of Tamil Nadu & World Bank. | Very High;<br>Short to mid-term |

- Assess benefits and scale of battery energy storage deployment along with renewable energy.
- Explore collaboration with TANGEDCOs to deploy RE power plants while also contributing to their renewable energy goals

[44]Tamil Nadu Climate Resilient Urban Development Programme (TNCRUDP). Accessed March 2024.

## 8.3.4 Wastewater

| | |
|---|---|
| **Baseline status (2021) Wastewater** | **GHG Emissions:** 4412 $tCO_2e$ (14.05% of total Municipal GHG emissions)<br><br>**Key Statistics:**<br><br>• 67% of total households are covered by underground sewerage networks.<br>• Trichy's total domestic wastewater generation was about 74.39 MLD.<br>• The city's sewerage infrastructure encompasses a network of 352.40 km of sewer lines and 49.03 km of sewer mains, complemented by 26 lifting stations and 26 sub-pumping stations scattered throughout the city.<br>• Out of 167.23 Sq.km area, 30.23 Sq.km of area has been already covered by the existing schemes, about 114 sq.km covering about 67% of the households currently served by the sewer network. |
| | **Opportunities and gaps:**<br><br>• Frequent break down and leakages due to old sewerage network and overflow of sewerage network due to illegal drainage connections.<br>• Inefficient sewerage network design and underutilized sewage treatment plants with low methane recovery<br>• Potential users of recycled wastewater are using groundwater due to limited control over ground water extraction.<br>• Ineffective implementation of faecal sludge and septage management action plan<br>• There is an opportunity to opt for anaerobic treatment systems in new STPs and thereby capture methane gas from wastewater and utilise it for energy generation. There is also a possibility to retrofit the existing STPs with secondary treatment technology to improve the current standards of the water quality to a non-hazardous level mandated by WHO after treatment. |
| **Ongoing plans and actions** | • With the support of **GoI's** AMRUT Scheme II, providing UGSS in the wards of 7, 8, 9, 12, 14, 15, 21, 27, 31, 46, 52, 53, 54, 57, 58, 59, 60, 63, 64, 65 and partially in the wards of 28, 29,30, 61, 62 at a cost of Rs 377.29 Crores.<br>• With the support of **GoI's** AMRUT Scheme III, administrative sanction has been provided at the cost of Rs 330.31 Crores for UGSS in wards 37,39,40,41 fully and 35,36,38,42,43,45,52,53,60,63 partially. |

**Climate Risk and BAU GHG emissions scenario**

**BAU GHG Emission:**

| BAU GHG Emissions (Million $tCO_2e$) | | | Share in overall BAU GHG Emissions | | |
|---|---|---|---|---|---|
| 2030 | 2050 | 2070 | 2030 | 2050 | 2070 |
| 0.03 | 0.04 | 0.05 | 1.5% | 1.2% | 1.0% |

**Note:** Projected emissions include those from electricity consumption in municipal wastewater services, as well as emissions from domestic wastewater management and treatment.

**Climate Risk Status: High** | High risk during intense rainfall

- Intense rainfall leads to sewage lines carrying storm water and also mixing with the water supply system. This has severe health implications. This also reduces the treatment capacity.
- Solid waste entering the sewage system due to various openings causes compromised flow and also blockage.

**Potential climate resilience impact from identified interventions (Net Zero Scenario)**

**GHG mitigation potential and indicative cost of interventions:**

| Parameters | Net-Zero Scenario | | |
|---|---|---|---|
| | 2030 | 2050 | 2070 |
| GHG Emissions Reduction from BAU (%) | 78% | 82% | 87% |
| Total cost of Adaptation actions by 2070 (Million INR) | NA | | |
| Total cost of Mitigation actions by 2070 (Million INR) | INR 218 million[45] | | |

**Climate Resilience Impact:**

- Reduces the contamination of groundwater and related health issues.
- Mitigate flooding risks
- Efficient and cost-effective sewage management and enhanced sanitation
- Circular economy through reuse of treated wastewater and reduces the demand for fresh water.
- Reduced direct methane emission from anaerobic treatment plants.

[45] Cost estimated only for Installation of Decentralized Wastewater Treatment System (DeWATs) & Methane Recovery from FSTP plants

| SDGs | **GOAL 3:** Good Health and Well-being, **GOAL 6:** Clean Water and Sanitation, **GOAL 7:** Affordable and Clean Energy, **GOAL:** Industry, Innovation and Infrastructure, **GOAL 10**: Reduced Inequality, **GOAL 11**: Sustainable Cities and Communities, **GOAL 12:** Responsible Consumption and Production, **GOAL 13**: Climate Action, **GOAL 14**: Life under Water, **GOAL 15:** Life on Land |
|---|---|

### 8.3.4.1 Adaptation Strategies for Wastewater Sector

**Goal:** Increase water resilience and foster a circular economy via complete wastewater treatment and reuse.

**Strategy 1: Optimise sewage processing facilities with the latest technology to ensure maximum efficiency and minimum environmental impact and increase the coverage to 100% and use RE powered pumping and lifting equipment.**

| | Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|---|
| 1 | Comprehensive Action Plan and Waste water Reuse and Recycling Strategies (including a Wastewater Reuse and Recycling Policy) | Current wastewater reuse is not done in any industry in Trichy. Reuse of treated wastewater in such industries may reduce dependency on ground water as well as fresh surface water.<br><br>Discussions on socially acceptable wastewater recycling and reuse policy are to be initiated. | **Potential areas for impleme-ntation:** Across city but more in areas where larger industries and institutions are located. |
| 2 | Replace aging sewerage network | **Current Status:**<br><br>Frequent issues of breakdown and leakage are being noted in some parts of the city.<br><br>Proposed projects: Replacement of old sewerage network with new network | **Potential wards for impleme-ntation (receiving high sewage related issues):**<br><br>17, 31, 18, 15, 54, 14, 12, 25, 24, 44, 45<br><br>**Potential beneficiaries:** ~ Citizens living around the location and also downstream due to enhanced continuity of the network. |

| Implementation Entities and Financing Mode | Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| TWAD Board, MAWS Department, Industries Department, DTCP, TCC | INR 5 million for preparation of action plan. | Very high impact, Short to medium term |
| Engineering Department, TCC | **Allocated Budget:** Currently being undertaken under AMRUT 2, and also funding from KfW. | Medium impact, Short term |

| | | | |
|---|---|---|---|
| 3 | **Construct Tertiary Treatment Plants for recycling and reuse of water** | **Current Status:**<br>City is not utilising the secondary treated wastewater (for industrial and irrigation purpose. | City wide scale |
| 4 | **Promote decentralised wastewater treatment and dual plumbing system as indicated in in TNDBCR for projects with 2500m² built up area or more** | As per the current TNDBCR STP is mandatory for all where dwelling units exceeds 50 nos. or 2500 sq.m. of commercial<br>Area only for cities with no piped sewage system.<br><br>This must be made mandatory irrespective of the piped sewage system availability in the city. | Applicable to all new constructions & consider retrospect implementation with future deadline.<br>**Potential beneficiaries:**<br>City scale implementation |

**Strategy 2: Achieve 100% Sludge and Septage Management**

| | | | |
|---|---|---|---|
| 1 | **Faecal sludge management action plan** | **Current Status**:<br><br>Sewage in 34% (114901 households) of the city area is managed via septage management. Sludge is being collected by private contractors and dumped in 3 authorised locations of TCC. | Newly merged areas in Ariyamangalam, Puratiyur, Vayalur |

| | | |
|---|---|---|
| Engineering Department, TCC | **Not estimated** | Very high impact, Short term |
| Engineering Department, TCC, DTCP, MAWS, Housing & Urban Development | Not estimated | High impact, Medium term |

| | | |
|---|---|---|
| Engineering Department, TCC | **Budget Requirement:** INR 5 million | Medium impact, Medium term |

### 8.3.4.2 Mitigation Strategies for Wastewater Sector

Targets:

- 35%, 50% & 880% of wastewater facilities adopt energy efficiency pumps by 2030, 2050 & 2070.
- 100% of new plants use anaerobic treatment with methane gas capture and reuse.

**Strategy 1: Transition to low-carbon technologies in all wastewater treatment processes.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1<br>**Implement energy efficiency in wastewater pumping**<br><br>**Adopt solar and wind power with net metering in wastewater treatment facilities with electricity connections** | All new pumps to be energy efficient pumps<br><br>**Estimated capacity/size Solar:**<br>**2030:** 20% of demand<br>**2050:** 40% of demand<br>**2070:** 60% of demand | Engineering Department, TCC<br>**Financing mode:** Municipal budget, ESCO model with private sector investment, MDB Funding<br><br>Engineering Department, TCC, TNGECL, TNERC, Technology providers<br>**Financing mode:** Municipal budget; RESCO model with private sector investment; 15[15] Finance Commission, MDB Funding. |

**Enabling Actions:**

- Adopt financing mechanisms such as Energy Performance Contracting for pump replacement through agencies such as EESL.
- Assess LT/HT load in wastewater treatment for assessing the scale of net metering and captive RE power plants.

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| Not estimated. | Very High; Short-term |
| **Solar:**<br>**2030:** INR 33 million<br>**2050:** INR 81 million<br>**2070:** INR 139 million | Very High; Short to mid-term |

- TCC may request TNERC to allow RE power banking for one year instead of monthly cycle. This can improve financial viability for RE.
- Assess benefits and scale of battery energy storage deployment along with renewable energy.
- Explore collaboration with TANGEDCO/TNGECL to deploy RE power plants while also contributing to their renewable energy goals

**Strategy 2: Implement state-of-the-art sludge treatment and recycling techniques to minimise waste and environmental hazards.**

| | Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|---|
| 1 | **All new wastewater treatment plants to use anaerobic treatment systems with dual membrane technology for biogas capture** | 100% of all new treatment plants to use anaerobic system with biogas capture technology: | Engineering Department, TCC, Technology providers<br>**Financing mode:** Municipal budget; PPP with private sector investment and sale of biogas to industries for replacing other lesser clean fuel types.; AMRUT 2.0.<br>Hybrid Annuity Model as adopted by Tamil Nadu Water Investment Company (TWIC) in the current plant at Panjapur in Trichy. |
| 2 | **Improve the efficiency of treatment and the operating performance of aerobic treatment facilities.** | Extent of aerobic treatment capacity targeted for improvements:<br>**2030:** 100% of aerobic capacity<br>**2050:** 100% of aerobic capacity<br>**2070:** 100% of aerobic capacity | Engineering Department, TCC, Technology providers<br>**Financing mode:** Municipal budget; AMRUT 2.0. |

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| Total required budget by 2070 for an additional 112.88 MLD plant: INR 2200 million[46] | Very High; Mid-term |
| Not estimated. | Very High; Short-term |

[46]Estimated based

| | | |
|---|---|---|
| 3 **Action plan for faecal sludge management to review baseline and make suggestions** | FSM Plan to include newly merged areas especially Ariyamangalam, Puratiyur, Vaiyalur | Engineering Department, TCC<br>**Financing mode:** Municipal budget |

## Enabling Actions:

- TCC will automate Wastewater Treatment Processes to guarantee plants operate at peak efficiency.
- TCC will put an SOP and undertake monitoring of Sewage Flows Regularly with catchment analyses and real-time data to optimise treatment plant intake.
- TCC will set and govern Minimum Operating Standards for wastewater treatment plants, utilising automated systems for information sharing among officials.

| | |
|---|---|
| INR 5 million required as noted in sub-section on Adaptation actions | High; Mid-term |

- TCC will Evaluate Treatment Plant Efficiencies to identify improvement opportunities in operations and pumping systems.
- Create a Policy for Sustainable Treatment Solutions by encouraging the adoption of anaerobic or decentralized systems and utilizing generated gas/electricity.

## 8.3.5 Storm Water

| | |
|---|---|
| **Baseline status (2021) Stormwater** | **Key statistics:**<br>• Inadequate micro drainage along the Uyakondan, Koraiayar and Cauvery banks. Also drains are unable to handle cloud burst events beyond 43mm in the city.<br>**Opportunities and challenges/gaps:**<br>• Illegal waste dumping in drains and low longitudinal profile in several drains leads to siltation and clogging of flows.<br>• Backflow protecting shutters have helped prevent backflow during high flow in river Cauvery. |
| **Ongoing plans and actions** | • From TCC's capital budget an amount of 50 Lakhs has been provided per ward to build drains in the budget of 2023-24.<br>• Interconnect the 13 water bodies (Annexure H - Table H6) in the TCC area to manage flood flow. |
| **Climate Risk and BAU GHG emissions scenario** | **Climate Risk Status:** High \| High risk during high intensity rainfall<br>• High intensity rainfall causes water logging issues, especially in low lying areas, and can lead to health hazards like water and vector borne diseases |
| **Potential climate resilience impact from identified interventions (Net Zero Scenario)** | Total Indicative Cost of Interventions:<br>**Total cost of adaptation actions (Million INR)**<br>INR 23746.57 Million[47] (for providing SWD in 48% of roads)<br>Cost of Interlinking INR 994.5 million[48]<br>**Climate Resilience Impact:**<br>• Preventing backflow during high water flows in river Cauvery will reduce riverine floods from causing damages.<br>• Increased water holding capacity of water bodies will increase adaptation capability of the city. This will also reduce temperature in the city and also improve the ground water level. |

[47]Note: Estimated at INR 35000/m based on ADB and Singara Chennai 2.0 Project
[48]Note: Estimated at INR 3.06 Cr/ km based on projects in Chennai at 2.5 average distance between the water bodies.

| SDGs | **GOAL 3:** Good Health and Well-being, **GOAL 6:** Clean Water and Sanitation, **GOAL 7**: Affordable and Clean Energy, **GOAL 11:** Sustainable Cities and Communities, **GOAL 12**: Responsible Consumption and Production, **GOAL 13:** Climate Action; **GOAL 14:** Life Below Water |
|---|---|

### 8.3.5.1 Adaptation Strategies for Stormwater Sector

**Goal:** Make the city resilient to urban flooding

**Strategy 1: Implement sustainable urban planning practices to reduce runoff and prevent urban flooding.**

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1<br>**Watershed evaluation and development of a conservation and augmentation strategy for water resources** | **Current Situation:**<br>Several urban flood points in Trichy are due to lack of consideration of natural contour during the planning phase.<br>**Proposed Action:**<br>Standard Operating Procedure (SOP) to consider natural contours based on watershed assessment may be added into the SOP Roads and town planning schemes. TCC shall indicate in planning maps about the vulnerability level of the various parts of the city. | In area where new planning permission is being accorded. |
| 2<br>**Protect and improve natural drains** | **Proposed Action:**<br>Trichy will try to recover and maintain the original natural drains found in the 1970 topographic map of the city. | Across the city.<br>**Potential beneficiaries:**<br>City wide benefit (people living along the banks of these natural drains will get direct benefits) |

| Implementation Entities and FinancingMode | Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| Engineering Department, TCC | **Budget Requirement:** INR 20 million[49] | Very high impact, Medium term |
| Engineering Department, TCC | Not estimate | Medium impact, Short term |

[49]Based on rates of similar studies done by TNUIFSL for other Corporations in TN

3

**Capture surface runoff through recharge pits / natural swales / hybrid ditches**

**Current Situation:**

TCC is already practicing the installation of recharge pits one every 30m in the storm water drains.

**Proposed Action:**

Build water retention pits on nearby OSR land and lint with SWD and create natural flows to improve ground water level.

Across city

**Potential beneficiaries:**
Low lying areas near the bank of the canals and river.

Traffic junctions impacted by floods

4

**Build Tree Box Filters and Permeable Pavement on Footpaths**

**Proposed Action:**

- Implement porous/permeable pavements and tree box filters to increase green cover and permeable surfaces, resulting in groundwater recharge and retention of runoff.
- Inclusion in the 'Standard Operating Procedure for Road Construction'.

**Potential wards:**

All the major roads in each ward and all the roads where footpaths are available currently.

Areas where canals are along the roads.

**Potential beneficiaries:** City wide implementation

5

**Desiltation and Maintenance of Existing Water Bodies**

**Proposed projects**
Increase and maintain the capacity of the 13 water bodies in the TCC area.

**Locations:**
13 water bodies in the TCC area.

**Beneficiaries:** City wide, but mostly areas within 500m buffer of these water bodies.

| | | |
|---|---|---|
| Engineering Department, TCC<br>**Climate Finance Sources accessible through MoEF&CC:** Adaptation Fund; Green Climate Fund and Global Environment Facilities (GEF) | Not estimated | High impact, Short to medium term |
| Engineering Department, TCC | Not estimate | High impact, Short term |
| Engineering Department, TCC<br>**Climate Finance Sources accessible through MoEF&CC:** Adaptation Fund; Green Climate Fund and Global Environment Facilities (GEF) | Not estimated | Medium impact, Short term |

| | | |
|---|---|---|
| 6<br>**Construct percolation wells in areas susceptible to urban flooding and in lake beds** | **Proposed Action:**<br>recharge wells in the city at all the 234 parks and OSR land. Focus more on flooding areas with low-lying topography and water-cul-de-sacs. | **All the parks and OSR in the city.**<br>**Potential beneficiaries:**<br>city wide itmplementation |

**Strategy 2: Achieve 100% SWD coverage and construct stormwater systems to manage projected cloud-bursts and fully restore historic natural drainage paths.**

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1<br>**Improve the coverage of storm water drainage networks in areas prone to flooding.**<br>**Sub-actions:**<br>• Augment storm water drainage network and pumping stations<br>• Construct and maintain culverts and outfalls.<br>• Deployment of flood sensors and developing an early warning system for urban floods | **Current Status:**<br>Storm water coverage in the city is very less. Flooding is also observed in the area where the stormwater network is available.<br>**Proposed project:**<br>Increase storm water network coverage.<br>Rebuild broken storm water drains. | Areas near the banks of the channels<br>**Other potential wards (impacted with flooding issues):** Ward numbers 28, part of 2, 27, 21, part of 17, part of 31, part of 33, part of 53, 52 and part of 30. |

| | | |
|---|---|---|
| Engineering Department, TCC<br><br>PPP mode through Corporate/ Environment Social Responsibility and schemes of GoTN like Nammaku Namme. | **Allocated Budget:** INR 40 million[50] proposed for 200 percolating wells in FY 2023-24 | High impact, Short term |

| Implementation Entities and FinancingMode | Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| Engineering Department, TCC | **Allocated Budget:** INR 5 million provided under Municipal Budget 2023-24 per ward for all 65 wards. | Medium impact, Short to medium term |

[50] Estimated at Rs 0.2 million INR per percolation well

## 8.3.6 Solid Waste

**Baseline status (2021) Solid Waste**

**GHG emissions:** 0.05 million $tCO_2e$ (3.6% of GHG emissions)

**Key statistics:**

- Per Capita Generation: 0.435 grams/day
- Total waste generation: 470 MT; ~90-95% door to door collection
- C&D Waste: 25 TPD
- Waste Processing Capacity: 216 TPD
- Waste Composition: Food waste (52.00%), Garden (1.00%), Paper (0.25%), Wood and straw (0.10%), Textiles (6.00%), and Rubber (0.15%).
- Waste going to dumpsite: 38% of collected waste

**Opportunities and challenges/gaps:**

- Lack of segregation at source leads to inefficient recycling and treatment
- Awareness campaigns by TCC for source segregation and promoting reduce, recycling and reuse to promote circular economy.
- During festival season, in Srirangam, the waste collection, transportation and processing is a huge challenge. The generation and collection deficiency are on the order of three times during these days (20 days/ year).
- Littering of solid waste on road; blocks sewerage and stormwater drains during extreme rainfall.

**Ongoing plans and actions Climate Risk and BAU GHG emissions scenario**

- GoI's Swachh Bharat Mission 2.0[51] supporting solid waste management infrastructure.

**BAU GHG Emission:**

| Sector | BAU GHG Emissions (Million $tCO_2e$) | | | Share in overall BAU GHG Emissions (%) | | |
|---|---|---|---|---|---|---|
| | 2030 | 2050 | 2070 | 2030 | 2050 | 2070 |
| **Solid Waste** | 0.05 | 0.08 | 0.11 | 2.5% | 2.3% | 2.4% |

**Climate Risk Status:** High | High risk during high temperature and high intensity rainfall

- Drainage network blockages increase during periods of high rainfall.
- Increased temperature accelerates decomposition rates and creates potentially hazardous conditions in open dumpsites by increasing the probability of dumpsite fires.
- Land, surface water and groundwater are contaminated due to increased leachate flows from the open dumpsite.

[51] Swachh Bharat Mission 2.0. Accessed March 2024.

**Potential climate resilience impact from identified interventions (Net Zero Scenario)**

GHG mitigation potential and indicative cost of interventions:

| Parameters | Net-Zero Scenario | | |
|---|---|---|---|
| | 2030 | 2050 | 2070 |
| GHG Emissions Reduction from BAU (%)[52] | 120% | 126% | 149% |
| Total cost of Adaptation actions by 2070 (Million INR) | Not estimated | | |
| Total cost of Mitigation actions by 2070 (Million INR) | INR 1,838.79 million | | |

Climate Resilience Impacts:

- Revenue generation through Reduce, Recycle and Reuse
- Higher resource efficiency and circular economy
- Reduced air pollution and improved public health.

**SDGs**

**GOAL 3:** Good Health and Well-being, **GOAL 6**: Clean Water and Sanitation, **GOAL 7:** Affordable and Clean Energy, **GOAL 9:** Industry, Innovation and Infrastructure, **GOAL 11:** Sustainable Cities and Communities, **GOAL 12:** Responsible Consumption and Production, **GOAL 13:** Climate Action; **GOAL 15:** Life on Land

[52] Note: The reduction % is higher than 100 as the processing creates additional energy and a significant part of the waste does not reach the dumpyard.

## 8.3.6.1 Adaptation Strategies for Solid Waste Sector

**Goal:** Advance towards a zero-waste urban environment.

**Strategy 1: Achieve near-zero waste by drastically reducing waste generation and enhancing recycling programs and adopt the principles of 3R's (Reduce, Reuse and Recycle)**

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1<br>**Towards Zero waste wards:**<br>**Sub Actions**<br>• IEC to popularize circular economy principles and source segregation.<br>• Waste Reduction strategies: lifestyle changes and related IEC<br>• Prevention of littering Decentralised dry waste collection centres: recyclables, C&D waste, and e-waste | **Current Status:**<br>Littering of waste blocks sewerage and stormwater drainage networks during the rainy season and increases risks of flooding.<br>**Projects Implemented by TCC:**<br>**Awareness Campaign:** IEC and Awareness campaign by TCC in partnership with several CSOs<br>**Waste collection centre:**<br>C&D waste and E-waste collection centres in city | **City wide initiative**<br>**Potential benefici aries:** City wide benefits |
| 2<br>**Towards zero plastic waste**<br>• Plastic value chain analysis,<br>• Ban Single Use Plastics and promote alternatives,<br>• Maximise recovery and recycling of plastic and other dry waste,<br>• Incentivise private/cooperative buy-back initiatives | **lProjects Implemented by TCC:**<br>• Drive against single use plastic<br>• Material Recovery Facilities (MRF) operationa | City wide initiative |

| Implementation Entities and FinancingMode | Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| TCC, CSOs, Academia, Business Bodies, Facility Managers of Institutions | **Budget Allocated for Awareness and IEC:** approx. INR 20 million in FY 2023-24 from capital budget allocation<br><br>**Budget required:** Budget to be estimated on a continuous basis based on adherence to outcomes. | Very high impact, Short term |
| TCC, TNPCB (EPR) | Implementation on PPP. | Medium impact, Short term |

| | | |
|---|---|---|
| 3 **Promote eco-parks: MRFs, manufacturers of alternate material, and recyclers.** | **Proposed Actions:**<br>• Framework to formalise rag pickers to be developed.<br>• Land allocation to develop eco-parks with support from private players.<br>• Incentivisation and enabling framework for eco-parks to be developed<br>Achieve 8%, 15% & 25% recycling rates by 2030, 2050 and 2070. | Not identified |
| 4 **Legacy waste management** | **Implemented by TCC:**<br>It is estimated (as per SBM 2.0 Action Plan) that Ariyam-angalam dumpsite currently has 3.32 lakh cubic meters of legacy Municipal Solid Waste with an average dump height of 6-7 meters above ground. The daily waste receipt stands at 398 TPD. About 7.76 lakh cubic meters of legacy waste has already been bio-mined by TCC. | Location: Ariyam-angalam dumpsite |

[53]As indicated in SBM 2.0 Action Plan

| | | |
|---|---|---|
| TCC, Material Manufacturers/ Consumers | Not estimated | Very high impact, Medium term |
| TCC, Services Providers under PPP mode | Budget Required: INR 250 million[53] | Very high impact, Short term |

### 8.3.6.2 Mitigation Strategies for Solid Waste Sector

**Target:** 100% segregated waste collection and 100% scientific waste processing, treatment and disposal by 2030

**Strategy 1: Achieve 100% source segregation and 100% waste collection system with minimal emissions footprint.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1  **100% segregation of waste and enhance primary and secondary collection systems** | 100% waste segregation and 100% collection efficiency by 2030. | TCC, CSOs, MAWS Department<br>**Financing mode:** Municipal budget; Swachh Bharat Mission 2.0; PPP mode via TNIDB |
| 2  **Develop an updated comprehensive solid waste management strategy**. | TCC has prepared a action plan for SWM under SBM 2.0. | TCC, CSO's, Service provider, MAWS Department<br>**Financing mode:** Municipal budget; Swachh Bharat Mission 2.0; |

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| Total required budget by 2070: INR 200 million[54] (waste collection) | High; Short-term |
| INR 5[55] million | High;<br>Short term |

[54] Based on PMU Inputs to convert fleet to e-Collection Vehicles
[55] Based on information from SBM PMU

**Strategy 2: Develop facilities for environmentally friendly and scientific waste processing and disposal.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1 **Increase composting capacity by utilising both centralised and distributed facilities.** | 100% waste processing and treatment by 2025 and beyond | TCC, CSO's, Service provider, MAWS Department<br><br>Financing mode: Municipal budget; Swachh Bharat Mission 2.0; |
| 2 **Deploy waste to bio-CNG plants for wet waste and produce renewable fuel from waste** | 100% waste processing and treatment by 2030 and beyond<br><br>Estimated capacity/size:<br><br>**2030:** 12% of MSW<br>**2050:** 20% of MSW<br>**2070:** 25% of MSW | TCC, CSO's, Service provider, MAWS Department<br><br>**Financing mode:** Municipal budget; Swachh Bharat Mission 2.0; MNRE Waste to Energy Programme; PPP with private sector investment and revenue from putting bio-CNG to gas grid; Support from multilateral financing institutions; Sale of carbon credits under Article 6.2 of Paris agreement |

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| INR 30 million / 25 TPD[56] plant - Expected to be INR 44.49 million by 2070 | High; Short-term |
| Project to be implemented on PPP basis, where capital expense is done by project developer | High;<br>Short term |

[56] Based on the SBM 2.0 Action Plan

| | | | |
|---|---|---|---|
| 3 | **Bio-Methanation** | 100% waste processing and treatment by 2030 and beyond<br><br>**Estimated capacity/size:**<br><br>2030: 8% of MSW<br><br>2050: 15% of MSW<br><br>2070: 25% of MSW | TCC, CSO's, Service provider, MAWS Department<br><br>**Financing mode:** Municipal budget; Swachh Bharat Mission 2.0; MNRE Waste to Energy Programme; PPP with private sector investment and revenue from putting bio-CNG to gas grid; Support from multilateral financing institutions; Sale of carbon credits under Article 6.2 of Paris agreement |
| 4 | **Sanitary landfill for the scientific disposal of inert materials and industrial rejects. A landfill gas collecting system to be installed at the dump.** | Effective, scientific and safe disposal of solid waste and gas capturing.<br><br>**Proposed Plan:**<br>TCC owns a larger 570-acre site at Panjapur village, including a Sewage Treatment Plant (STP) designated for future development into a compost yard and landfill site. | TCC, CSO's, Service provider, MAWS Department<br><br>**Financing mode**: Municipal budget; Swachh Bharat Mission 2.0 |

## Enabling Actions:

- Identify gaps and strengthen primary collection to ensure 100% door-to-door collection of segregated waste.
- Ensure effective street sweeping and cleaning.
- Conduct IEC and community engagement activities to promote waste minimization, effective segregation, home composting.
- Establish recognition mechanisms, incentives and tax rebates at household and community-level.

| | |
|---|---|
| Project to be implemented on PPP basis, where capital expense is done by project developer | High; Short term |
| Not estimated | High, Short to mid-term |

- Strengthen implementation of 3R (Reuse, Reduce, Recycle) practices and recovery of recyclables at the city-scale.
- Enhance secondary storage, collection and transport of solid waste.

  -Upgrade transfer stations with pre-sorting facilities

  -GPS enabled route rationalisation of solid waste vehicles to optimize fuel use.
- Enforce measures and regulation to minimise unscientific handling and processing of plastic, electronic waste and C&D waste and establish mechanisms for their processing

## 8.3.7 Urban Greening & Biodiversity

| | |
|---|---|
| **Baseline status (2021) Greening and Biodiversity** | **Key statistics:**<br>• TCC has a tree cover (dense canopy) of 1.06 sq.km.<br>• Trichy already has 10.67 sq.m of green cover per person which is greater than the WHO recommended minimum of 9 sq.m per person.<br>**Opportunities and challenges/gaps:**<br>• Increase in impermeable areas due to increase in built up and limited consideration for green cover during the planning phase. |
| **Ongoing plans and actions** | • Under the Smart City Mission scheme, Trichy City developed 21 parks (out of 234) at a cost of Rs. 157.1 million, further enhancing its urban greenery.<br>• As part of the Jal Shakti Abhiyan initiative, 21,864 saplings have been planted. This will increase the green cover by 60,422 sq.m. |
| **Climate Risk and BAU GHG emissions scenario** | **Climate Risk Status:** High \| High risk during high temperature and high intensity rainfall due to impermeable areas<br>• Extreme heat conditions increase the heat island effect in the densely populated areas, while intense rainfall may create urban flood situations due to limited permeable areas. |
| **Potential climate resilience impact from identified interventions (Net Zero Scenario)** | **After exploring all the alternatives in the Climate Action strategies, TCC will consider using the potential of carbon reduction from Carbon sequestration.**<br>**Climate Resilience Impact:**<br>• Reduced effects of heat island, flood mitigation, improved air quality, improved groundwater table<br>• Improved health of existing natural ecosystems<br>• Increased carbon sequestration |
| **SDGs** | **GOAL 3:** Good Health and Well-being, **GOAL 6:** Clean Water and Sanitation, **GOAL 11**: Sustainable Cities and Communities, **GOAL 12:** Responsible Production and Consumption, **GOAL 13**: Climate Action, **Goal 14:** Life Below Water, **GOAL 15**: Life on Land |

### 8.3.7.1 Adaptation Strategies for Urban Greening & Biodiversity

Goal:

- Increase Blue-Green Infrastructure to improve climate resilience.
- Reduce heat stress through enhanced adaptive measures.
- Enhance the green cover to improve the potential of carbon sequestration.

**Strategy 1: Transform the cityscape with extensive native green spaces that have native species to ensure sustainability and improve ecosystems (including river/lake & ponds).**

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1 **Increase additional plantation in wards that are exposed to urban heats.** | Proposed Action:<br>Substantially increase the green cover in wards where severe heat stress is experienced through plantation of native species.<br>Park Redevelopments / Improvements at the cost of INR 16.53 million. This will increase the green cover and also the carbon sequestration potential of TCC. Care needs to be taken to focus on native floral species.<br>TCC will actively work with private enterprises under the CSR programme for afforestation projects. | Potential Wards: 36, 2, 22, 61, 47, 56 (Western Part), 25 and 24 |

**Strategy 2: Establish diverse microhabitats across the city to promote and preserve rich biodiversity (including river/lake & ponds).**

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1 **Prepare Local Biodiversity Strategies and Action Plan (LBSAP)** | Current Status:<br>No assessment of ecosystems and their health has been undertaken yet. | City wide |

| Implementation Entities and Financing Mode | Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| TCC | Not estimated | High impact, Short to medium term |

| Implementation Entities and Financing Mode | Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| TCC | **Budget Requirement:** INR 2 million | High impact, Short term |

| | | |
|---|---|---|
| **Sub-Actions**<br>• City wide assessment to document the critical ecosystems, their present health status and the threats faced by them. Risk assessment study of invasive alien species in major natural ecosystems of the city (including river, lake and ponds).<br>• Development of a strategy and action plan (including water bodies & lake ecosystems) to improve the health of the critical ecosystems. targeted action plans for identified species and risks | | |
| 2<br>**Develop micro-habitats in existing urban green spaces such as pollinator gardens, grasslands/scrublands** | **Proposed Actions:**<br>• Develop a Natural Asset Map<br>• Identify areas, with expert support where pollinator gardens, grasslands etc can be developed.<br>• Develop the micro-habitats, with focus on native species. | **City wide initiative**<br>(potential location may be identified based on feasibility and expert opinion) |
| 3<br>**Partnering with institutions to develop green corridors that link the city's green ecosystems** | **Proposed Actions:**<br>• Identify institutional and public areas for greening along with native flora species.<br>• Establish city-level nurseries in collaboration with the Department of Urban Forestry (is this in the State Forest Department)?<br>• Coordinate with partners and institutions to develop green corridors | • **City wide initiative**<br>(potential location may be identified based on feasibility and expert opinion) |

| | | |
|---|---|---|
| | | |
| TCC, Forest Department,<br><br>Financing<br>• 15th FC and National Clean Air Programs; Nagar Van Scheme of MoEF&CC<br>• CSR/ESR may be promoted for this initiative | Not estimated | Very high impact, Medium term |
| TCC, Trichy Smart City Forest Department, CSO's<br><br>• 15th FC and National Clean Air Programs; Nagar Van Scheme of MoEF&CC<br><br>• CSR/ESR may be promoted for this initiative | Not estimated | Very high impact, Medium term |

## 8.3.7.2 Mitigation Strategies for Urban Greening & Biodiversity

**Target:**

- Trichy already has above 9 sq.m per person green cover. However, Trichy will work to substantially increase this in areas that are vulnerable to extreme heat stress.

**Strategy 1: Maximize carbon absorption (carbon sink) by expanding urban forests and creating green corridors.**

| Actions | Detailed Targets | Implementation Entities and Financing Mode |
|---|---|---|
| 1<br>**Increase green cover by using appropriate tree species to leverage carbon sequestration potential** | TCC has a tree cover (dense canopy) of 1.06 sq.km.<br>**Targeted additional green cover in wards with high heat stress:**<br>**2030:** 2 sq. km/ ward<br>**2050:** 2.5 sq. km/ ward<br>**2070:** 3 sq. km/ ward | TCC, Forest Department, TN Biodiversity Board<br>**Financing mode:** Municipal and State budgets; Corporate Social/ Environment responsibility; National Clean Air Program; Nagar Van scheme of MoEFCC, TNGCC |

**Enabling Actions:**

- Identify native tree species with high carbon sequestration potential and integrate into greening programs.
- Tap into CSR funding from corporate houses
- Adopt public adoption scheme for tree

| Total Indicative Cost by Timeline | Climate Resilience Benefits and Period to Realize Impact |
|---|---|
| Not estimated | High; Short-term |

- Explore the possibility of converting large OSR land into Miyawaki forests to increase carbon sequestration potential in short time.
- Make it mandatory for real estate developers to develop areas equal to their construction space as green areas.
- Amend TNDBCR 2019, to mandate creation of green spaces for every new development in the city limit.

## 8.3.8 Air Quality

| | |
|---|---|
| **Baseline status (2021) Air Quality** | **Key statistics:**<br>• Average monthly concentration of PM10 (2019-21)[57] varies from 16 µg/m3 to 86 µg/m3<br>• Road dust is the highest contributor to $PM_{10}$ emission followed by construction activities.<br>**Opportunities and challenges/gaps:**<br>• Trichy is a NCAP city and receives funding to improve its air quality.<br>• One of the cities receiving support under 15th Finance Commission support<br>• TCC initiated air quality awareness and enforcement to reduce air pollution as part of its Action Plan<br>• Trichy has seen a significant spike in the private vehicle usage. |
| **Ongoing plans and actions** | • 15th Finance Commission supporting betterment of air quality in the city.<br>• Action Plan under NCAP.<br>• Micro level strategy has been proposed as part of the Action Plan prepared by the city. |
| **Climate Risk and BAU GHG emissions scenario** | **Climate Risk Status: High \|** High air pollution and related health issues<br>• High feel like temperature in air polluted areas, may impact on public health |
| **Potential climate resilience impact from identified interventions (Net Zero Scenario)** | **Total Indicative Cost of Interventions:**<br>**Total cost of mitigation and adaptation actions (Million INR)**<br>Not Applicable<br>**Climate Resilience Impact:**<br>• Reduced air pollution and related health issues<br>• Reduced urban heat island impact. |
| **SDGs** | **GOAL 3:** Good Health and Well-being, **GOAL 11:** Sustainable Cities and Communities, **GOAL 12**: Responsible Consumption and Production, **GOAL 13:** Climate Action; **GOAL 15:** Life on Land |

[57]Average PM10 concentration in Trichy. Accessed March 2024

### 8.3.8.1 Adaptation Strategies for Air Quality

**Goal:**

Adopt a comprehensive strategy to ensure cleaner air and a healthier environment, in alignment with the National Clean Air Program objectives by 2025.

**Strategy 1: Implement strict emissions standards and promote zero-emission vehicles city-wide.**

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1<br>**Ensure strict monitoring of old vehicles.**<br>**Sub-Actions:**<br>• PUC checking drive.<br>• Fuel adulteration drive | **Proposed Actions:**<br>Regular checking of vehicular emission and issue of Pollution under Control Certificate (PUC)<br>At present 17 PUC centres are available and PUC centres numbers will be increased to meet the demand for the issue of PUC certificates.<br>Checking of fuel adulteration | **Potential Locations:**<br>City wide initiative |
| 2<br>**Awareness and Incentives for scrapping of 15 years old vehicles**<br>**Sub-Actions:**<br>• Provide scraping yards.<br>• Awareness and IEC<br>• Incentives for scrapping and procuring cleaner fuel vehicles | Proposed Actions<br>Retrofitting of particulate filter in diesel driven vehicles and ban on registration of Diesel driven auto rickshaws.<br>Restriction on plying and phasing out of 15 years old commercial diesel drive vehicles | City wide initiative |

| Implementation Entities and Financing Mode | Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| Transport Department and Police Department and Traffic Police<br><br>District administration, Oil companies, Food and Civil Supplies department. | Not estimated | Very High impact, Short term |
| Transport Department/ District Collector | Not estimated | Very high impact, Medium term |

**Strategy 2: Enforce rigorous pollution control measures in all construction projects to minimize dust and debris.**

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1 **Good Construction Practises Policy at the City Level** | **Proposed Actions:**<br>Identify road stretches with high dust generation and Increase frequency of mechanised clearing of road and sprinkling of water on paved and unpaved roads. Stringently enforce rules for dust control in construction activities and close non – compliant sites.<br><br>Transportation of construction materials like sand, soil, stone chips etc in covered conditions.<br><br>Restriction on storage of construction materials along the road. | City wide initiative<br>**Potential beneficiaries:** City wide (particularly people living in areas where construction is in progress) |

**Strategy 3: Require industries to adopt advanced pollution control technologies and switch to cleaner production methods.**

| Strategy and Actions | Status and Ongoing/ Planned Initiatives | Potential Locations and Beneficiaries |
|---|---|---|
| 1 **Strict enforcement of pollution mitigation equipment and fuel switches in industries** | Proposed Actions:<br><br>Ensuring emission standards in industries (as applicable by TNPCB norms)<br><br>Adoption of cleaner technology in brick kilns[58]<br><br>Shifting of polluting industries. Ban on polluting industries. | **Potential areas:**<br>Industrial areas |

[58] Trichy NCAP Action Plan recommends that all brick kilns be relocated beyond 50m of the city limits.

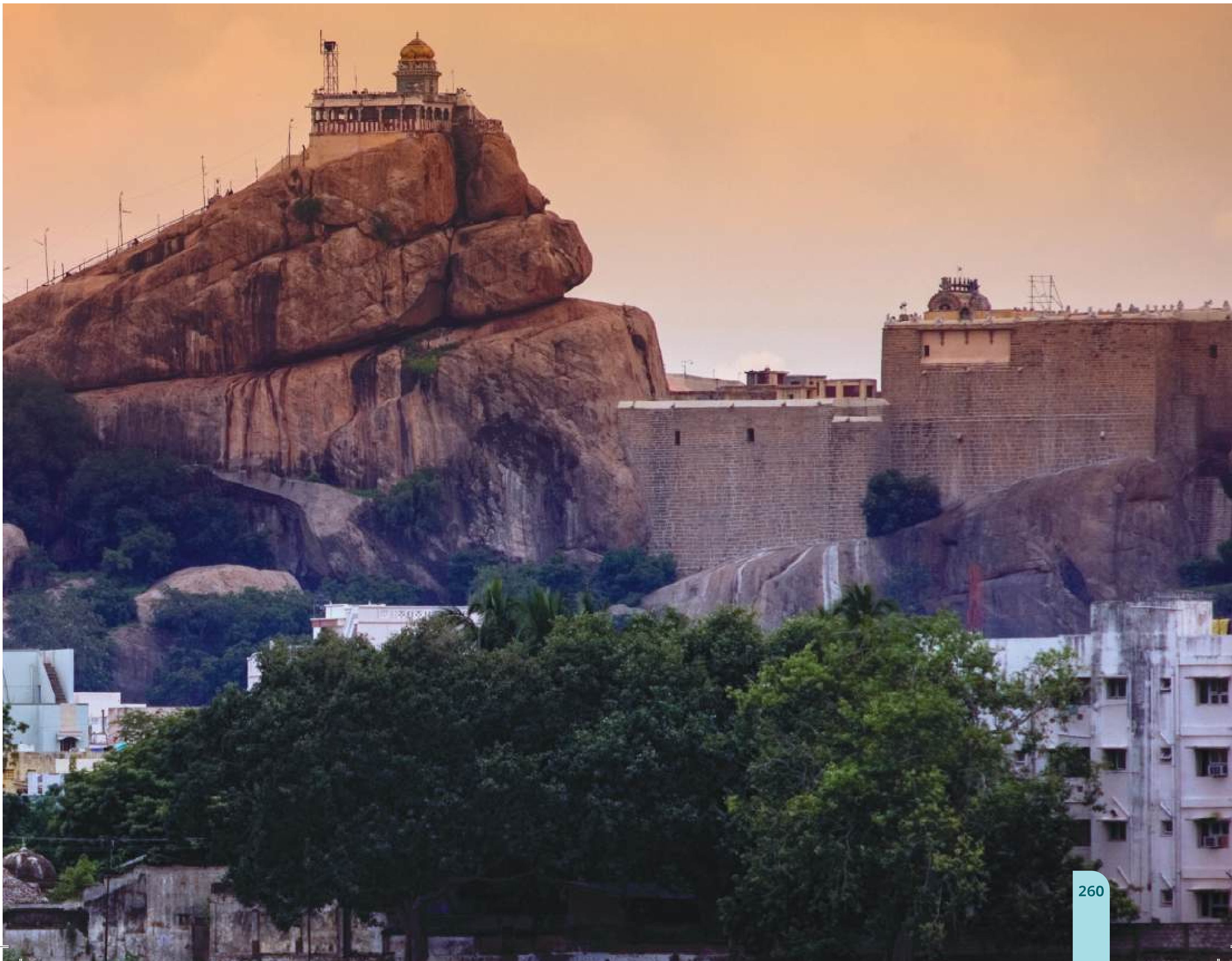
| Implementation Entities and Financing Mode | Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| TCC, Transport Department, Builders Association, Traffic Police | Not estimated | High impact, Short term |

| Implementation Entities and Financing Mode | Indicative Cost | Climate Resilience Benefits and Period to Realize Impact |
|---|---|---|
| TNPCB, District Industries Center, TCC, Industries Department | Not estimated | Very high impact, Short to medium term |

## Enabling Actions:

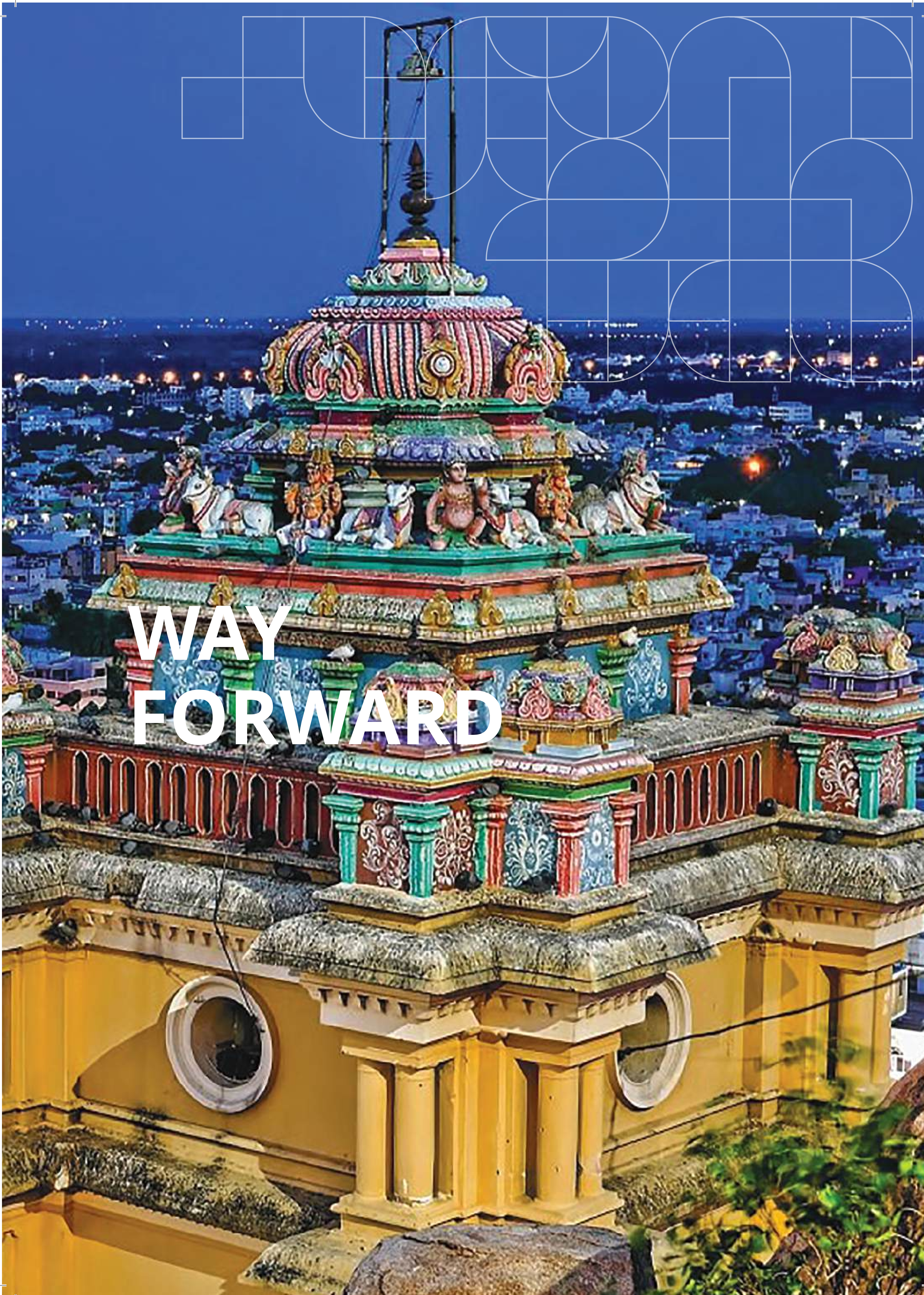
- Install Monitoring Cameras: Set up cameras that can automatically recognise number plates to identify old vehicles that pollute too much.
- Educate Vehicle Owners: Run campaigns to teach people about the benefits of getting rid of polluting vehicles.
- Use Media: Use TV, radio, and social media to explain the bad effects of old cars on health and the environment.
- Incentivize Transition to Electric Vehicles: Provide money back or discounts to those who scrap their old cars and buy cleaner ones.
- Industry Audits: Regularly check industries in collaboration with TNPCB, District Industry Centre (DIC) to make sure they maintain and use their pollution control equipment correctly. Support of the MSME department can be taken to scale the impact further.

- Advanced Monitoring: Use drones or satellites to keep an eye on industrial pollution more efficiently and cheaply. Support of institutions Institute of Remote Sensing (IRS), Anna University can be taken to achieve this on a sustainable basis.
- Tough Penalties: Set high fines or stop operations for those who don’t follow the rules.
- Involve Everyone: Bring in experts, groups, and the public to help make better policies.
- Work with Universities: Collaborate with universities like NIT Trichy, Anna University, IIT Madras and research centres to develop new ways to control pollution and support in piloting and scaling the same.



# 09

# WAY FORWARD



09

# WAY FORWARD

Trichy's Net-zero - Climate Resilient City Action Plan (Net-zero CRCAP) aims for net zero emissions by 2070, which was developed through meticulous inter-departmental coordination and stakeholder engagement. To achieve its ambitious climate goals, Trichy will focus on governance, climate data management, and mechanisms for monitoring, reporting, and verification (MRV), alongside capacity building, community engagement, and securing financing for climate actions. The Trichy City Corporation (TCC) emphasises a robust governance framework to ensure the effective implementation of these crucial components. This chapter mentions the various actionable steps TCC will consider to implement the strategies mentioned in Chapter 08 and address the multiple barriers to achieving net zero in Trichy.

## 9.1 Addressing Governance, Vision & Policy

To enhance its climate governance, vision and integrated policy making to effectively tackle the changes due to climate change and achieve the strategies mentioned in Chapter 89 and reach net-zero by 2070.

- **Strengthen the Climate Core Committee (CCC) & Broaden the Responsibilities & Establish a Climate Change Department:**
  The climate core team has already been created in TCC under the leadership of the Commissioner. TCC will consider allocating a budget to the CCC to help implement some of the cross-cutting projects especially on the policy side from the strategies and actions mentioned. Beyond strategy development & project implementation, the CCC will engage in research, stakeholder liaison, awareness campaigns, secure funding, and represent Trichy in climate forums. TCC will also consider the formation of a Climate Change Department, that will be the focal point of all mitigation and adaptation actions proposed in this Net-zero CRCAP and also work closely with other departments where necessary.

- **Form a High-Powered Steering Committee:**
  TCC recognises that several projects and actions proposed in this Net-zero CRCAP require cross-department collaboration with not only other agencies at city level but also state agencies. TCC will consider creating a high-powered committee from various departments headed by the Commissioner. Representation from the state Finance department will help align the activity and goals with the state's priorities and also help TCC achieve funding.

- **Create a Climate Action Council - Advisory Group:**
  The strategies proposed in the Net-zero CRCAP talk about evolving technologies like battery storage and carbon capture. Other strategies and actions proposed required a good understanding of similar projects. To make this knowledge available to TCC, TCC will create a Climate Action Council, that will consist of experts from several thematic areas who will assist TCC in this journey to Net-Zero.

- **Develop a Climate Volunteers Pool:**
  As seen in several post-disasters in the state of Tamil Nadu, support from volunteer community experts across all thematic areas can be key in scaling climate action. These volunteers will be engaged on a pro-bono basis in disaster management, climate modelling, and assessments to bolster TCC's climate initiatives.

- **Urban Planning Integration:**
  TCC will work with the Directorate of Town & Country Planning (DTCP) to embed climate action components in urban development plans, ensuring that projects across all horizons contribute to net-zero objectives.

- **Climate-Responsive Budgeting:**
  TCC will incorporate climate considerations into the city's budgeting process, aligning financial decisions with climate goals.

- **Alignments with Other State & National Policies & Programs:**
  TCC will align Trichy's Climate Action Plan and budget priorities with state and national programs to ensure cohesive and effective climate action implementation and achieve net zero ahead of 2070 as committed by the Government of Tamil Nadu.

- **Disaggregating State Targets:**
  TCC will work with the state government to disaggregate Tamil Nadu's SAPCC targets into city-level targets. This process will ensure that Trichy's actions are appropriately scaled and focused on contributing towards state goals.

## 9.2 Building Climate Awareness & Community Engagement

Climate Change is a 'part to whole' challenge and requires strong communication to make behavioural changes to achieve net zero goal. In this regard, TMC will create a strong and robust framework for communication and engagement. All of these initiatives will be undertaken after significant consultation with the various stakeholders on a continuous basis. TCC will undertake the following activities to strengthen its communication and community engagement:

**Conducting Climate Education and Awareness Programs:**

TCC will work with the school education department & higher education department of Government of Tamil Nadu to add modules on climate change and climate action into school and college curriculums.

**Setting up Climate Information Centres:**

TCC will help create climate information centres including mobile information centres that will serve as platforms to exchange knowledge, disseminate information on climate change, best practices, and future strategies.

**Facilitating Community-Led Initiatives:**

TCC will provide resources and support for community-led initiatives, such as community gardens, clean-up drives, and neighbourhood composting. This will empower local action towards the net-zero goal.

## 9.3 Strengthening Data Collection & Management

In creating this document, TCC realised that in some cases the granularity of data needed for analysis is different from the data currently captured and in some cases they are absent. TCC will proactively work to address these data gaps across capturing, managing and updating. This will help TCC create a more accurate Net-zero CRCAP revision and also measure the outcomes and progress with greater accuracy. To bridge these gaps, TCC aims to do the following:

- **Developing a Climate Data Policy:**
  TCC will build on the data policy created by Trichy Smart City and revise the same with a Climate lens. This revision will include details on data collecting standards, managing, and disseminating climate-related data across city departments. It will also establish data format guidelines, reporting frequencies, and protocols for data sharing.

- **Investing in Data Infrastructure:**
  TCC will also leverage the computing capability of the Integrated Command & Control Centre (ICCC), implemented under the smart cities initiative to capture and process climate related data. To this effect TCC will invest in infrastructure, such as GIS systems dedicated to climate information, as well as recruiting data analysts and upskilling current staff.

## 9.4 Climate Financing

Financing is a significant barrier for implementing all the strategies identified in chapter 09. TCC will explore various financial instruments and also innovative financing methods to fund its climate goals. To do the same, TCC will actively and closely work with the Department of Finance, Government of Tamil Nadu and other organisation like Tamil Nadu Infrastructure Finance Management Company (TNIFMC), Tamil Nadu Infrastructure Development Board (TNIDB) and Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) to raise climate finance to fund mitigation and adaptation projects. Additional, TCC will also do the following:

- **Creating a Dedicated Climate Fund:**
  TCC will consider creating a dedicated climate fund that can provide a stable source of funding for climate action initiatives. This fund will be fed by a variety of sources, including the city budget, state and national grants, and contributions from businesses and citizens.

- **Leveraging Public-Private Partnerships:**
  TCC will consider leveraging private financing for several projects to fund climate action by implementing PPP projects. TCC will consider offering incentives such as tax breaks or streamlined permitting processes for businesses investing in clean energy and helping the city in accelerating climate action to achieve net-zero.

## 9.5 Other Key Activities for Accelerating Climate Action

**Procurement:** Based on the learnings in the implementation of several green climate friendly projects in TCC, it was determined that the lack of a Schedule of Rates (SoR) for several components of these projects was a barrier in finalising and completing these projects and administrative sanctions were extended because of the same. To address this challenge, TCC will create a SoR that will add several climate friendly components & materials into the schedule to facilitate such projects in the future. This will also significantly mainstream NbS solutions in the city.

**Capacity Building:** The capacity needed to manage the rapidly evolving stress laid by climate change, is severely lacking across cities in the world. Recognising this need for specialised knowledge and skills to tackle climate change, TCC will plan to include the following actions:

- **Training Programs:**
  Regular training sessions on climate science, impact assessment, and climate response strategies will build the capacity of city officials and staff. These could be in collaboration with academic or non-profit organisations with climate expertise. A training policy and training calendar for Climate Action will be prepared by TCC.

- **Hiring Climate Experts:**
  TCC will consider on-boarding climate experts across thematic areas to manage the shortfall in capacity in these emerging areas on a short-term basis. These specialists will lead and advise on climate initiatives and represent the city in broader discussions.

**Residual Emissions:** Even after implementing all the emissions indicated in Chapter 08, Trichy will still have about 9% of residual emissions. Trichy City Corporation will undertake investments in newer & evolving methods on emission reduction by funding projects like battery storage, green hydrogen etc. to reduce its emission footprint to net-zero levels.

## 9.6 Monitoring & Tracking Progress

For Trichy to effectively implement the strategies mentioned in Chapter 09 of this document, establishing a robust Monitoring and Reporting (MR) system is essential. Key strategies to enhance Trichy's MR of Climate Action include:

**Institutional Arrangement:**

A structured institutional framework is essential for a reliable monitoring system. This involves the Climate Core Team overseeing progress towards climate goals and a Nodal Officer specifically responsible for tracking select climate initiatives, compiling departmental reports, conducting regular progress reviews with the Core Team, and producing an annual climate action report. These clear roles and operational guidelines for the Core Team will facilitate consistent monitoring and reporting.

### Accountability and Transparency

Effective climate governance and progress on climate action depends on accountability and transparency. The Climate Core Team will regularly analyse and audit climate data, making it accessible on public platforms like the Urban Outcomes Framework and the Global Covenant of Mayors through the CDP-ICLEI Reporting Platform, among other global climate initiatives.

### Frequency of Reporting:

Consistent reporting intervals are vital for tracking and evaluating the progress of climate actions. TCC will proactively disseminate this information with all the relevant stakeholders.

### Annual Climate Performance Review:

The Nodal Officer can employ Tool 4: The ClimateResilientCities methodology's Basket of Solutions for annual reviews. Meetings of the Climate Core Team, along with semi-annual gatherings of the High-powered Steering Committee and Stakeholder Committee, are crucial for comprehensive oversight.

### Measurement Complexity & Technology Adoption:

TCC will leverage the technological tools available through the ICCC and collaborate with departments like the TNPCB & Climate Studio in Anna University. TCC will work actively with the Institute of Remote Sensing (IRS) to use remote sensing, satellite imagery, and data analytics to enhance the MRV system's efficiency and accuracy.

*An aerial view of the Rockfort Temple, also known as Trichy Malaikottai, reveals two temples nestled within its premises: the Ucchi Pillayar Temple and the Thayumanaswamy Temple.*

Implementing these strategies will strengthen TCC's capacity to monitor and report, thereby effectively managing its climate action initiatives and driving forward the goals outlined in its Net-zero CRCAP.

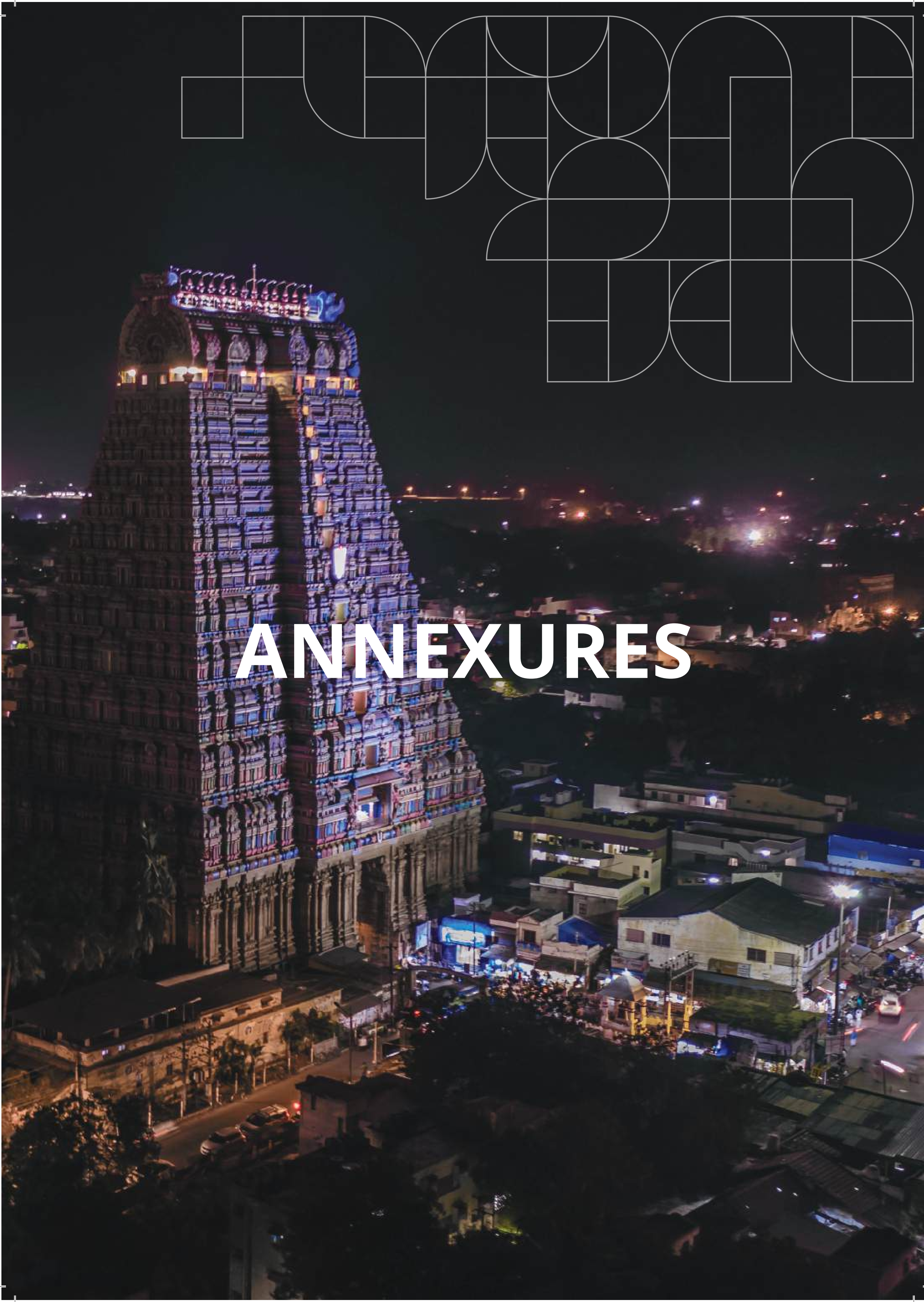
## 9.7 Leading in Climate Ambition & Action

Trichy Municipal Corporation (TCC) is determined to reach the ambitious net-zero goal well before 2070, as committed by the Government of Tamil Nadu. TCC showcases its commitment through various initiatives and policies. With its rich history of urban governance excellence in Tamil Nadu, TCC aims not only to achieve this target but also to set a precedent by aiming for an earlier completion date, thus asserting its climate leadership on a global scale.

TCC's actions span multiple sectors and involve a wide range of stakeholders, underscoring the belief that attaining a sustainable, climate-resilient future is a collective journey that requires a decisive and bold collaborative effort.

This climate action plan is designed to guide Trichy towards mitigating climate change impacts, fostering local economic growth, and improving the lives of its residents. Trichy's plan, which aligns with state and national climate goals, contributes to India's climate ambitions and showcases how cities can lead in the global climate action arena.

# ANNEXURES



# ANNEXURES

## Annexure A - Introduction

*Table A1: List of mitigation & adaptation action currently in progress and allocate budget in 2024-25*

| Sl. No / Type of Schemes | Description of Works | Budget allocated (in Lakhs) | Type of Climate Action |
|---|---|---|---|
| IUDM & PPP | Construction of New Stormwater Drainage Structures in different locations | 142.48 | Adaptation |
| | Maintenance of Stormwater Drainage Structures | 407.26 | Adaptation |
| | Dredging and desilting the main Storm water drainage | 212.75 | Adaptation |
| | Park Redevelopments / Improvements | 165.32 | Mitigation & Adaptation |
| | Street Light Maintenance and Newly Installed under Integrated Urban Development Mission (IUDM) and Public Private Partnership (PPP) | 520.53 | Mitigation |
| SuWaSeM | Restoration of Tank near Panjappur under the scheme of SuWaSeM | 30.00 | Adaptation |

| Sl. No / Type of Schemes | Description of Works | Budget allocated (in Lakhs) | Type of Climate Action |
|---|---|---|---|
| Amrut 2.0 | Proposed New Sewerage Treatment Plant with the Capacity of 100 MLD (Tamil Nadu Water Investment Company Ltd, Chennai (Hybrid Annuity Method) | 22062.97 | Mitigation |
| | Underground Drainage Work Phase IV ((Tamil Nadu Water Investment Company Ltd, Chennai) | 2100.00 | Mitigation |
| | Integrated Urban Development Project and PPP the conversion of LED street lights in areas under five zones of Tiruchirappalli Corporation | | Mitigation |
| | State Disaster Response Fund for Emergency | 103.57 | Adaptation |
| 15th Finance Commission | Clean Air Action Plan (Source Apportionment & emission Inventory study) | 89.00 | Mitigation & Adaptation |
| | Purchased Battery Operated Vehicle 88 Nos | 195.00 | Mitigation |
| | Installed the Treatment station to treat the wastewater for Recycled and Reused near Panjappur | 77.00 | Mitigation |
| | Micro composting Centre - 5 Nos | 185.20 | Mitigation |
| | Micro composting Centre - 4 Nos | 142.90 | Mitigation |

| Sl. No / Type of Schemes | Description of Works | Budget allocated (in Lakhs) | Type of Climate Action |
|---|---|---|---|
| | Bio Mining (Phase - II) | 2540.00 | Mitigation |
| | National Clean Air Programme (NCAP) | 13.00 | Mitigation |
| | Air Quality Improvement Study - IIT Madras | 17.00 | |
| | NALLA Cleaning vehicle (3 Nos) | 120.00 | Adaptation |
| Smart City Mission | Purchased Battery Operated Vehicle 100 Nos | 220.00 | Mitigation |
| | Rooftop Solar 831 Kwp in 206 Office Buildings | 644.00 | Mitigation |
| | Ground Mounted Solar with the Capacity of 9.6 Mwp | 5000.00 | Mitigation |
| | Library Cum Knowledge Centre (Green Building) in Two Location (Cantonment & Palakkarai) | 500.00 | Mitigation & Adaptation |
| General Fund | Desilting of Muds and Solid Waste from the Existing Storm Water Drainage Channels 25 Works | 167.75 | Adaptation |
| | Restoration and Desilting of muds from Water Tanks (Kotappu Kulam, Thulashig Nagar Kulam, Health Colony Kulam and Sundharadas Kulam) in part of cities. | 346.50 | Adaptation |

| Sl. No / Type of Schemes | Description of Works | Budget allocated (in Lakhs) | Type of Climate Action |
|---|---|---|---|
| | TCC allocated 50 lakhs each ward to constructed the Storm Water Drainage | 3250.00 | Adaptation |
| | Total Budget allocated for Mitigation and Adaptations related Projects and works using different schemes and funds | 39252.23 | |

# Annexure B - Methodology

**Memorandum of Understanding**

For

**Implementing "Capacity Building Project on Low Carbon and Climate Resilient City Development in India" (CapaCITIES Phase II) Project.**

Between

Commissionerate of Municipal Administration

Government of Tamil Nadu

&

TiruchirappalliCity Municipal Corporation(TCC)

&

CapaCITIES (Phase II) Project Implementing Agency

(ICLEI South Asia represents the project Implementing Agency consisting of South Pole Group Ltd, econcept Ltd and ICLEI South Asia)

COMMISSIONER
Tiruchirappalli City Corporation

I.C.L.E.I. SOUTH ASIA

COMMISSIONER OF MUNICIPAL
ADMINISTRATION,
M.R.C NAGAR, CHENNAI-28

*Figure A1: MoU Signed between TCC & ICLEI South Asia*

| Climate Core Committee Team – CapaCITIES Project | | | | |
|---|---|---|---|---|
| **S. No** | **Designation** | **Organization** | **Contact Details** | **E-Mail ID** |
| 1 | Special Officer & Commissioner | Tiruchirappalli City Corporation | 7397389311 | commr.trichy@tn.gov.in |
| 2 | City Engineer | Tiruchirappalli City Corporation | 9443326648 | trichycitycorporation@gmail.com |
| 3 | City Health Officer | Tiruchirappalli City Corporation | 7502706026 | healthtcc@gmail.com |
| 4 | Executive Engineer (West) | Tiruchirappalli City Corporation | 9443410761 | tpsec.tcc@gmail.com |
| 5 | Executive Engineer (East) | Tiruchirappalli City Corporation | 9842466621 | gkmaeetry@gmail.com |
| 6 | Assistant Commissioner's | Tiruchirappalli City Corporation | 431 -2432255, 2467615, 2319843, 2772098. | acsri.tcc@gmail.com, acari.tcc@gmail.com, acpon.tcc@gmail.com, ackabi.tcc@gmail.com |
| 7 | Assistant Executive Engineer (Mech) | Tiruchirappalli City Corporation | 9566770800 | |
| 8 | Assistant Engineers | Tiruchirappalli City Corporation | | ae3.tmc@gmail.com |
| 9 | Trichy Smart City | Tiruchirappalli City Corporation | | |

*Figure A2: Climate Core Committee of TCC*

| Stakeholder Committee Team – CapaCITIES Project | | | | | |
|---|---|---|---|---|---|
| **S. No** | **Head of the Department / Designation** | | **Department** | **Contact No** | **Email - ID** |
| 1 | Special Tahsildar (Disaster Management) | Disaster Management Cell | Disaster Management (DM) | 04312418995 | collrtry.gsec@ gmail.com |
| 2 | Chief Engineer, P.W.D., W.R.O., | Trichy Region | Public Work Department (PWD) | 0431-2331411 | cetrydh@hotmail. com |
| 3 | Superintending Engineer, | Trichy Circle | Tamilnadu Water Supply and Drainage Board | 0431-2420599 | setwadtry@gmail. com |
| 4 | Executive Engineer | Urban | Tamilnadu Water Supply and Drainage Board | 9894625165 | eetwadtry@gmail. com |
| 5 | District Environmental Engineer | Trichy | Tamilnadu Pollution Control Board (TNPCB) | 0431-2501558 | deetnpcbtrichy@ gmail.com |
| 6 | Chief Scientific Officer, Advanced Environmental Laboratory | Trichy | Tamilnadu Pollution Control Board (TNPCB) | 0431 - 2501558 | aeltry@tnpcb. gov.in |
| 7 | Superintending Engineer | Trichy Metro | Tamilnadu Electricity Board (TNEB) | 04312422216 | setrym@tnebnet. org |
| 8 | Executive Engineer | Urban | Tamilnadu Electricity Board (TNEB) | 04312793131 | trm4421ee1@ tnebnet.org |

| Stakeholder Committee Team – CapaCITIES Project | | | | | |
|---|---|---|---|---|---|
| 9 | Regional Transport Officer | Trichy West | Regional Transport Office (RTO) | 0431-2403333 | rtotn45@nic.in |
| 10 | Regional Transport Officer | Srirangam | Regional Transport Office (RTO) | 0431-2231993 | rtotn48@nic.in |
| 11 | Chief Conservator of Forests | Trichy Circle | Tamil Nadu Forest Department | 0431-2420915 | cftry@tn.nic.in |
| 12 | District Forest Office | Trichy Division | Tamil Nadu Forest Department | 0431-2414265 | dfotry@nic.in / dfotry@gmail.com |
| 13 | Managing Director | Trichy Region | Tamil Nadu Forest Plantation Corporation Limited | 0431-270 6602 0431-270 6604 | tafcorntry@ sancharnet.in |
| 14 | General Manager | Trichy Region | District Industries Centre (DIC) | 0431-2460823 | dictrichy@gmail. com |
| 15 | Joint Director | Trichy | Trichy District Town and Country Planning Office | 0431-2420838 | tryjddtcp@gmail. com |
| 16 | District Youth Officer | Tiruchirappalli | Nehru Yuva Kendra | 0431- 2421240 | nyk_trichy@ yahoo.i |
| 17 | Executive Engineer | Tiruchirappalli | Tamilnadu Slum Clearance Board (Slum Board) | 0431- 2705772 | eetrytnscb@ yahoo.co |
| 18 | General Manager | Tiruchirappalli | Tamilnadu State Transport Corporation (TNSTC) | 0431- 2415551 | tnstctry@gmail. com |

| Stakeholder Committee Team – CapaCITIES Project | | | | | |
|---|---|---|---|---|---|
| 19 | Tourist Officer | Tiruchirappalli | Tourism office | 0431-2460136 | tourismtrichy@gmail.com |
| 20 | Managing Director & LPG | Indane Area Office | Indian Oil Corporation Ltd. | 0431-270066, 2742011 | |
| 21 | Territory Manager & The Divisional Consumer Sales Manager | Tanjore LPG Territory BPCL | Bharat Petroleum Corporation Limited | 0431-2717015 | kaushiksrajan@yahoo.com |
| 22 | Trichy Retail RO | Retail Officer | Hindustan Petroleum Corporation Limited | 0431-2401180 | dheerajmurali@hpcl.in |
| 23 | Superintending Engineer | Trichy Circle | Highways Department | 0431-2316636 | tnsehtry@gmail.com |
| 24 | Divisional Engineer (H) | Trichy Division | Highways Department | 0431-2311634 | tndehtrycm@gmail.com |

*Figure A3: Stakeholder Committee of TCC*

# Annexure C - City Profile

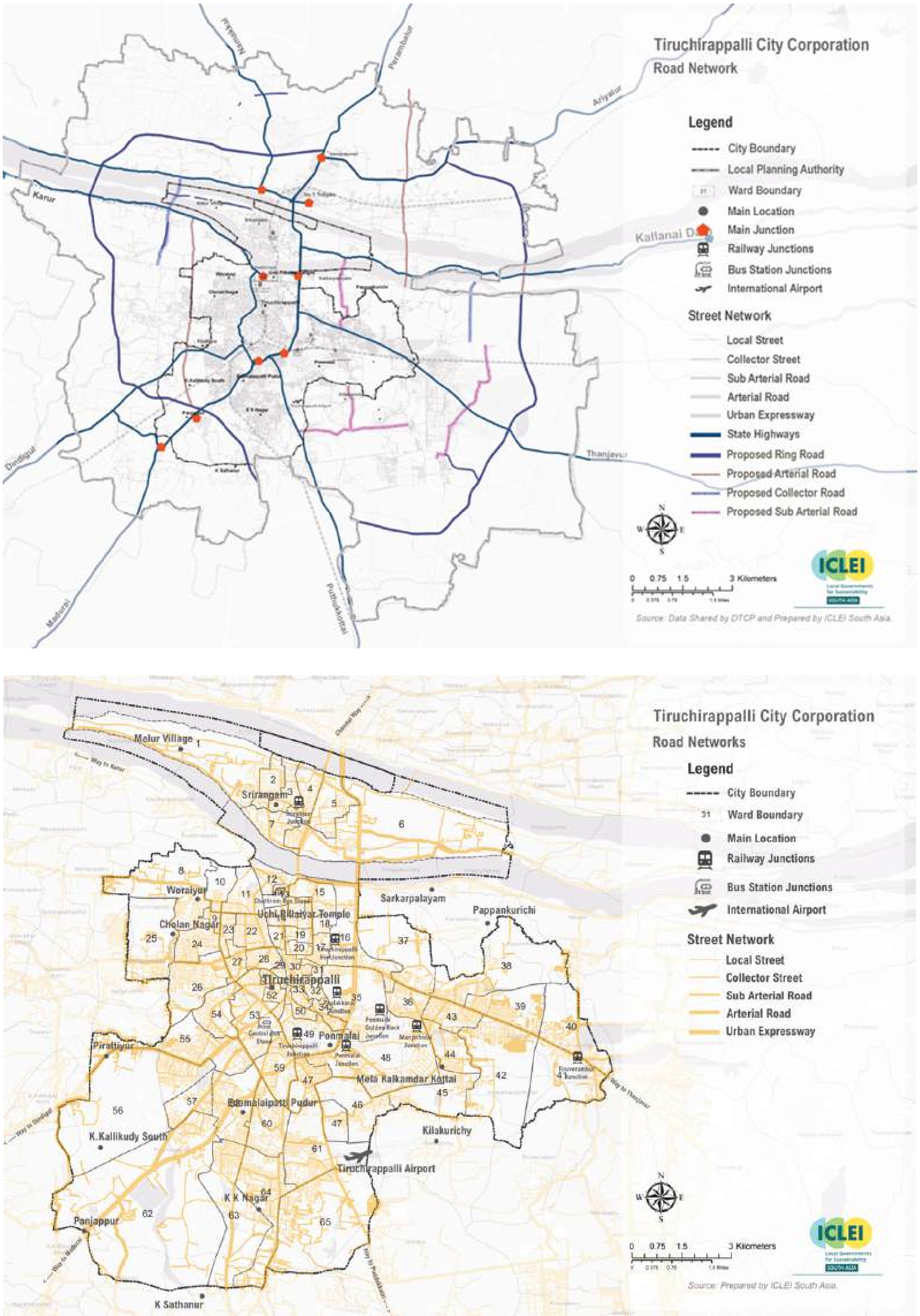



*Figure C1: Road network of roads in TCC ULB Area*

*Table C1: Historical & Projected Population of Trichy City*
*Source: Tiruchirappalli City Corporation & DTCP*

| Tiruchirappalli City - Population Projection | | | | |
|---|---|---|---|---|
| **S.No** | **Year** | **Population Tiruchirapalli** | **in Sq. Km** | **Reference / Source** |
| 1 | 1951 | 3,23,693 | 125.76 | Source: TCC |
| 2 | 1961 | 3,74,284 | 125.76 | Source: TCC |
| 3 | 1971 | 4,78,363 | 125.76 | Source: TCC |
| 4 | 1981 | 5,78,767 | 125.76 | Source: TCC |
| 5 | 1991 | 6,69,452 | 137.48 | Source: TCC |
| 6 | 2001 | 7,46,137 | 146.9 | Source: TCC |
| 7 | 2011 | 9,15,869 | 167.2 | Reference: G.O No 152 |
| 8 | 2021 | 10,81,234 | 167.2 | Reference: G.O No 152 |

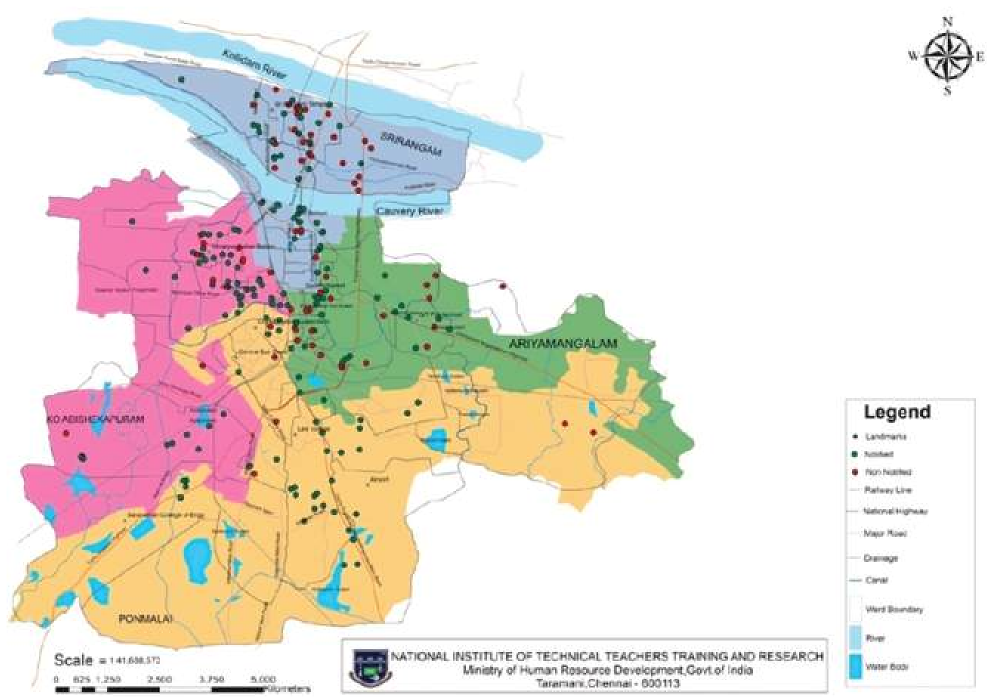



*Figure C2: Map of notified and non-notified slums in TCC boundary in 2015.*

*Note N1: Procedure of preparation of LULC map for Trichy*

### Land Use - Land Cover Classification Methodology

The Land Use and Land Cover (LULC) map of Coimbatore is created using Sentinel-2A data. Sentinel-2A is used due to its ready availability and sub-10m composite resolution over multiple years. The first step was the acquisition of cloud-free imagery from the Sentinel-2A satellite for the desired study area. To analyse trends over multiple years, we checked the availability of data for corresponding days in the same week of 2019, 2021, and 2023. It was found that data for the first week of April (specifically May 19, 2019, May 18, 2021, and May 23, 2023) was consistently available, so it was used to prepare the LULC map. Once obtained, the imagery was pre-processed, this involved correcting for atmospheric effects, orthorectifying, and image quality enhancement.

Following pre-processing, image classification was performed using 'Maximum Likelihood' supervised classification algorithms. An improvised version of the USGS 9-step classification was used to classify land into the following land uses:


This process required training data representing various land cover types within the study area. Ground truth data and existing maps were utilised to create these training samples for over 100 locations in the city.

Once the classification was complete, the accuracy of the results was assessed through validation using independent ground truth data or validation points. The ground truthing in the case of Coimbatore was done using a combination of field observation and Google satellite images. Post-processing techniques were then applied to refine the classification results, removing noise and misclassifications.

The final LULC map was generated by assigning land cover classes to each pixel based on the classification results.

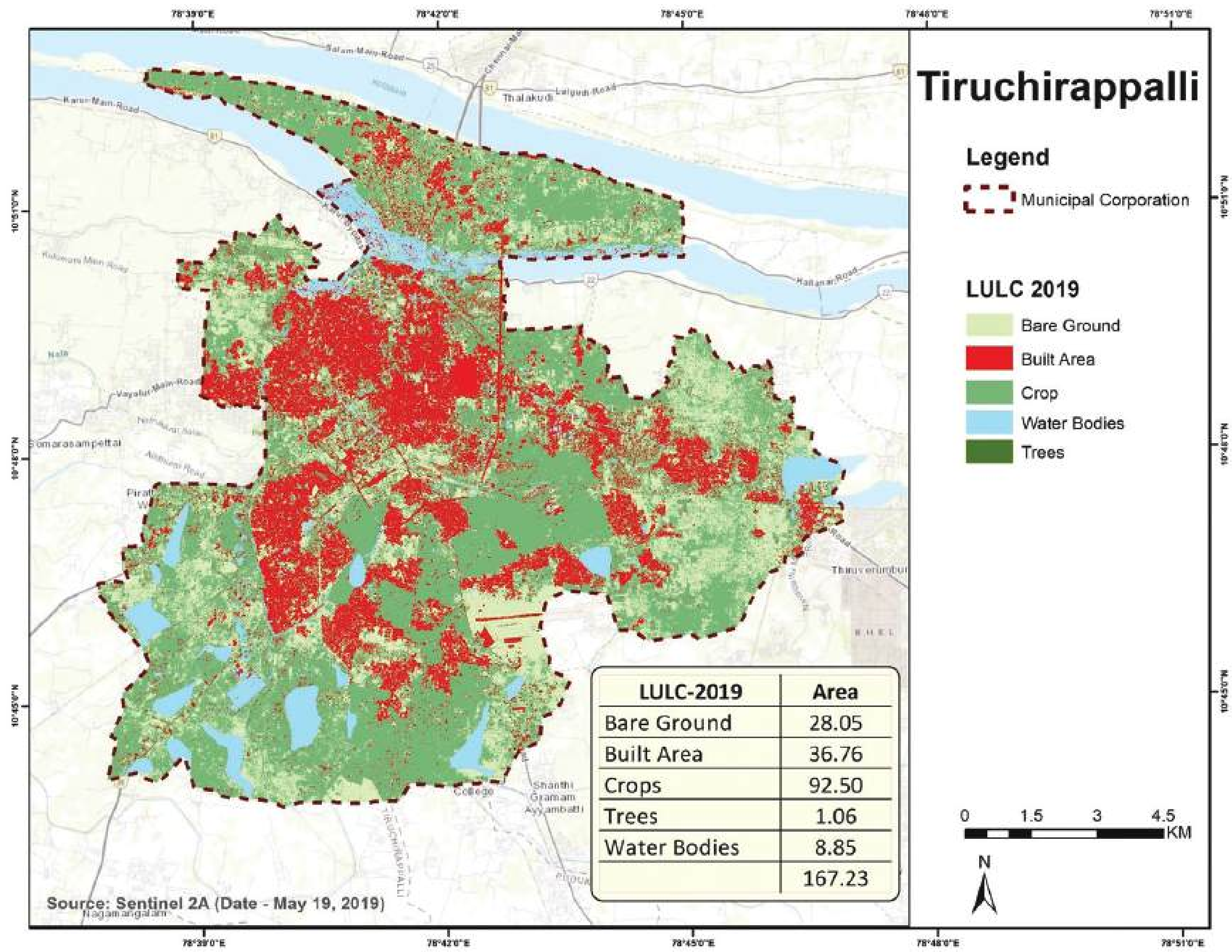



*Figure C3: LULC Map of Trichy 2019*

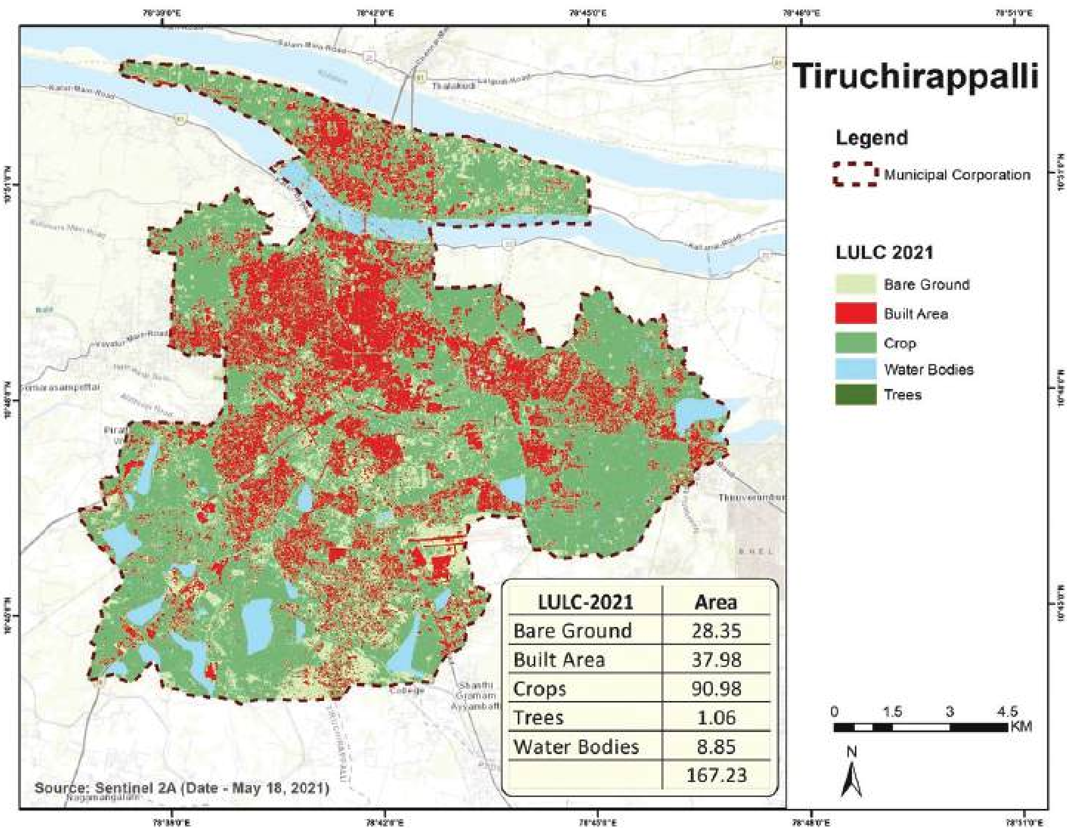



*Figure C4: LULC Map of Trichy 2021*

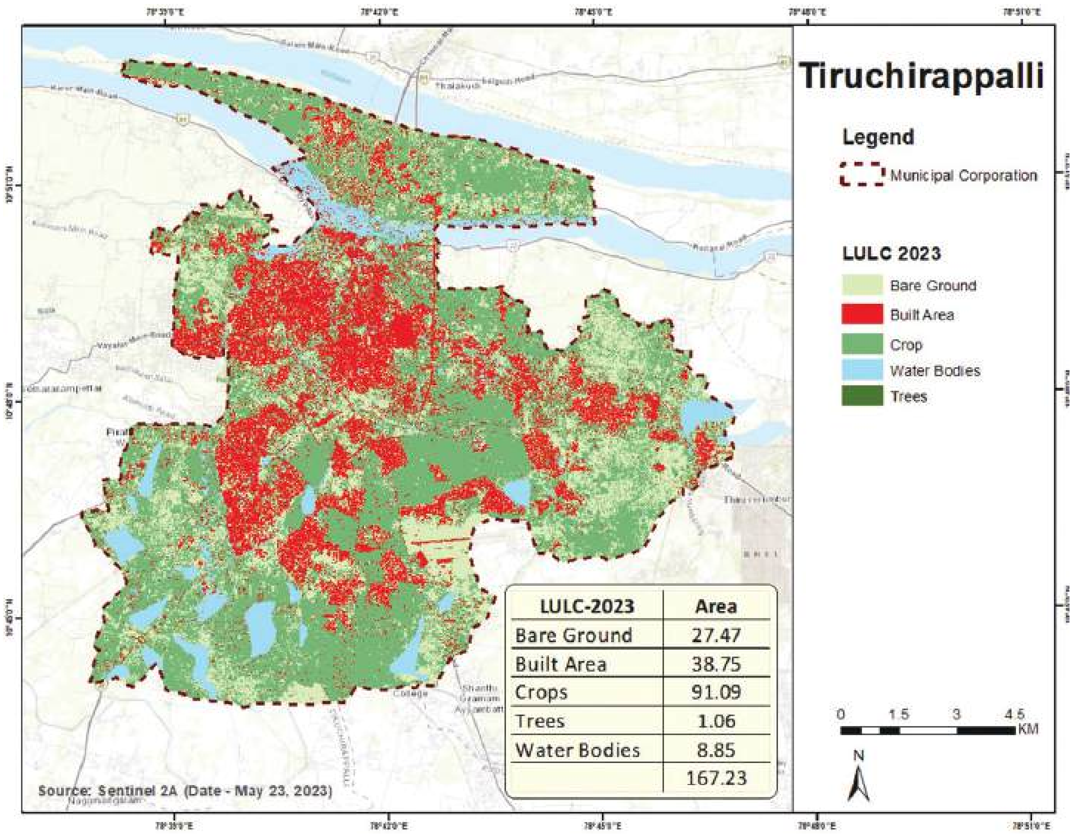



*Figure C5: LULC Map of Trichy 2023*

# Annexure D - Urban System Gap Analysis

*Table D1: Ground Water level (in m) Below Ground Level for Pre and Post Monsoon.*
*Source: Tamilnadu Water Supply and Drainage Board (TWAD Board)*

| Year | Post Monsoon (JAN) | Pre-Monsoon (MAY) |
|---|---|---|
| 2013 | 10.6 | 13.42 |
| 2014 | 11 | 13.87 |
| 2015 | 13.8 | 11.8 |
| 2016 | 3.11 | 12.03 |
| 2017 | 15.08 | 13.9 |
| 2018 | 15.7 | 19.1 |
| 2019 | 20.5 | 23.1 |
| 2020 | 19.8 | 22.5 |
| 2021 | 17.7 | 20.6 |
| Average | 14.13 | 16.7 |

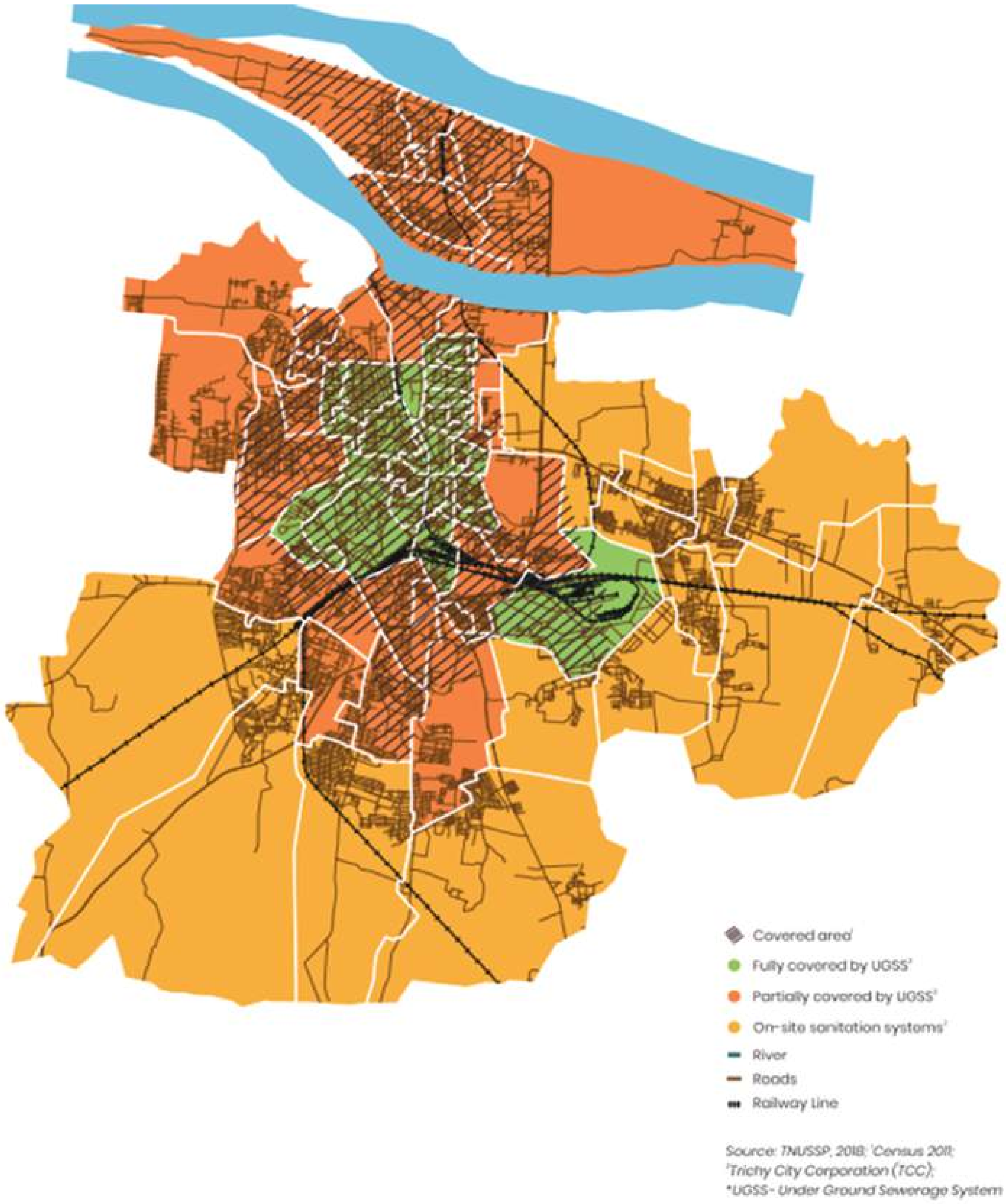



*Figure D1: UGSS Coverage Map of Trichy as on 2018[1]*

**Covered Area:** Sewer connections are laid at HH side, yet to be connected to main,

**Fully Covered by UGSS:** 100% collection achieved,

**Partially covered by UGSS:** Combination of UGSS collection & septic system,

**On-site sanitation systems:** Only septic system

[1]This sewage network coverage has increased in the last 3 years, however a combined map is not available.

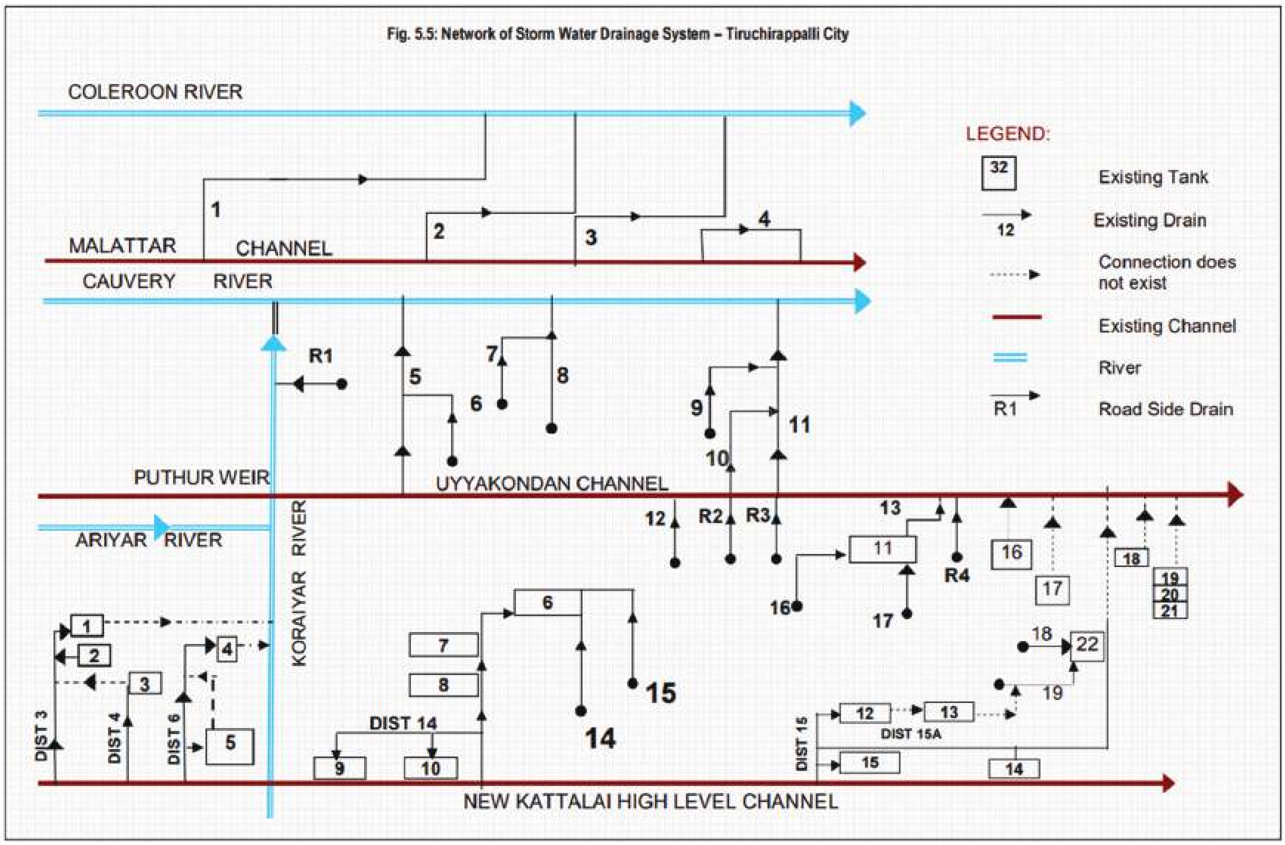



*Figure D2: SWD System in TCC Administrative Area*

*Table D2: Type of Road & Road Length by Authority within TCC Administrative Boundary*
*Source: Tiruchirappalli City Corporation (as of 2017)*

| Authority | Type of road | Length of Road (in km) |
|---|---|---|
| Corporation | B.T. Roads | 721.99 |
| | Cemented Concrete Pavement | 256.15 |
| | Cut Stone Slab | 14.61 |
| | W.B.M. Roads | 33.11 |
| | Earthen Roads | 268.41 |
| | **Total** | **1294.27** |
| Highways | NHAI Roads | 29.8 |
| | National Highways | 5.2 |
| | State Highways | 21.6 |

| Authority | Type of road | Length of Road (in km) |
|---|---|---|
| | Major District Roads | 11.6 |
| | Other District Roads | 49.5 |
| | Total | 117.7 |
| Total Length of the roads in the city | 1411.97 | |

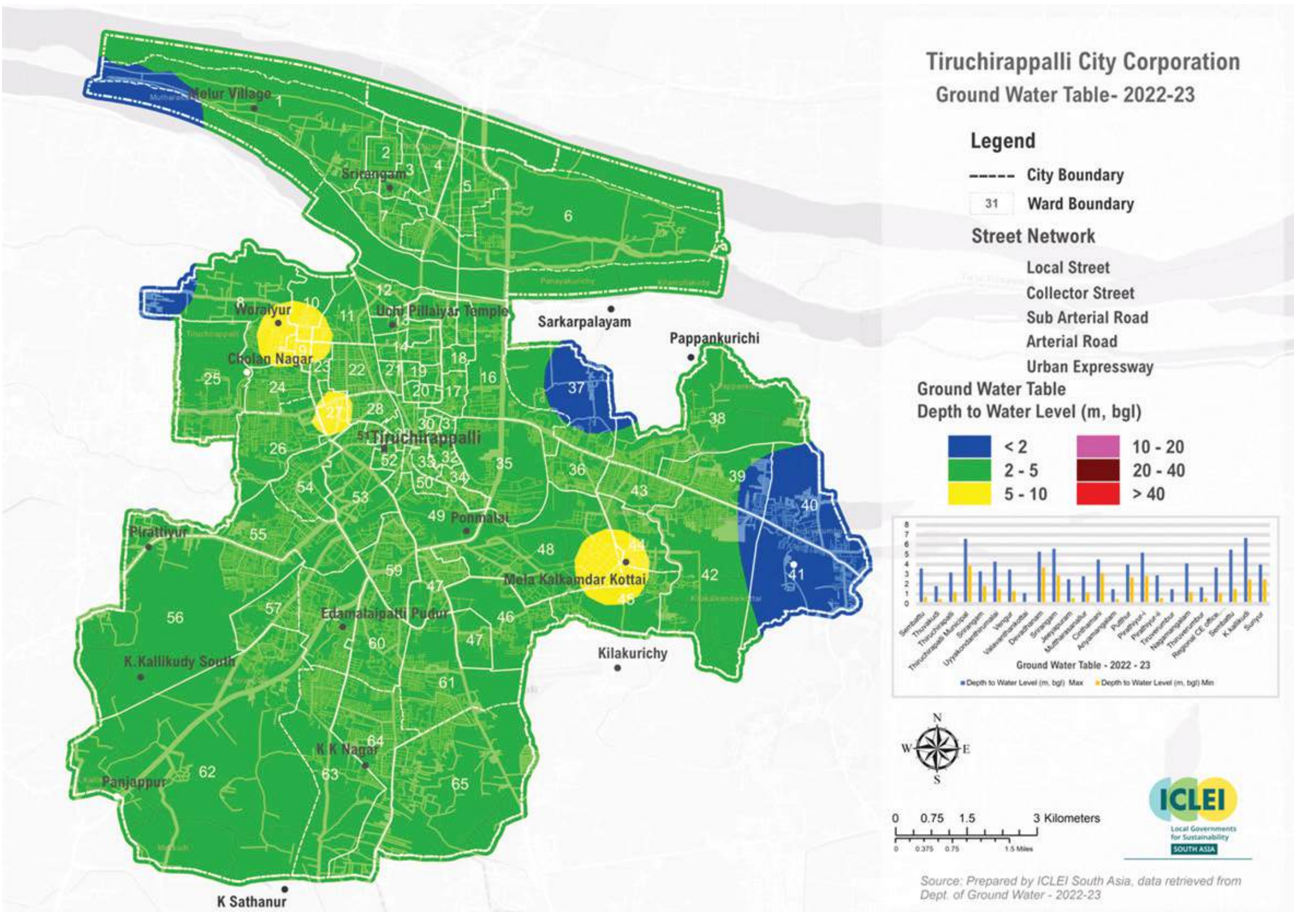



*Figure D3: Ground Water Level map of Trichy*

# Annexure E - Climate Risk & Vulnerability Assessment

*Table E1: Locations of Sensors in Trichy*

| S.No | Stations | Land Use Type | Lat | Long | Owned Buy |
|---|---|---|---|---|---|
| 1 | Thennur (GandhiMarket) | Commercial Zone | 10.8158 | 78.6972 | Tamilnadu Pollution Control Board - Tiruchirappalli |
| 2 | MainGuard Gate | Traffic Intersection | 10.8278 | 78.6933 | |
| 3 | Bishop Heber College | Commercial Zone | 10.8149 | 78.6731 | |
| 4 | Golden Rock | Residential Zone | 10.7859 | 78.7246 | |
| 5 | Central Bus Stand (2004 - 2021) relocated to (Trichy City Corporation (2022-23) | Traffic Intersection | 10.7989 | 78.6803 | |
| 6 | Tiruchirappalli International Airport | Airport (Traffic Intersection) Zone | 10.7653 | 78.7155 | Indian Meteorological Department - Tiruchirappalli |
| 7 | Musiri | Agricultural Zone | 10.9548 | 78.4439 | Tamilnadu Agriculture Weather Stations - Tiruchirappalli |
| 8 | Thottiyam | Agricultural Zone | 10.9910 | 78.3356 | |
| 9 | Thuraiyur | Residential Zone | 11.1405 | 78.5957 | |
| 10 | Tiruverambur | Agricultural Zone | 10.7856 | 78.7745 | |

*Table E1: Locations of Sensors in Trichy*

| Ward No | Number of Urban System Impacted due to Urban Heat | Number of Urban Systems Impacted due to Urban Flooding | Combined |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 3 | 1 | 4 |
| 3 | 3 | 2 | 5 |
| 4 | 3 | 1 | 4 |
| 5 | 1 | 1 | 2 |
| 6 | 0 | 1 | 1 |
| 7 | 1 | 1 | 2 |
| 8 | 3 | 5 | 8 |
| 9 | 2 | 0 | 2 |
| 10 | 1 | 3 | 4 |
| 11 | 3 | 2 | 5 |
| 12 | 2 | 3 | 5 |
| 13 | 2 | 2 | 4 |
| 14 | 0 | 1 | 1 |
| 15 | 1 | 1 | 2 |
| 16 | 0 | 2 | 2 |
| 17 | 2 | 4 | 6 |
| 18 | 0 | 3 | 3 |
| 19 | 0 | 2 | 2 |
| 20 | 1 | 1 | 2 |
| 21 | 2 | 3 | 5 |
| 22 | 2 | 1 | 3 |

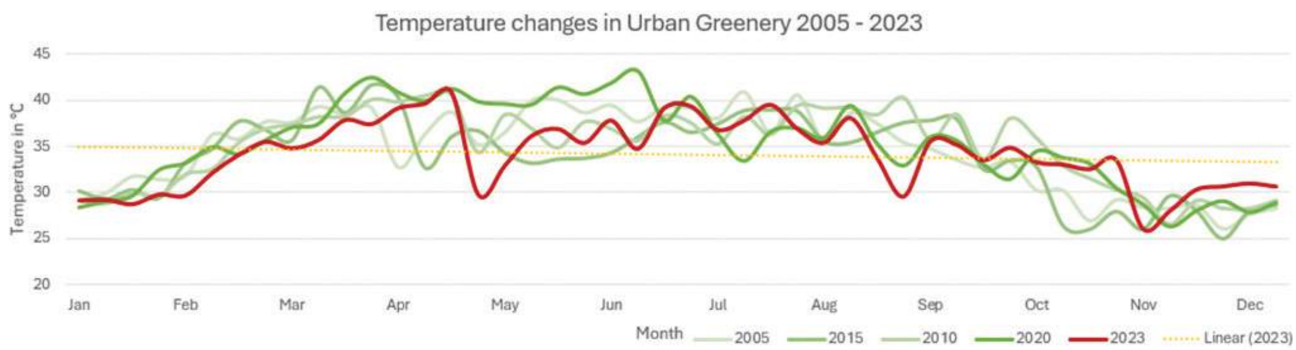
| Ward No | Number of Urban System Impacted due to Urban Heat | Number of Urban Systems Impacted due to Urban Flooding | Combined |
|---|---|---|---|
| 23 | 1 | 1 | 2 |
| 24 | 5 | 4 | 9 |
| 25 | 2 | 3 | 5 |
| 26 | 3 | 3 | 6 |
| 27 | 1 | 0 | 1 |
| 28 | 2 | 3 | 5 |
| 29 | 4 | 4 | 8 |
| 30 | 2 | 1 | 3 |
| 31 | 2 | 3 | 5 |
| 32 | 1 | 0 | 1 |
| 33 | 0 | 0 | 0 |
| 34 | 1 | 0 | 1 |
| 35 | 0 | 2 | 2 |
| 36 | 5 | 0 | 5 |
| 37 | 0 | 1 | 1 |
| 38 | 1 | 2 | 3 |
| 39 | 3 | 1 | 4 |
| 40 | 2 | 0 | 2 |
| 41 | 0 | 0 | 0 |
| 42 | 0 | 1 | 1 |
| 43 | 1 | 1 | 2 |
| 44 | 0 | 2 | 2 |
| 45 | 1 | 0 | 1 |

| Ward No | Number of Urban System Impacted due to Urban Heat | Number of Urban Systems Impacted due to Urban Flooding | Combined |
|---|---|---|---|
| 46 | 1 | 0 | 1 |
| 47 | 5 | 0 | 5 |
| 48 | 0 | 0 | 0 |
| 49 | 0 | 1 | 1 |
| 50 | 1 | 1 | 2 |
| 51 | 1 | 0 | 1 |
| 52 | 2 | 0 | 2 |
| 53 | 2 | 3 | 5 |
| 54 | 1 | 0 | 1 |
| 55 | 0 | 3 | 3 |
| 56 | 1 | 1 | 2 |
| 57 | 0 | 0 | 0 |
| 58 | 1 | 0 | 1 |
| 59 | 2 | 0 | 2 |
| 60 | 0 | 0 | 0 |
| 61 | 1 | 2 | 3 |
| 62 | 3 | 1 | 4 |
| 63 | 1 | 0 | 1 |
| 64 | 0 | 0 | 0 |
| 65 | 2 | 0 | 2 |

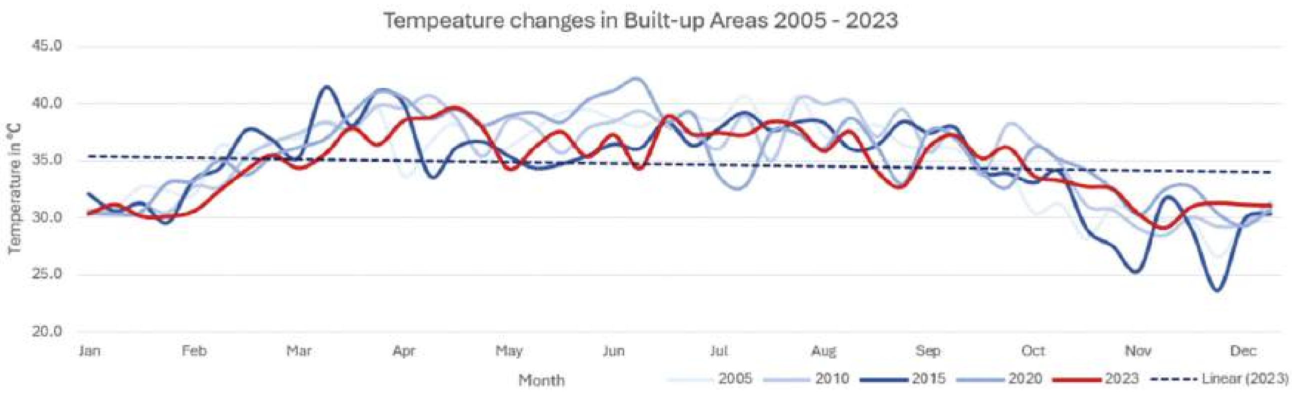
*Note E1: Land Surface Temperature Pattern (by Land Use)*

| Daytime Patterns: | Nighttime Patterns: |
|---|---|
| River Sand and Open land exhibits significantly higher LST during the day than areas with built infrastructure. | Conversely, land parcels with built infrastructure, particularly concrete structures, tend to have higher LST at night. |
| This phenomenon is attributed to the sandy loam to sandy soil type prevalent in Trichy, characterized by high thermal conductivity and diffusivity. | Concrete surfaces absorb heat during the day and release it during the cooler nighttime hours, leading to elevated land surface temperatures during the night. |
| Due to its thermal characteristics, Barren land absorbs heat rapidly during the day and releases it quickly, resulting in cooler temperatures at night. Daytime temperatures for barren land vary between 37.8°C to 39.4°C. | |

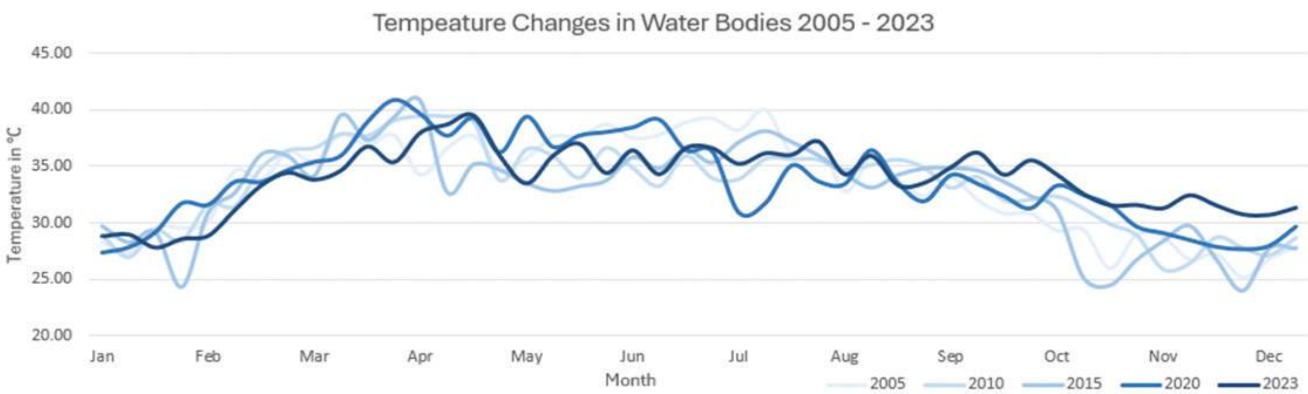
## Day Time - Temperature Variation in different land uses



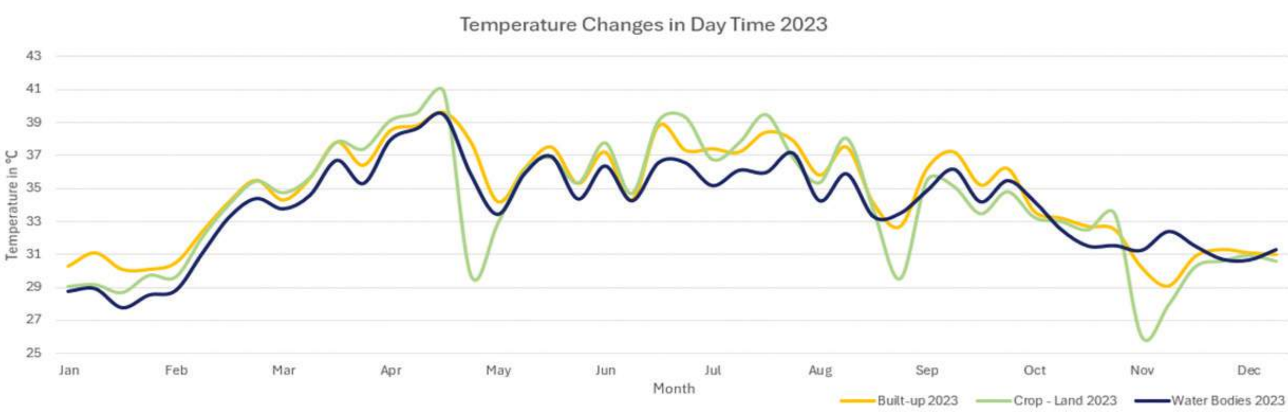

*Day time Temperature Pattern / variation in Urban Greenery Areas from (2015 - 2023)*




*Day time Temperature Pattern / various in Build-up area from (2015 - 2023)*

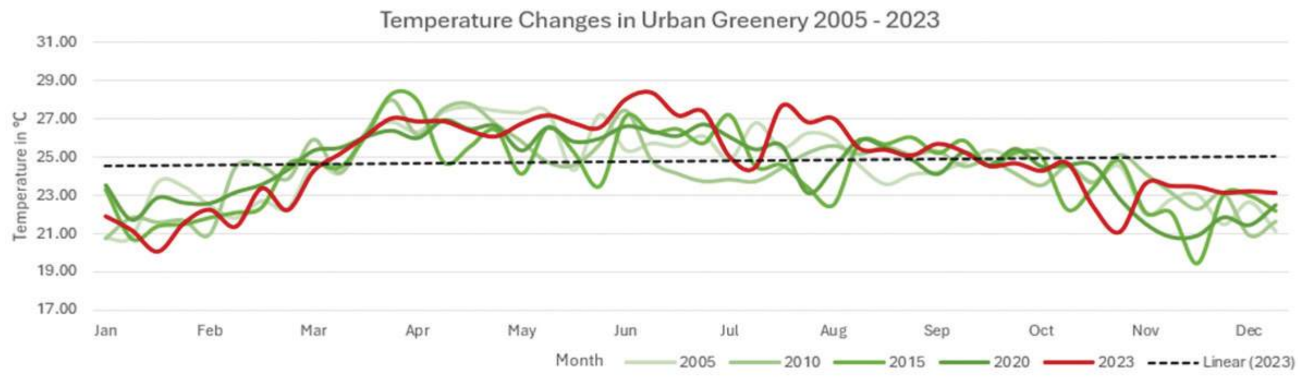



*Day time Temperature Pattern / variations in Water Bodies*

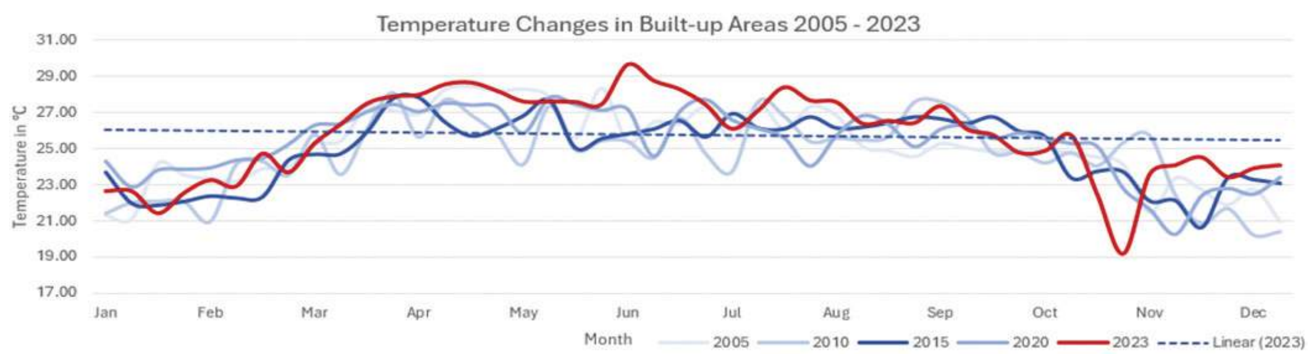



*Day Time Temperature Variations in Built Up, Urban Greenery and Water Bodies.*

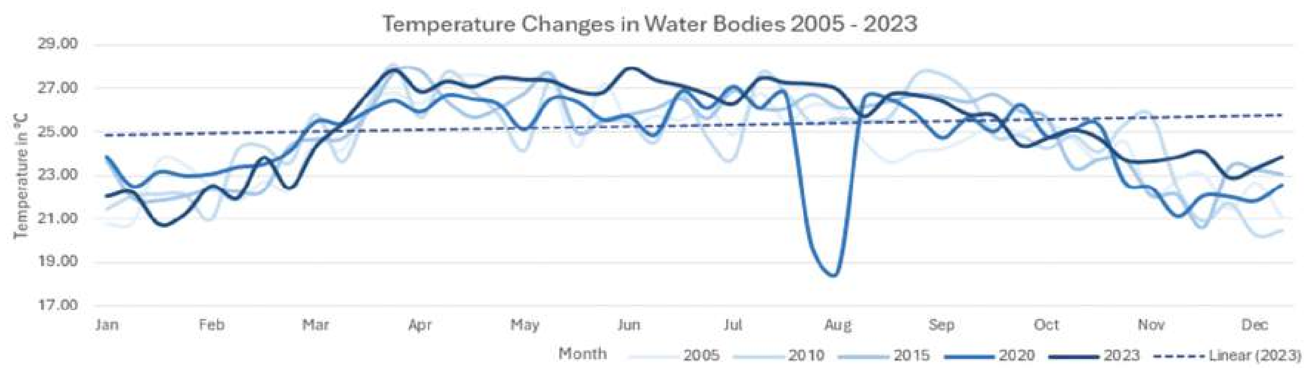
## Night Time - Temperature Variation in Built Up area, Urban Greenery and Water Bodies.



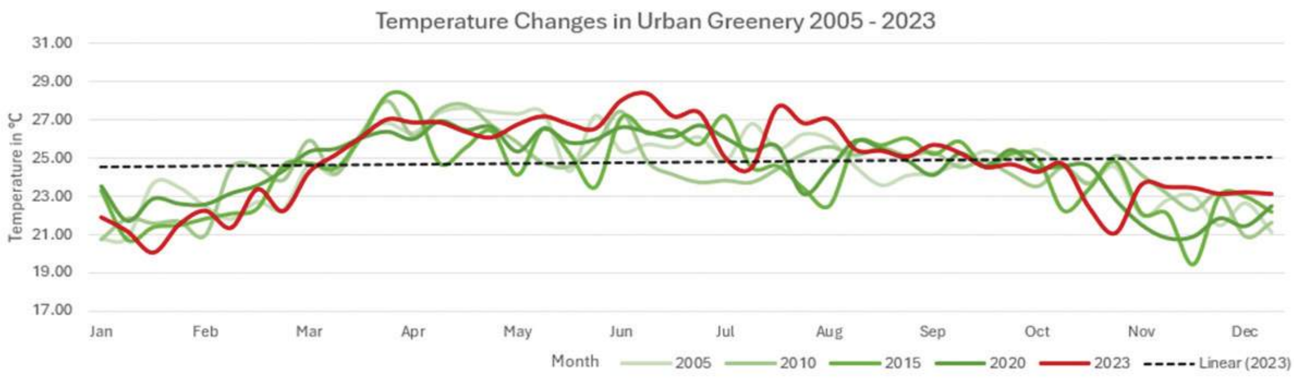

*Night time Temperature Pattern / variation in Urban Greenery Areas from (2015 - 2023)*




*Night time Temperature Pattern / various in Build-up area from (2015 - 2023)*




*Night time Temperature Pattern / variations in Water Bodies*




*Night time Temperature Variations in Built Up, Urban Greenery and Water Bodies.*

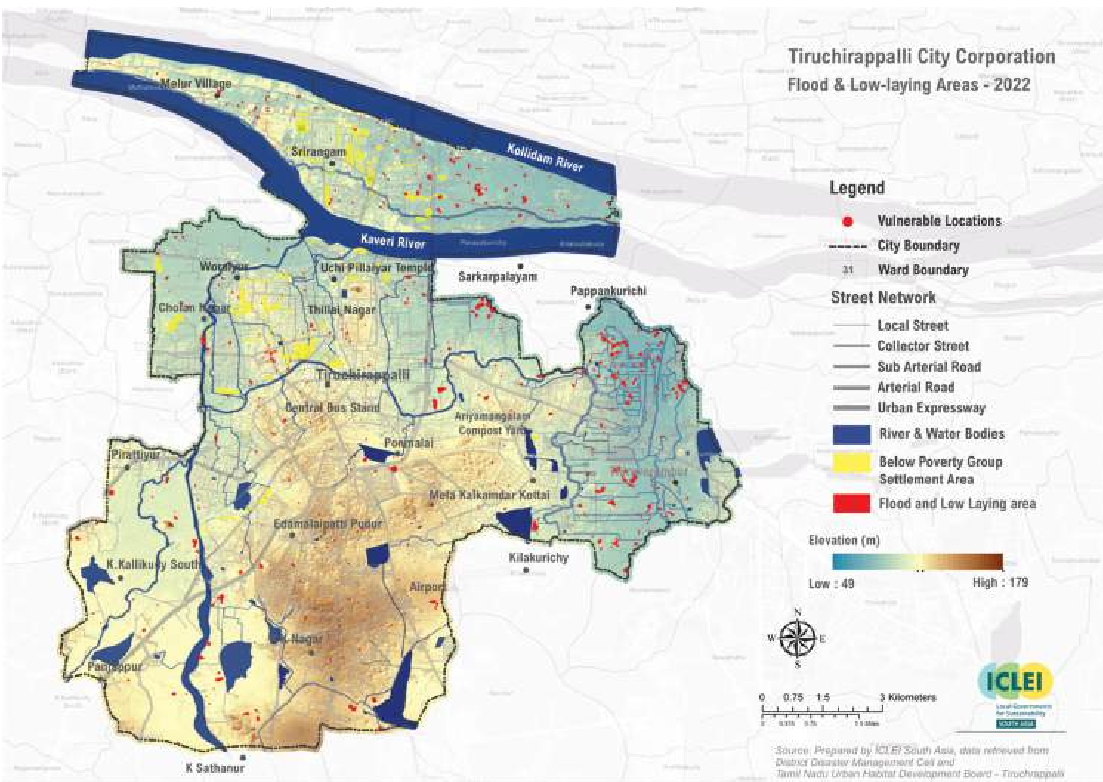



*Figure E1: Flood prone area assessment*
*Source: Prepared by ICLEI South Asia*

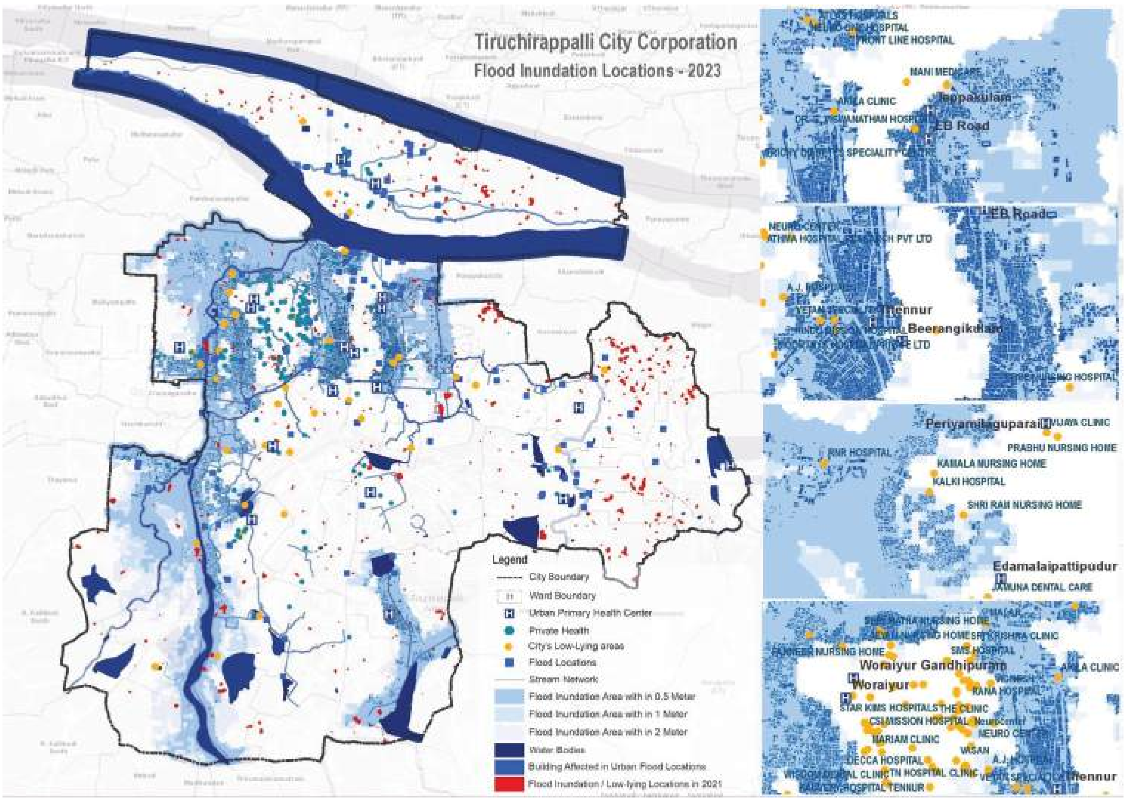



*Figure E2: Flood prone area assessment*
*Source: Prepared by ICLEI South Asia*

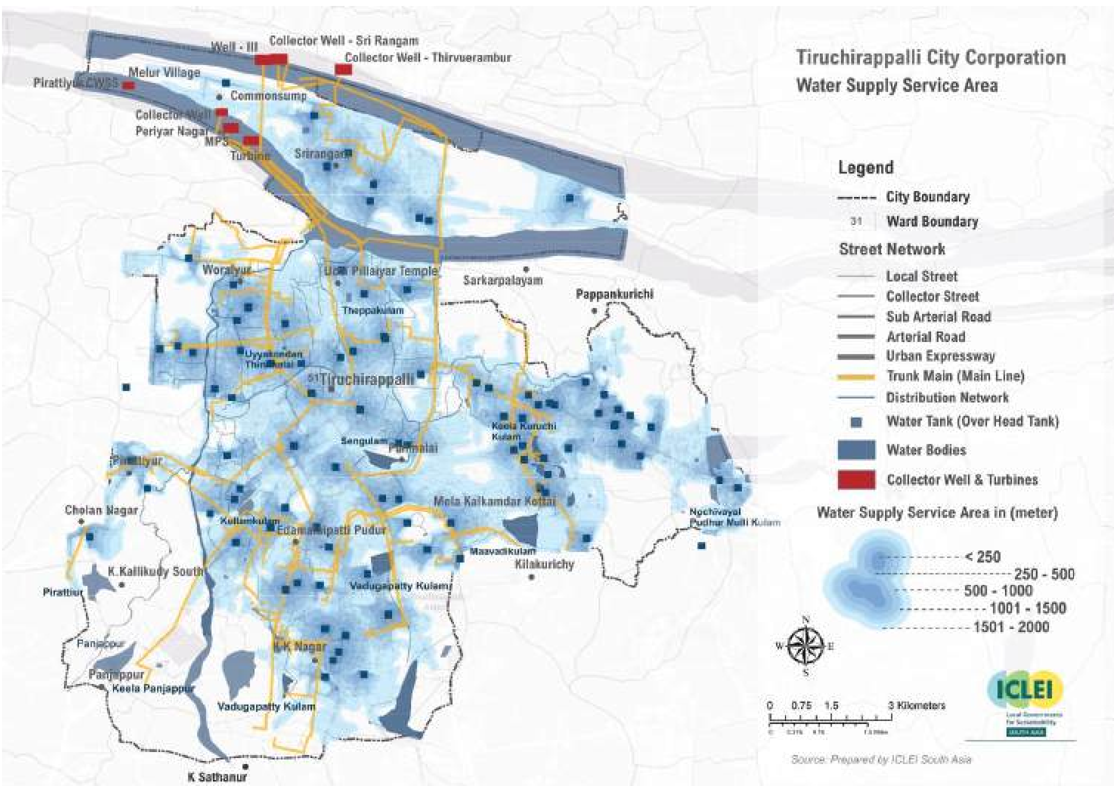



*Figure E3: Water Supply Infrastructure & Service Area*
*Source: Prepared by ICLEI South Asia*

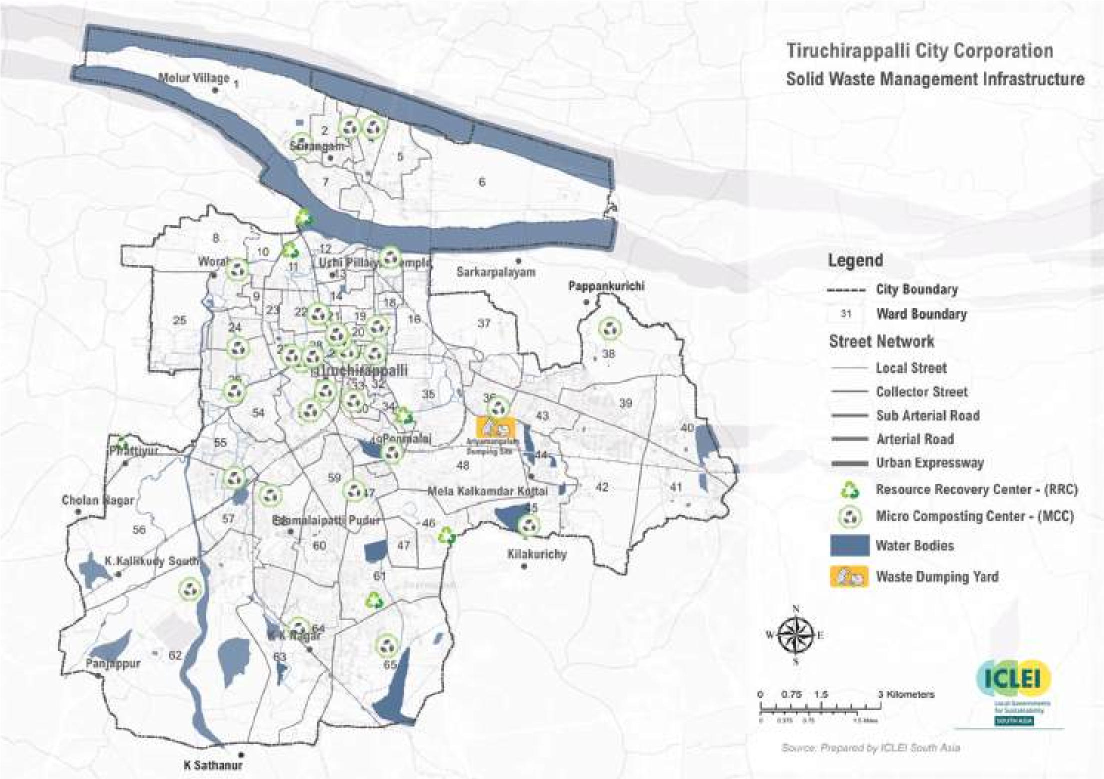



*Figure E4: Solid Waste Management Infrastructure*
*Source: Prepared by ICLEI South Asia*

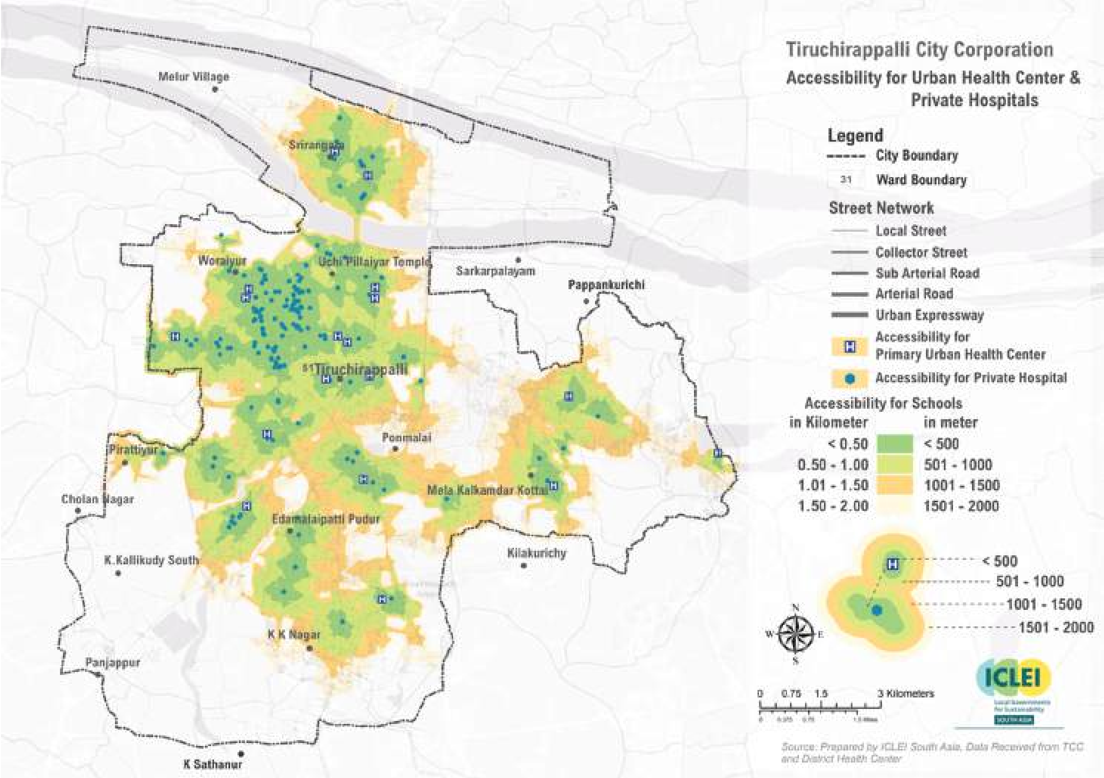



*Figure E5: Accessibility of Urban Health Center & Private Hospitals*
*Source: Prepared by ICLEI South Asia*

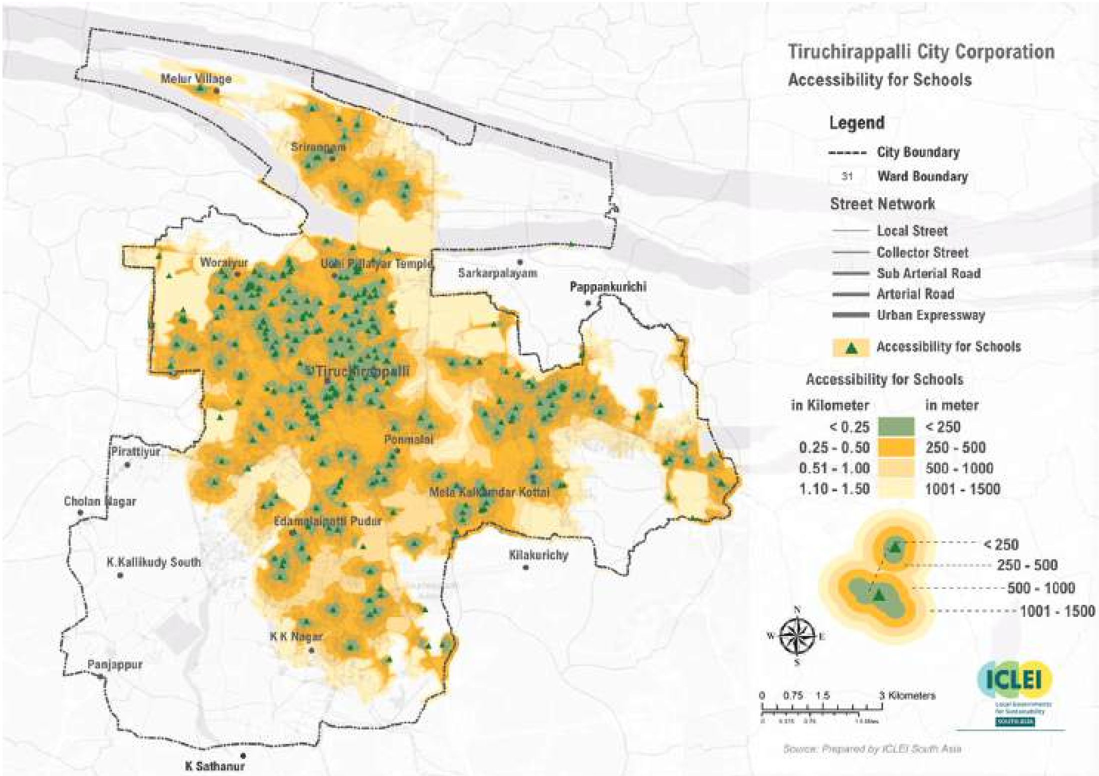



*Figure E6: Accessibility of Schools*
*Source: Prepared by ICLEI South Asia*

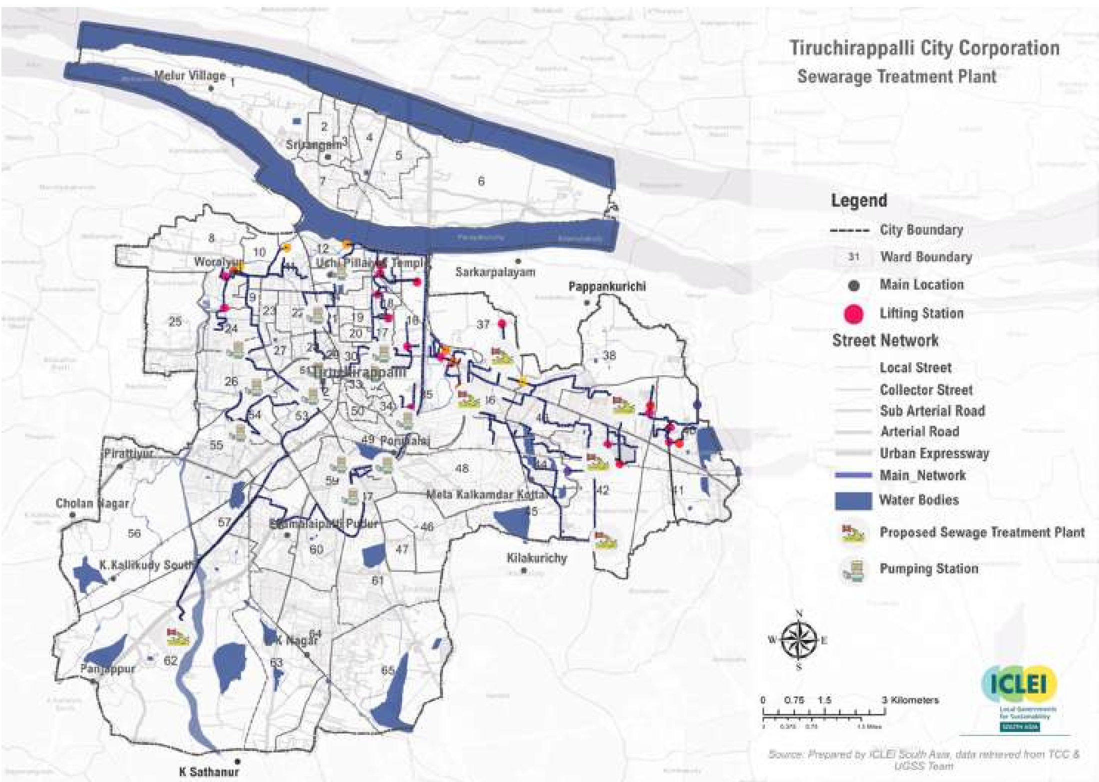



*Figure E7: Water Treatment Infrastructure*
*Source: Prepared by ICLEI South Asia*

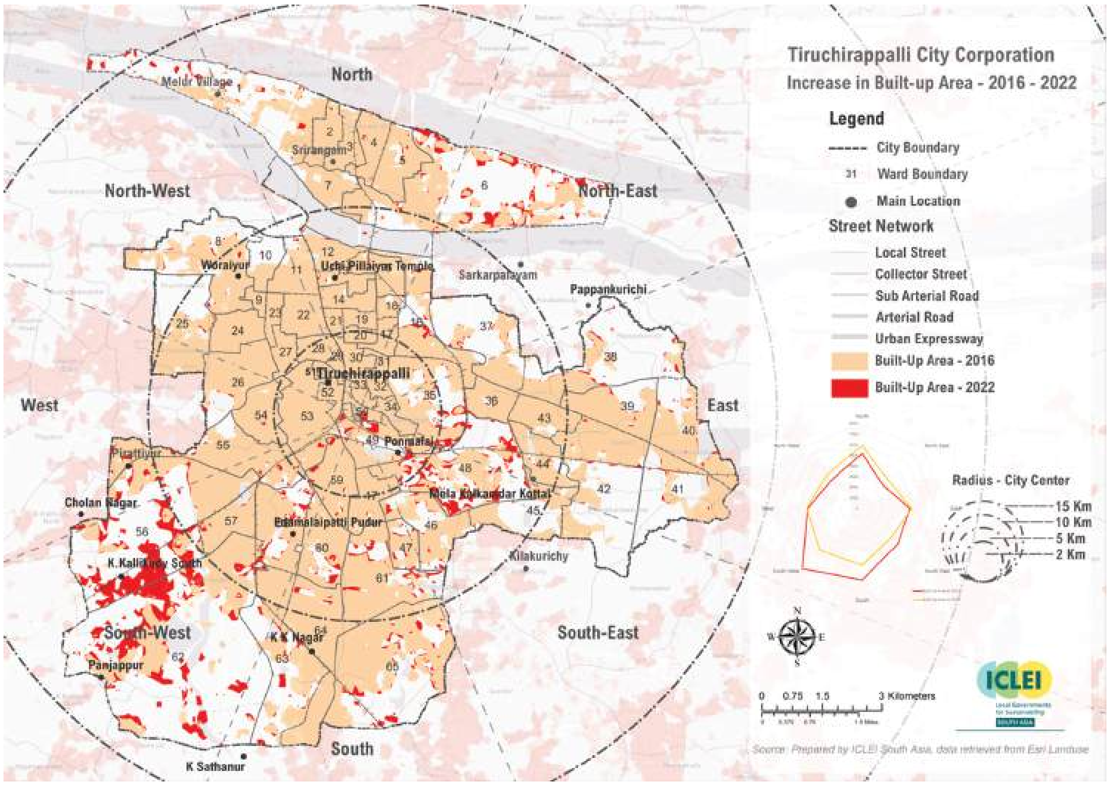



*Figure E8: Increase in Built-up area*
*Source: Prepared by ICLEI South AsiaTiruchirappalli Urban Expansion*

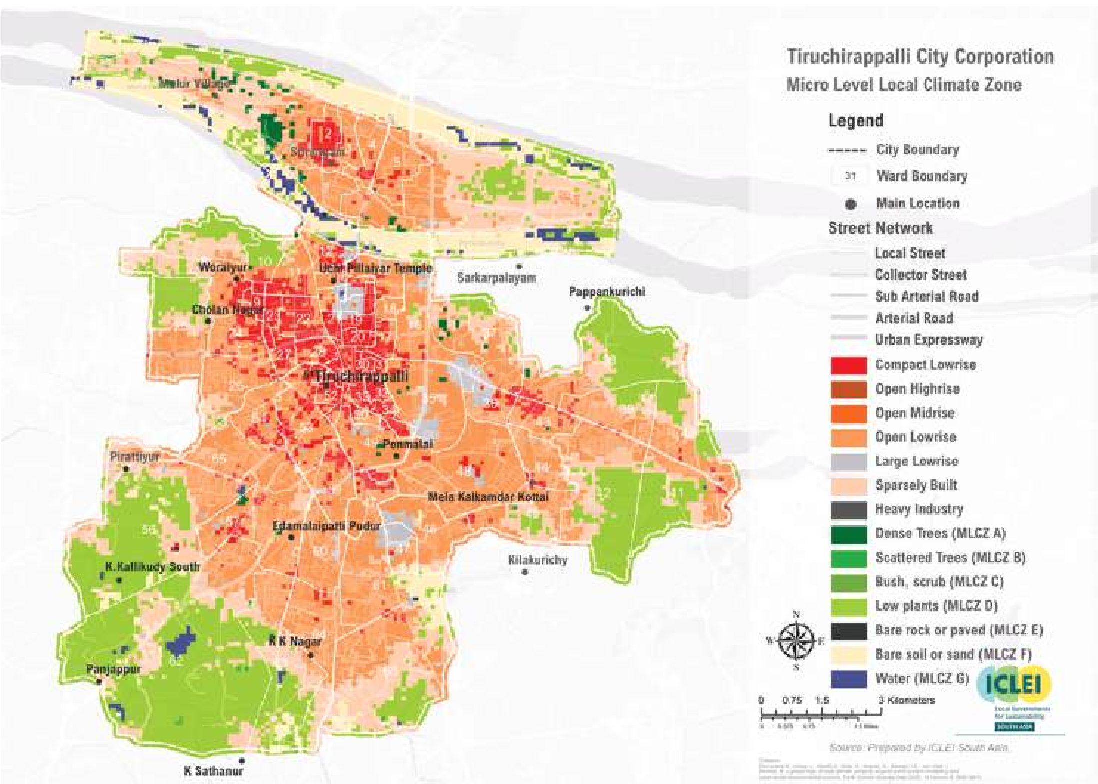



*Figure E9: Tiruchirappalli Micro Level Land Use*
*Source: Prepared by ICLEI South AsiaTiruchirappalli Urban Expansion*

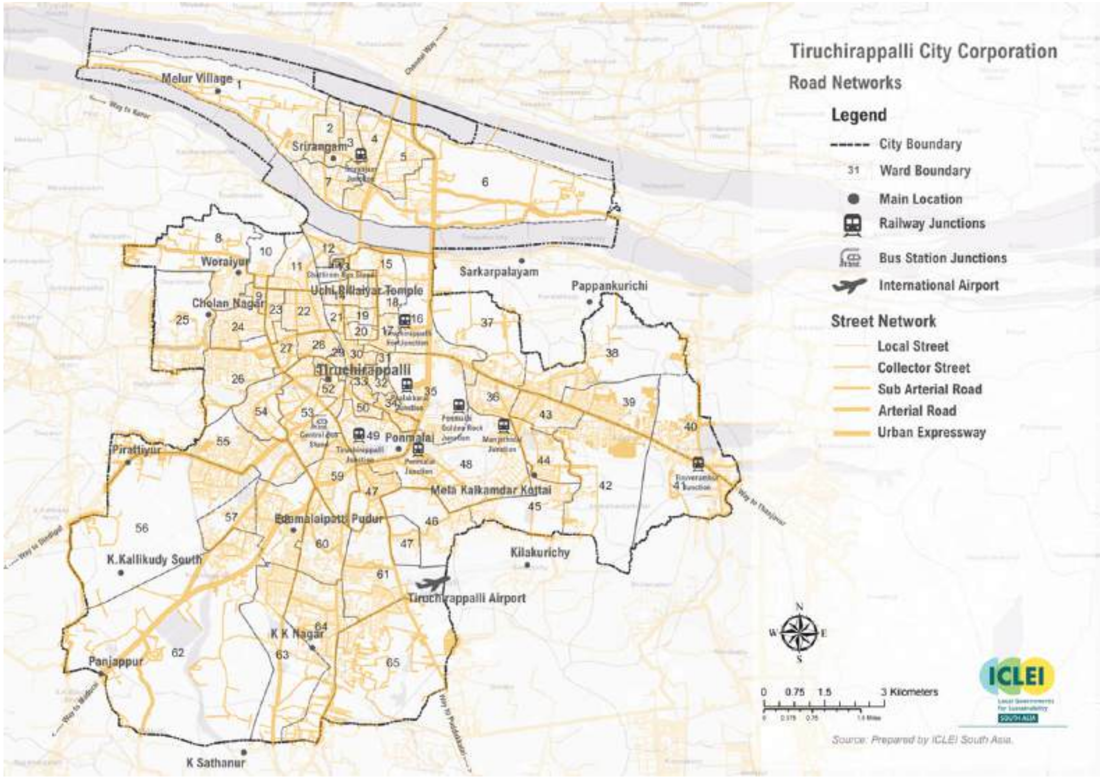



*Figure E10: Tiruchirappalli Road Network*
*Source: Prepared by ICLEI South AsiaTiruchirappalli Urban Expansion*

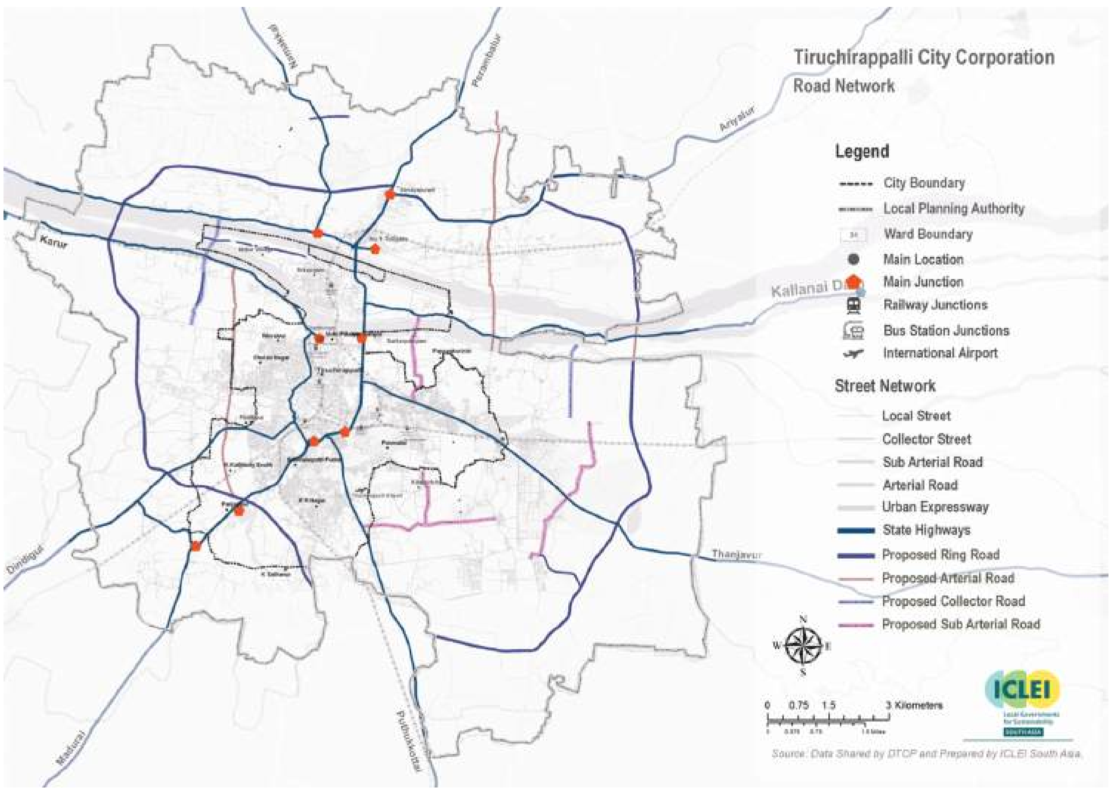



*Figure E11: Proposed Road Network*
*Source: Prepared by ICLEI South AsiaTiruchirappalli Urban Expansion*

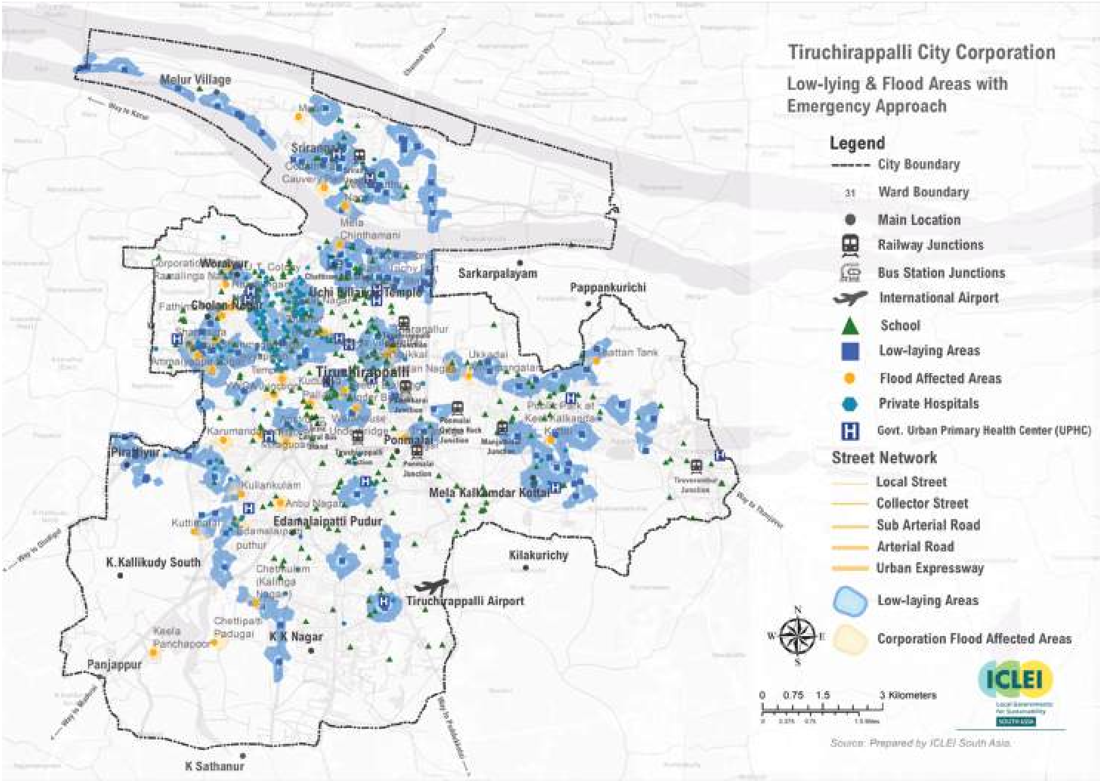



*Figure E12: Low-lying & Flood Areas with Emergency Approach*
*Source: Prepared by ICLEI South AsiaTiruchirappalli Urban Expansion*

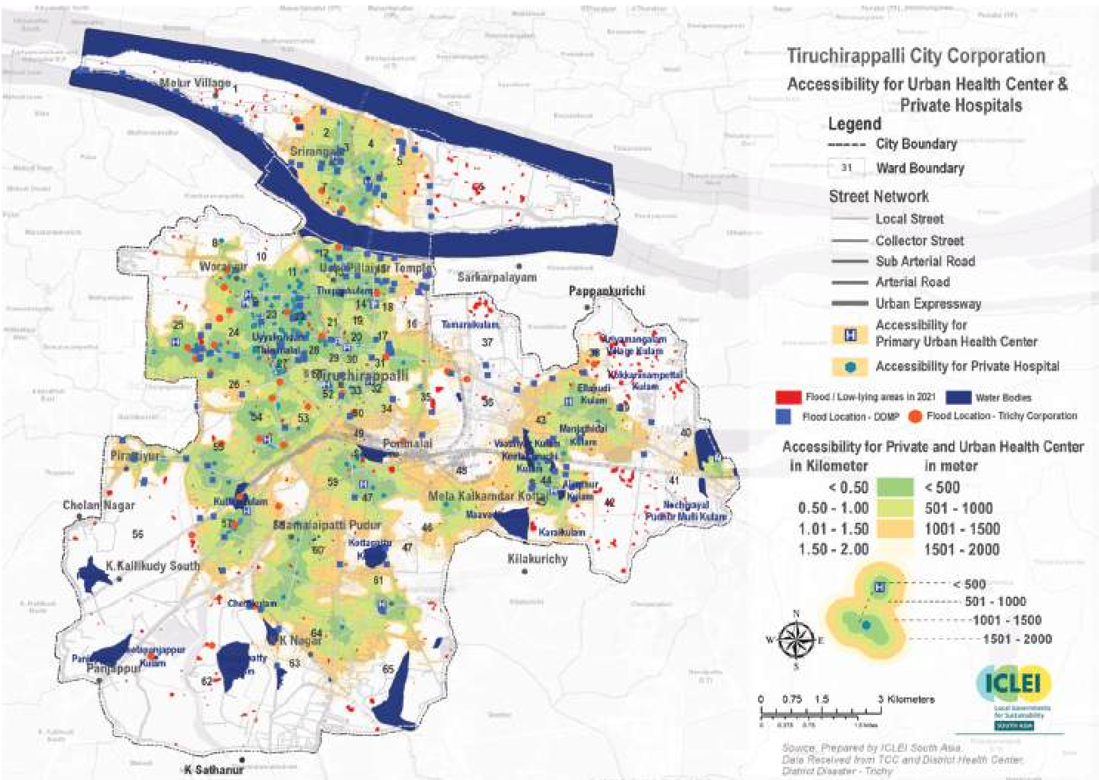



*Figure E13: Tiruchirappalli Urban Health Center's Accessibility during the flood hazard 0.5m to 2km*
*Source: Prepared by ICLEI South AsiaTiruchirappalli Urban Expansion*

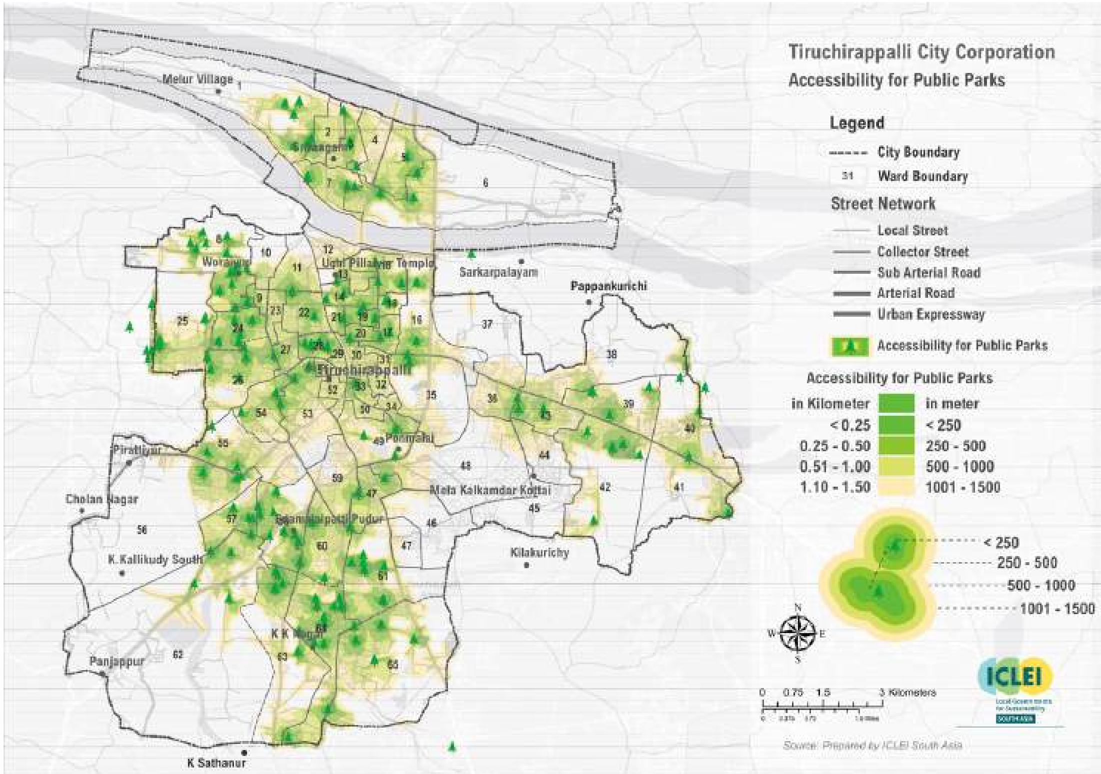



*Figure E14: Tiruchirappalli Public Park's Accessibility with in the 0.25 meter to 1.5 km*
*Source: Prepared by ICLEI South AsiaTiruchirappalli Urban Expansion*

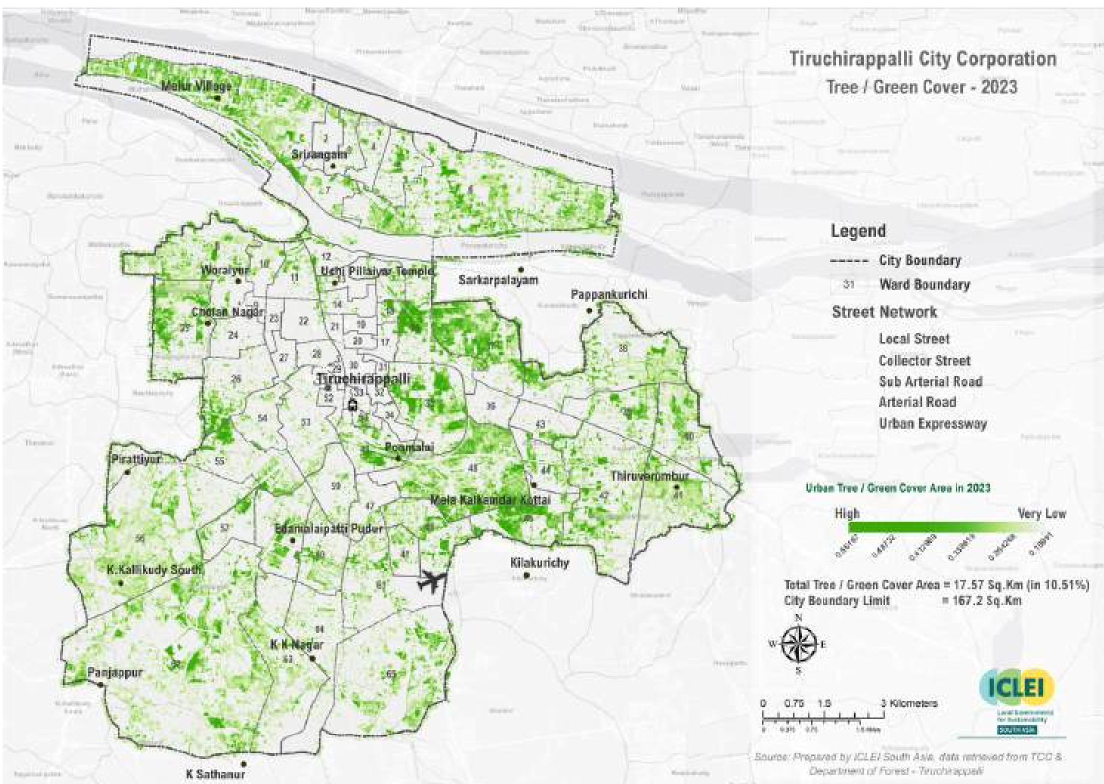



*Figure E15: Urban Green Cover*
*Source: Prepared by ICLEI South AsiaTiruchirappalli Urban Expansion*

# Annexure F - GHG Inventory

# Annexure G - Scenario Planning

# Annexure H - Goals & Strategies for Climate Resilience

## Mitigation Scenario Planning

**The feasibility exercise also shows the period to realize the impact of the intervention.**

**Period to Realize Impact:** Actions that are based on readily available technology, that meet development/political priorities and are easily financed (readily available funds), can be implemented quickly with a short lead time for impact realization. Based on these characteristics, the time required for implementing projects is categorized as short, medium, and long term.

## Feasibility Assessment of Mitigation Actions

### Built Environment and Energy

*Table H1: Feasibility Assessment of the Climate Resilient Interventions*

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Integrate advanced green building designs to significantly reduce urban heat effects. | Develop and enforce a green building regulation specific to Trichy's context and climate addressing emissions across the entire lifecycle of a building. | Yes | |
| | Adopt Green Building policies and concepts in new building design and construction inline with ECBC and Eco Niwas Samhita | Yes | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | No | Medium | Medium |
| | Yes | No | Medium | Medium-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 2:** Mandate comprehensive energy-saving and sustainable building standards. | Promote and mandate high-energy efficiency appliances – LED Lighting | Yes | |
| | Promote and mandate high-energy efficiency appliances – LED Lighting | Yes | |
| | Promote high-energy efficiency appliances – Ceiling Fans | Yes | |
| | Promote high-energy efficiency appliances – Refrigerators | Yes | |
| | Promote high-energy efficiency appliances – HVAC | Yes | |
| | Promote high-energy efficiency appliances – Energy Efficient Water Pumps in large apartments and residential societies | Yes | |
| **Strategy 3:** Achieve a full transition to sustainable energy systems for all city energy needs. | Encourage hotels and hospitals with roof space to install solar water heaters.. | Yes | |
| | Scale up use of renewable energy through:<br>• Solar energy through decentralized and grid-connected deployment<br>• Captive Solar<br>• Utilization of wind-based power<br>Purchase of green power from DISCOM | No | |

| | | | | |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | Period to Realize Impact |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Long-term |
| | Yes | Yes | High | Medium-term |
| | Yes | Yes | High | Medium-term |
| | Yes | Yes | High | Medium-term |
| | Yes | No | Medium | Long-term |
| | Yes | Yes | Medium | Medium-term |

## Transport

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Expand infrastructure for NMT (biking and walking), and increase the capacity and efficiency of public transit. | Adopt an non-motorised transit Policy and implement strategies to promote use of non-motorised mobility especially for shorter trips. | Yes | |
| | Promote public transport by providing high quality buses with information systems and BRT | No | |
| **Strategy 2:** Mandate electric transition of transport systems and develop renewable energy powered charging stations. | Electrification of public and private vehicles | Yes | |
| | 100% electrification of SETC, Trichy's Region public bus fleet and RE integration in E-bus charging | Yes | |
| | Encourage the electrification of E-commerce delivery vehicles and goods. | Yes | |
| **Strategy 3:** Implement smart traffic management systems and create more pedestrian zones to ensure smoother traffic flow and reduced congestion. | Improve road infrastructure and implement traffic control measures. | Yes | |

| | | | | |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | Period to Realize Impact |
| | No | No | Medium | Medium-term |
| | Yes | Yes | Medium | Medium-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Short-term |

## Water Supply

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Upgrade all water supply systems to be powered exclusively by renewable energy with enhanced efficiency measures. | Implement energy efficiency in water pumping | Yes | |
| | Utilize solar and wind power in water supply facilities with electricity connections | Yes | |
| | Reduce non-revenue water and leakages to reduce energy usage in water networks. | Yes | |

## Wastewater

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Transition to low-carbon technologies in all wastewater treatment processes. | Implement energy efficiency in wastewater pumping. All new STPs use anaerobic technology with biogas capture | Yes | |
| | Improve performance and wastewater treatment efficiency of aerobic STPs | Yes | |
| | Adopt solar and wind power with net metering in wastewater treatment facilities with electricity connections | Yes | |

| | | | | |
|---|---|---|---|---|
| | | | | Period to Realize Impact |
| | Political | Financial | Overall feasibility | |
| | Yes | Yes | High | Short-term |
| | No | No | Low | Medium-term |
| | Yes | Yes | High | Long-term |

| | | | | |
|---|---|---|---|---|
| | | | | Period to Realize Impact |
| | Political | Financial | Overall feasibility | |
| | Yes | Yes | High | Long-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 2:** Implement state-of-the-art sludge treatment and recycling techniques to minimize waste and environmental hazards. | All new wastewater treatment plants to use anaerobic treatment systems with dual membrane technology for biogas capture | Yes | |
| | Improve the efficiency of treatment and the operating performance of aerobic treatment facilities. | Yes | |
| | Action plan for faecal sludge management to review baseline and make suggestions | Yes | |

### Solid Waste

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Achieve 100% source segregation and 100% waste collection system with minimal emissions footprint. | 100% segregation of waste and enhance primary and secondary collection systems | Yes | |
| | Develop an updated comprehensive solid waste management strategy. | Yes | |

| | | | | |
|---|---|---|---|---|
| | | | | **Period to Realize Impact** |
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |

| | | | | |
|---|---|---|---|---|
| | | | | **Period to Realize Impact** |
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | Yes | High | Short-term |
| | Yes | No | Medium | Short-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 2:** Develop facilities for 4environmentally friendly and scientific waste processing and disposal. | Increase composting capacity by utilising both centralised and distributed facilities. | No | |
| | Deploy waste to bio-CNG plants for wet waste and produce renewable fuel from waste | Yes | |
| | Develop an updated comprehensive solid waste management strategy. | Yes | |
| **Strategy 3:** Develop facilities for environmentally friendly and scientific waste processing and disposal | Increase composting capacity by utilising both centralised and distributed facilities. | Yes | |
| | Deploy waste to bio-CNG plants for wet waste and produce renewable fuel from waste | Yes | |
| | Bio-Methanation | Yes | |
| | Sanitary landfill for the scientific disposal of inert materials and industrial rejects. A landfill gas collecting system to be installed at the dump. | Yes | |

| | | | | |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | Period to Realize Impact |
| | Yes | Yes | Medium | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |

## Feasibility Assessment of Adaptation Actions

### Built Environment and Energy

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Integrate advanced green building designs to significantly reduce urban heat effects. | Develop a Urban Cool Roof program for Trichy, and implement especially in areas that have high temperatures; focusing on slum settlements | Yes | |
| | Facilitate the adoption of sustainable architectural practices, particularly those outlined in the ECBC 2017, including within affordable housing projects.<br><br>**Sub-Action:** Facilitate widespread training in green building principles, specifically targeting relevant professionals and artisans, by utilizing academic institutions, state training facilities, and builders' associations. | Yes | |
| | Develop innovative cooling strategies for streets and vending zones, integrating them into localized street vending development plans. | Yes | |
| | Support vertical gardening and roof-top gardening to reduce heat stress on built environment | Yes | |

| | | | | |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | Period to Realize Impact |
| | Yes | No | Medium | Medium-term |
| | No | Yes | Medium | Long-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |

## Water Supply

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Establish governance models, policy & regulatory framework for water conservation improve water resilience. | Create an Action Plan for sustainable water balance that will maximize water recharge and help achieve self sufficiency. | Yes | |
| | 24X7 water supply with Water metering policy (Target to reduce 20% NRW by 2024-25 and reach 10% by 2070) | Yes | |
| **Strategy 2:** Universal access to high-quality 24/7 water through distribution networks with reduced NRW. | Increase water treatment capacity to satisfy rising demand from new growth regions. | Yes | |
| | Conduct a robust NRW study | Yes | |
| | Improve the water delivery systems through SCADA and smart meter-based monitoring | Yes | |
| | Promote rainwater harvesting and ground water recharge.<br>**Sub-actions:**<br>• Awareness generation on benefits<br>• Approach organizations to implement such initiatives under CSR/CER | Yes | |
| | Monitoring of RWH structures implemented by builders as per TNCDBR - 2019. | Yes | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | Yes | High | Short-term |
| | No | No | Low | Medium-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 3:** Launch comprehensive lake restoration projects to restore ecological balance and recreational value. | Rejuvenation and ecological restoration of lakes<br><br>**Sub-actions:**<br>• Build STP before lakes entry points or DEWATS systems<br>• Removing encroachments.<br>• Desilting of lakes.<br>• Establishment of bird islands.<br>• Developing constructed/ floating wetlands to treat water | Yes | |

## Wastewater

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Optimize sewage processing facilities with the latest technology to ensure maximum efficiency and minimum environmental impact and increase the coverage to 100% and use RE powered pumping and lifting equipment. | Comprehensive Action Plan and Wastewater Reuse and Recycling Strategies (including a Wastewater Reuse and Recycling Policy) | Yes | |
| | Replace aging sewerage network | Yes | |
| | Construct Tertiary Treatment Plants for recycling and reuse of water | Yes | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | Yes | High | Long-term |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | No | No | Low | Short-term |
| | Yes | Yes | High | Medium-term |
| | Yes | No | Medium | Medium-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| | Promote decentralized wastewater treatment and dual plumbing system as indicated in in TNDBCR for projects with 2500m² built up area or more | Yes | |
| **Strategy 2:** Achieve 100% Sludge and Septage Management | Fecal sludge management action plan | Yes | |

## Stormwater

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Implement sustainable urban planning practices to reduce runoff and prevent urban flooding. | Watershed evaluation and development of a conservation and augmentation strategy for water resources | No | |
| | Protect and improve natural drains | Yes | |
| | Capture surface runoff through recharge pits / natural swales / hybrid ditches | Yes | |
| | Build Tree Box Filters and Permeable Pavement on Footpaths | Yes | |

| | | | | |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | Period to Realize Impact |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Short-term |

| | | | | |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | Period to Realize Impact |
| | Yes | Yes | Medium | Short-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Medium-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| | Desiltation and Maintenance of Existing Water Bodies | Yes | |
| | Construct percolation wells in areas susceptible to urban flooding and in lake beds | Yes | |
| **Strategy 2:** Achieve 100% SWD coverage and construct stormwater systems to manage projected cloud-bursts and fully restore historic natural drainage paths. | Improve the coverage of storm water drainage networks in areas prone to flooding.<br><br>**Sub-actions:**<br>• Augment storm water drainage network and pumping stations<br>• Construct and maintain culverts and outfalls.<br><br>Deployment of flood sensors and developing an early warning system for urban floods | No | |

| | | | | |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | Period to Realize Impact |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Low | Short-term |

## Solid Waste

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Achieve near-zero waste by drastically reducing waste generation and enhancing recycling programs and adopt the principles of 3R's (Reduce, Reuse and Recycle) | Towards Zero waste wards:<br>**Sub-actions:**<br>• IEC to popularize circular economy principles and source segregation.<br>• Waste Reduction strategies: lifestyle changes and related IEC<br>• Prevention of littering<br>Decentralized dry waste collection centers: recyclables, C&D waste, and e-waste | Yes | |
| | Towards zero plastic waste<br>• Plastic value chain analysis,<br>• Ban Single Use Plastics and promote alternatives,<br>• Maximise recovery and recycling of plastic and other dry waste,<br>Incentivise private/cooperative buy-back initiatives | Yes | |
| | Promote eco-parks:<br>MRFs, manufacturers of alternate material, and recyclers. | Yes | |
| | Legacy waste management | No | |

| | | | | |
|---|---|---|---|---|
| | | | | **Period to Realize Impact** |
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | Yes | High | Long-term |
| | Yes | No | Medium | Long-term |
| | Yes | No | Medium | Medium-term |
| | Yes | Yes | Medium | Long-term |

## Urban green cover and biodiversity

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Transform the cityscape with extensive native green spaces that have native species to ensure sustainability and improve ecosystems (including river/lake & ponds). | Increase additional plantation in wards that are exposed to urban heats. | No | |
| **Strategy 2:** Establish diverse microhabitats across the city to promote and preserve rich biodiversity (including river/lake & ponds). | Prepare Local Biodiversity Strategies and Action Plan (LBSAP)<br><br>**Sub-actions:**<br>• City wide assessment to document the critical ecosystems, their present health status and the threats faced by them. Risk assessment study of invasive alien species in major natural ecosystems of the city (including river, lake and ponds).<br><br>Development of a strategy and action plan (including water bodies & lake ecosystems) to improve the health of the critical ecosystems. targeted action plans for identified species and riskss | Yes | |
| | Develop micro-habitats in existing urban green spaces such as pollinator gardens, grasslands/scrublands | No | |
| | Partnering with institutions to develop green corridors that link the city's green ecosystems | No | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | Yes | Medium | Short-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | Medium | Short-term |
| | Yes | Yes | Medium | Short-term |

## H3. Prioritization of Resilience Actions

**The prioritization exercise uses five key criteria/characteristics:**

**Redundancy:** A resilient system can function and achieve results through multiple paths or nodes when one fails and when performance is critical. In contrast, a "single best solution" is not resilient because if it fails, the system collapses. Back-up systems, or decentralized nodes for service delivery in a linked network, are preferable.

**Flexibility and diversity:** Essential systems should be able to work under a variety of conditions; they should not be rigid or designed only for a specific situation. Any system will fail if overloaded beyond its capacity, but it should be designed to fail under stress in a safe and predictable way, rather than suddenly and catastrophically.

**Access to information:** Resilient systems have mechanisms to learn from and build on experience, so that past mistakes are not repeated and lessons from other cities can be integrated into planning. This requires procedures for monitoring and evaluating performance under stress, and multiple sources of knowledge and documentation (strengthening "corporate memory").

*Table H2: Prioritization for Resilience Actions*

| Sector | Action | Redundancy | |
|---|---|---|---|
| Built Environment and Energy | Develop and enforce a green building regulation specific to Trichy's context and climate addressing emissions across the entire lifecycle of a building. | Yes | |
| | Adopt Green Building policies and concepts in new building design and construction inline with ECBC and Eco Niwas Samhita | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | Yes | Yes | High |
| | Yes | Yes | Yes | Yes | Very High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| | Promote and mandate high-energy efficiency appliances – LED Lighting | Yes | |
| | Promote high-energy efficiency appliances – Ceiling Fans | Yes | |
| | appliances – Refrigerators | Yes | |
| | Promote high-energy efficiency appliances – HVAC | Yes | |
| | Promote high-energy efficiency appliances – Energy Efficient Water Pumps in large apartments and residential societies | No | |
| | Encourage hotels and hospitals with roof space to install solar water heaters. | Yes | |
| | Scale up use of renewable energy through:<br>• Solar energy through decentralized and grid-connected deployment<br>• Captive Solar<br>• Utilization of wind-based power<br>Purchase of green power from DISCOM | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score<br>5/5: Very high<br>4/5: High<br>3/5: Medium<br>2/5: Average<br>1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | Yes | Yes | Very High |
| | Yes | Yes | Yes | Yes | Very High |
| | Yes | Yes | Yes | Yes | Very High |
| | Yes | No | No | Yes | Medium |
| | No | No | Yes | Yes | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Transport | | Yes | |
| | Policy and implement strategies to promote use of non-motorised mobility especially for shorter trips. | No | |
| | Promote public transport by providing high quality buses with information systems and BRT | No | |
| | Electrification of public and private vehicles | Yes | |
| | 00% electrification of SETC, Trichy's Region public bus fleet and RE integration in E-bus charging | Yes | |
| | Encourage the electrification of E-commerce delivery vehicles and goods. | Yes | |
| | Improve road infrastructure and implement traffic control measures. | | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | Yes | High |
| | Yes | No | Yes | Yes | Medium |
| | Yes | Yes | Yes | Yes | High |
| | Yes | Yes | Yes | Yes | Very High |
| | Yes | Yes | No | Yes | High |
| | Yes | Yes | Yes | No | High |
| | | | | | |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Water supply | Implement energy efficiency in water pumping | Yes | |
| | Utilize solar and wind power in water supply facilities with electricity connections | Yes | |
| | Reduce non-revenue water and leakages to reduce energy usage in water networks. | Yes | |
| Wastewater | Implement energy efficiency in wastewater pumping. All new STPs use anaerobic technology with biogas capture | Yes | |
| | Improve performance and wastewater treatment efficiency of aerobic STPs | No | |
| | Adopt solar and wind power with net metering in wastewater treatment facilities with electricity connections | Yes | |
| | All new wastewater treatment plants to use anaerobic treatment systems with dual membrane technology for biogas capture | Yes | |
| | Improve the efficiency of treatment and the operating performance of aerobic treatment facilities. | Yes | |
| | Action plan for faecal sludge management to review baseline and make suggestions | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score<br>Overall resilience score<br>5/5: Very high<br>4/5: High<br>3/5: Medium<br>2/5: Average<br>1/5: Low |
|---|---|---|---|---|---|
| | No | Yes | Yes | Yes | High |
| | Yes | Yes | No | Yes | High |
| | Yes | Yes | No | Yes | High |
| | Yes | No | Yes | Yes | High |
| | Yes | No | Yes | Yes | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Solid waste management | 100% segregation of waste and enhance primary and secondary collection systems | Yes | |
| | Develop an updated comprehensive solid waste management strategy. | No | |
| | Increase composting capacity by utilising both centralised and distributed facilities. | Yes | |
| | Deploy waste to bio-CNG plants for wet waste and produce renewable fuel from waste | Yes | |
| | Develop an updated comprehensive solid waste management strategy. | Yes | |
| | Increase composting capacity by utilising both centralised and distributed facilities. | Yes | |
| | Deploy waste to bio-CNG plants for wet waste and produce renewable fuel from waste | Yes | |
| | Bio-Methanation | Yes | |
| | Sanitary landfill for the scientific disposal of inert materials and industrial rejects. A landfill gas collecting system to be installed at the dump. | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | Yes | Yes | High |
| | Yes | No | Yes | Yes | High |
| | Yes | Yes | No | Yes | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |

*Table H3: Prioritization for Adaptation Actions*

| Sector | Action | Redundancy | |
|---|---|---|---|
| Built Environment and Energy | Design and implement a Heat-Reflective Roofing initiative for Trichy, prioritizing regions that experience urban heat, with a specific focus on improving conditions in slum areas. | Yes | |
| | Facilitate the adoption of sustainable architectural practices, particularly those outlined in the ECBC 2017, including within affordable housing projects.<br><br>**Sub-Action:** Facilitate widespread training in green building principles, specifically targeting relevant professionals and artisans, by utilizing academic institutions, state training facilities, and builders' associations. | Yes | |
| | Develop innovative cooling strategies for streets and vending zones, integrating them into localized street vending development plans. | Yes | |
| | Support vertical gardening and roof-top gardening to reduce heat stress on built environment . | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | Yes | High |
| | Yes | No | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Water supply | Create an Action Plan for sustainable water balance that will maximize water recharge and help achieve self sufficiency. | Yes | |
| | 24X7 water supply with Water metering policy (Target to reduce 20% NRW by 2024-25 and reach 10% by 2070) | Yes | |
| | Implement regulations that encourage the reuse of treated wastewater by restricting ground water extraction and rationalizing water tariffs for industrial and commercial customers. | Yes | |
| | Increase water treatment capacity to satisfy rising demand from new growth regions. | Yes | |
| | Conduct a robust NRW study | Yes | |
| | Improve the water delivery systems through SCADA and smart meter-based monitoring | Yes | |
| | Promote rainwater harvesting and ground water recharge.<br><br>**Sub-actions:**<br>• Awareness generation on benefits<br>• Approach organizations to implement such initiatives under CSR/CER | Yes | |
| | Monitoring of RWH structures implemented by builders as per TNCDBR - 2019. | | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | No | Medium |
| | No | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | No | Yes | No | Medium |
| | Yes | No | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |
| | | | | | |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Wastewater | Rejuvenation and ecological restoration of lakes<br><br>**Sub-actions:**<br>• Build STP before lakes entry points or DEWATS systems<br>• Removing encroachments.<br>• Desilting of lakes.<br>• Establishment of bird islands.<br>• Developing constructed/floating wetlands to treat water | | |
| | Comprehensive Action Plan and Wastewater Reuse and Recycling Strategies (including a Wastewater Reuse and Recycling Policy) | Yes | |
| | Replace aging sewerage network | No | |
| | Construct Tertiary Treatment Plants for recycling and reuse of water | No | |
| | Promote decentralized wastewater treatment and dual plumbing system as indicated in in TNDBCR for projects with 2500m$^2$ built up area or more | Yes | |
| | Fecal sludge management action plan | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | | | | | |
| | No | Yes | No | No | Average |
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | No | Yes | Yes | Medium |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Storm water | Watershed evaluation and development of a conservation and augmentation strategy for water resources | Yes | |
| | Protect and improve natural drains | | |
| | Capture surface runoff through recharge pits / natural swales / hybrid ditches | | |
| | Build Tree Box Filters and Permeable Pavement on Footpaths | Yes | |
| | Desiltation and Maintenance of Existing Water Bodies | Yes | |
| | Construct percolation wells in areas susceptible to urban flooding and in lake beds | No | |
| | Improve the coverage of storm water drainage networks in areas prone to flooding.<br><br>**Sub-actions:**<br>• Augment storm water drainage network and pumping stations<br>• Construct and maintain culverts and outfalls.<br><br>Deployment of flood sensors and developing an early warning system for urban floods | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | No | Medium |
| | | | | | |
| | | | | | |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | No | No | Medium |
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Solid Waste Management | Towards Zero waste wards:<br><br>**Sub-actions:**<br>• IEC to popularize circular economy principles and source segregation.<br>• Waste Reduction strategies: lifestyle changes and related IEC<br>• Prevention of littering<br><br>Decentralized dry waste collection centers: recyclables, C&D waste, and e-waste | No | |
| | Towards zero plastic waste<br>• Plastic value chain analysis,<br>• Ban Single Use Plastics and promote alternatives,<br>• Maximise recovery and recycling of plastic and other dry waste,<br><br>Incentivise private/cooperative buy-back initiatives | No | |
| | Promote eco-parks:<br><br>MRFs, manufacturers of alternate material, and recyclers. | Yes | |
| | Legacy waste management | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | Yes | Very High |
| | Yes | Yes | Yes | Yes | Very High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Urban Green Cover and Biodiversity | Increase additional plantation in wards that are exposed to urban heats. | Yes | |
| | Prepare Local Biodiversity Strategies and Action Plan (LBSAP)<br><br>**Sub-actions:**<br>• City wide assessment to document the critical ecosystems, their present health status and the threats faced by them. Risk assessment study of invasive alien species in major natural ecosystems of the city (including river, lake and ponds).<br><br>Development of a strategy and action plan (including water bodies & lake ecosystems) to improve the health of the critical ecosystems. targeted action plans for identified species and riskss | Yes | |
| | Develop micro-habitats in existing urban green  spaces such as pollinator gardens, grasslands/scrublands | Yes | |
| | Partnering with institutions to develop green corridors that link the city's green ecosystems | No | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score<br>5/5: Very high<br>4/5: High<br>3/5: Medium<br>2/5: Average<br>1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | No | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | Medium |

## Built Environment and Energy

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Integrate advanced green building designs to significantly reduce urban heat effects. | Develop and enforce a green building regulation specific to Trichy's context and climate addressing emissions across the entire lifecycle of a building. | Yes | |
| | Adopt Green Building policies and concepts in new building design and construction inline with ECBC and Eco Niwas Samhita | Yes | |
| **Strategy 2:** Mandate comprehensive energy-saving and sustainable building standards. | Promote and mandate high-energy efficiency appliances – LED Lighting | Yes | |
| | Promote high-energy efficiency appliances – Ceiling Fans | Yes | |
| | Promote high-energy efficiency appliances – Refrigerators | Yes | |
| | Promote high-energy efficiency appliances – HVAC | Yes | |
| | Promote high-energy efficiency appliances – Energy Efficient Water Pumps in large apartments and residential societies | Yes | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | No | Medium | Medium |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Long-term |
| | Yes | Yes | High | Medium-term |
| | Yes | Yes | High | Medium-term |
| | Yes | Yes | High | Medium-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 3:** Achieve a full transition to sustainable energy systems for all city energy needs. | Encourage hotels and hospitals with roof space to install solar water heaters.. | Yes | |
| | Scale up use of renewable energy through:<br>• Solar energy through decentralized and grid-connected deployment<br>• Captive Solar<br>• Utilization of wind-based power<br>Purchase of green power from DISCOM | No | |

| | | | | |
|---|---|---|---|---|
| | | | | Period to Realize Impact |
| | Political | Financial | Overall feasibility | |
| | Yes | No | Medium | Long-term |
| | Yes | Yes | Medium | Medium-term |

## Transport

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Expand infrastructure for NMT (biking and walking), and increase the capacity and efficiency of public transit. | Adopt an non-motorised transit Policy and implement strategies to promote use of non-motorised mobility especially for shorter trips. | Yes | |
| | Promote public transport by providing high quality buses with information systems and BRT | No | |
| **Strategy 2:** Mandate electric transition of transport systems and develop renewable energy powered charging stations. | Electrification of public and private vehicles | Yes | |
| | 100% electrification of SETC, Trichy's Region public bus fleet and RE integration in E-bus charging | Yes | |
| | Encourage the electrification of E-commerce delivery vehicles and goods. | Yes | |
| **Strategy 3:** Implement smart traffic management systems and create more pedestrian zones to ensure smoother traffic flow and reduced congestion. | Improve road infrastructure and implement traffic control measures. | Yes | |

| | | | | |
|---|---|---|---|---|
| | | | | **Period to Realize Impact** |
| | **Political** | **Financial** | **Overall feasibility** | |
| | No | No | Medium | Medium-term |
| | Yes | Yes | Medium | Medium-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Short-term |

## Water Supply

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Upgrade all water supply systems to be powered exclusively by renewable energy with enhanced efficiency measures. | Implement energy efficiency in water pumping | Yes | |
| | Utilize solar and wind power in water supply facilities with electricity connections | Yes | |
| | Reduce non-revenue water and leakages to reduce energy usage in water networks. | Yes | |

## Wastewater

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Transition to low-carbon technologies in all wastewater treatment processes. | Implement energy efficiency in wastewater pumping. All new STPs use anaerobic technology with biogas capture | Yes | |
| | Improve performance and wastewater treatment efficiency of aerobic STPs | Yes | |
| | Adopt solar and wind power with net metering in wastewater treatment facilities with electricity connections | Yes | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | Yes | High | Short-term |
| | No | No | Low | Medium-term |
| | Yes | Yes | High | Long-term |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | Yes | High | Long-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 2:** Implement state-of-the-art sludge treatment and recycling techniques to minimize waste and environmental hazards. | All new wastewater treatment plants to use anaerobic treatment systems with dual membrane technology for biogas capture | Yes | |
| | Improve the efficiency of treatment and the operating performance of aerobic treatment facilities. | Yes | |
| | Action plan for faecal sludge management to review baseline and make suggestions | Yes | |

## Solid Waste

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Achieve 100% source segregation and 100% waste collection system with minimal emissions footprint. | 100% segregation of waste and enhance primary and secondary collection systems | Yes | |
| | Develop an updated comprehensive solid waste management strategy. | Yes | |

| | | | | |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | **Period to Realize Impact** |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |

| | | | | |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | **Period to Realize Impact** |
| | Yes | Yes | High | Short-term |
| | Yes | No | Medium | Short-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 2:** Develop facilities for environmentally friendly and scientific waste processing and disposal. | Increase composting capacity by utilising both centralised and distributed facilities. | No | |
| | Deploy waste to bio-CNG plants for wet waste and produce renewable fuel from waste | Yes | |
| | Develop an updated comprehensive solid waste management strategy. | Yes | |
| **Strategy 3:** Develop facilities for environmentally friendly and scientific waste processing and disposal | Increase composting capacity by utilising both centralised and distributed facilities. | Yes | |
| | Deploy waste to bio-CNG plants for wet waste and produce renewable fuel from waste | Yes | |
| | Bio-Methanation | Yes | |
| | Sanitary landfill for the scientific disposal of inert materials and industrial rejects. A landfill gas collecting system to be installed at the dump. | Yes | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | Yes | Medium | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |

# Feasibility Assessment of Adaptation Actions

## Built Environment and Energy

*Table H4: Feasibility Assessment of Adaptation Actions*

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Promote green construction concepts to reduce the risk of urban heat | Design and implement a Heat-Reflective Roofing initiative for Trichy, prioritizing regions that experience urban heat, with a specific focus on improving conditions in slum areas. | Yes | |
| | Facilitate the adoption of sustainable architectural practices, particularly those outlined in the ECBC 2017, including within affordable housing projects.<br><br>**Sub-Action:** Enable mass training on green building principles, especially for relevant professionals and artisans by leveraging academic institutions, state training institutions, and builders associations. | Yes | |
| | Develop innovative cooling strategies for streets and vending zones, integrating them into localized street vending development plans. | Yes | |
| | Support vertical gardening and roof-top gardening to reduce heat stress on built environment. | Yes | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | No | Medium | Medium-term |
| | No | Yes | Medium | Long-term |
| | Yes | No | Medium | Short-term |
| | Yes | No | Medium | Short-term |

## Water Supply

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Establish governance models, policy & regulatory framework for water conservation improve water resilience. | Create an Action Plan for sustainable water balance that will maximize water recharge and help achieve self sufficiency. | Yes | |
| | 24X7 water supply with Water metering policy (Target to reduce 20% NRW by 2024-25 and reach 10% by 2070) | Yes | |
| | Implement regulations that encourage the reuse of treated wastewater by restricting ground water extraction and rationalizing water tariffs for industrial and commercial customers. | Yes | |
| **Strategy 2:** Establish governance models, policy & regulatory framework for water conservation improve water resilience. | Increase water treatment capacity to satisfy rising demand from new growth regions. | Yes | |
| | Conduct a robust NRW study | Yes | |
| | Improve the water delivery systems through SCADA and smart meter-based monitoring | Yes | |
| | Promote rainwater harvesting and ground water recharge.<br><br>**Sub-actions:**<br>• Awareness generation on benefits<br>• Approach organizations to implement such initiatives under CSR/CER | Yes | |

| | | | | |
|---|---|---|---|---|
| | | | | **Period to Realize Impact** |
| | **Political** | **Financial** | **Overall feasibility** | |
| | Yes | Yes | High | Short-term |
| | No | No | Low | Medium-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| | Monitoring of RWH structures implemented by builders as per TNCDBR - 2019. | Yes | |
| **Strategy 3:** Launch comprehensive lake restoration projects to restore ecological balance and recreational value. | Rejuvenation and ecological restoration of lakes<br><br>**Sub-actions:**<br>• Build STP before lakes entry points or DEWATS systems<br>• Removing encroachments.<br>• Desilting of lakes.<br>• Establishment of bird islands.<br>• Developing constructed/ floating wetlands to treat water | Yes | |

| | | | | |
|---|---|---|---|---|
| | | | | Period to Realize Impact |
| | Political | Financial | Overall feasibility | |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | High | Long-term |

## Wastewater

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Optimize sewage processing facilities with the latest technology to ensure maximum efficiency and minimum environmental impact and increase the coverage to 100% and use RE powered pumping and lifting equipment. | Comprehensive Action Plan and Wastewater Reuse and Recycling Strategies (including a Wastewater Reuse and Recycling Policy) | Yes | |
| | Replace aging sewerage network | Yes | |
| | Construct Tertiary Treatment Plants for recycling and reuse of water | Yes | |
| | Promote decentralized wastewater treatment and dual plumbing system as indicated in in TNDBCR for projects with 2500m$^2$ built up area or more | Yes | |
| **Strategy 2:** Achieve 100% Sludge and Septage Management | Fecal sludge management action plan | Yes | |

| | | | | |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | Period to Realize Impact |
| | No | No | Low | Short-term |
| | Yes | Yes | High | Medium-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Short-term |

## Stormwater

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Implement sustainable urban planning practices to reduce runoff and prevent urban flooding. | Watershed evaluation and development of a conservation and augmentation strategy for water resources | No | |
| | Protect and improve natural drains | Yes | |
| | Capture surface runoff through recharge pits / natural swales / hybrid ditches | Yes | |
| | Build Tree Box Filters and Permeable Pavement on Footpaths | Yes | |
| | Desiltation and Maintenance of Existing Water Bodies | Yes | |
| | Construct percolation wells in areas susceptible to urban flooding and in lake beds | Yes | |
| **Strategy 2:** Achieve 100% SWD coverage and construct stormwater systems to manage projected cloud-bursts and fully restore historic natural drainage paths. | Improve the coverage of storm water drainage networks in areas prone to flooding.<br><br>**Sub-actions:**<br>• Augment storm water drainage network and pumping stations<br>• Construct and maintain culverts and outfalls.<br><br>Deployment of flood sensors and developing an early warning system for urban floods | No | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | |
| | Yes | Yes | Medium | Short-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Medium | Medium-term |
| | Yes | No | Low | Short-term |

## Solid Waste

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Achieve near-zero waste by drastically reducing waste generation and enhancing recycling programs and adopt the principles of 3R's (Reduce, Reuse and Recycle) | Towards Zero waste wards:<br><br>**Sub-actions:**<br>• IEC to popularize circular economy principles and source segregation.<br>• Waste Reduction strategies: lifestyle changes and related IEC<br>• Prevention of littering<br><br>Decentralized dry waste collection centers: recyclables, C&D waste, and e-waste | Yes | |
| | Towards zero plastic waste<br>• Plastic value chain analysis,<br>• Ban Single Use Plastics and promote alternatives,<br>• Maximise recovery and recycling of plastic and other dry waste,<br><br>Incentivise private/cooperative buy-back initiatives | Yes | |
| | Promote eco-parks:<br>MRFs, manufacturers of alternate material, and recyclers. | Yes | |
| | Legacy waste management | No | |

| | | | | |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | Period to Realize Impact |
| | Yes | Yes | High | Long-term |
| | Yes | No | Medium | Long-term |
| | Yes | No | Medium | Medium-term |
| | Yes | Yes | Medium | Long-term |

## Urban green cover and biodiversity

| Resilience Strategy | Action | Feasibility of the intervention | |
|---|---|---|---|
| | | Technical | |
| **Strategy 1:** Transform the cityscape with extensive native green spaces that have native species to ensure sustainability and improve ecosystems (including river/lake & ponds). | Increase additional plantation in wards that are exposed to urban heats. | No | |
| **Strategy 2:** Establish diverse microhabitats across the city to promote and preserve rich biodiversity (including river/lake & ponds). | Prepare Local Biodiversity Strategies and Action Plan (LBSAP)<br><br>**Sub-actions:**<br>• City wide assessment to document the critical ecosystems, their present health status and the threats faced by them. Risk assessment study of invasive alien species in major natural ecosystems of the city (including river, lake and ponds).<br><br>Development of a strategy and action plan (including water bodies & lake ecosystems) to improve the health of the critical ecosystems. targeted action plans for identified species and risks | Yes | |
| | Develop micro-habitats in existing urban green spaces such as pollinator gardens, grasslands/scrublands | No | |
| | Partnering with institutions to develop green corridors that link the city's green ecosystems | No | |

| | | | | Period to Realize Impact |
|---|---|---|---|---|
| | Political | Financial | Overall feasibility | |
| | Yes | Yes | Medium | Short-term |
| | Yes | Yes | High | Long-term |
| | Yes | Yes | Medium | Short-term |
| | Yes | Yes | Medium | Short-term |

## H3. Prioritization of Resilience Actions

**The prioritization exercise uses five key criteria/characteristics:**

**Redundancy:** A resilient system can function and achieve results through multiple paths or nodes when one fails and when performance is critical. In contrast, a "single best solution" is not resilient because if it fails, the system collapses. Back-up systems, or decentralized nodes for service delivery in a linked network, are preferable.

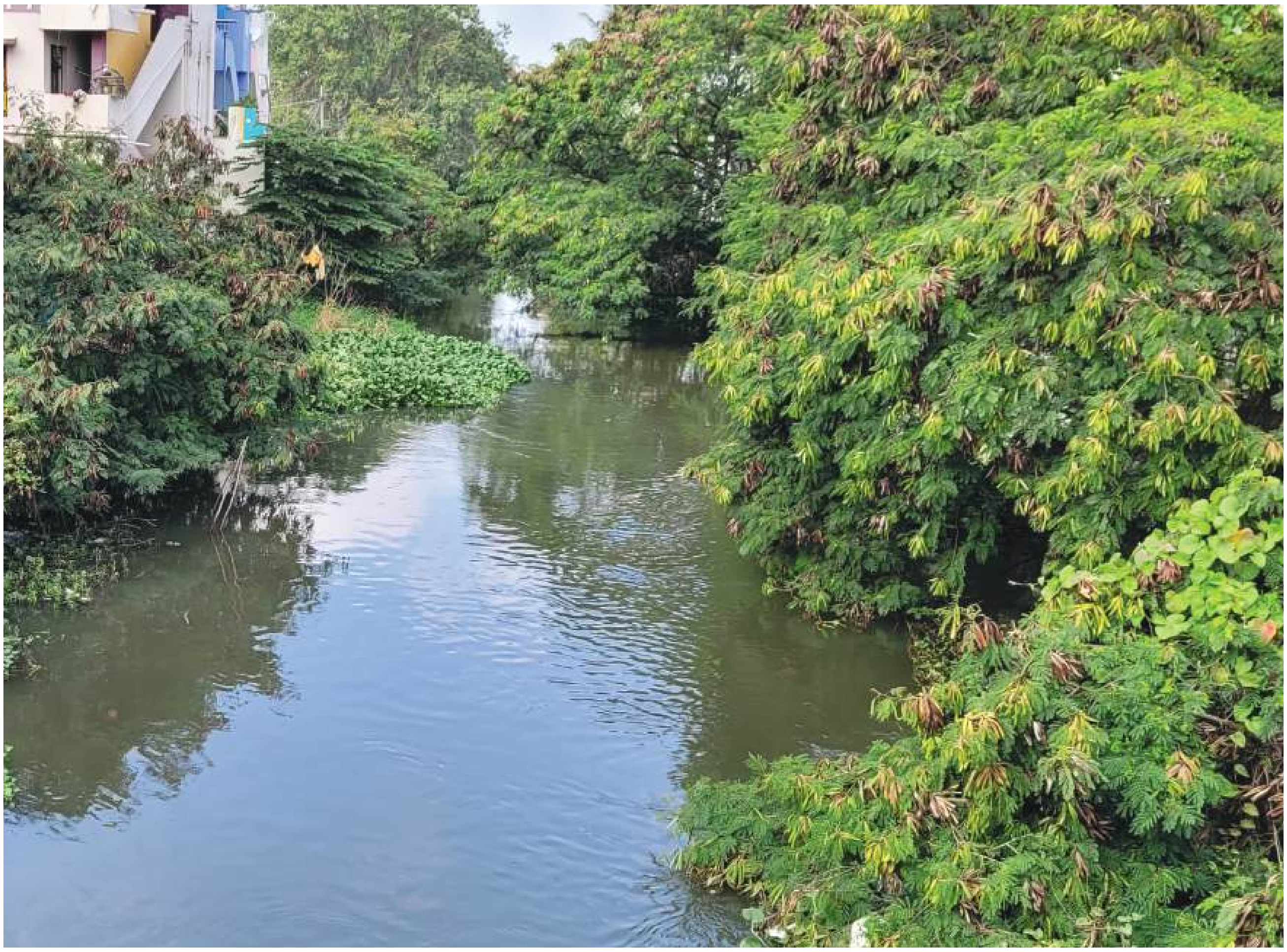
**Flexibility and diversity:** Essential systems should be able to work under a variety of conditions; they should not be rigid or designed only for a specific situation. Any system will fail if overloaded beyond its capacity, but it should be designed to fail under stress in a safe and predictable way, rather than suddenly and catastrophically.

**Re-organization and responsiveness:** Under extreme conditions, systems should be able to respond and change to meet unexpected shocks. This requires flexible organizations and access to different kinds of resources (information, skills, equipment, knowledge and experience). It also requires a high level of coordination and flexible organizational structures capable of adjusting to new conditions.

**Access to information:** Resilient systems have mechanisms to learn from and build on experience, so that past mistakes are not repeated and lessons from other cities can be integrated into planning. This requires procedures for monitoring and evaluating performance under stress, and multiple sources of knowledge and documentation (strengthening "corporate memory").

*Table H5: Prioritisation for Mitigation Actions*

| Sector | Action | Redundancy | |
|---|---|---|---|
| Built Environment and Energy | Develop and enforce a green building regulation specific to Trichy's context and climate addressing emissions across the entire lifecycle of a building. | No | |
| | Adopt Green Building policies and concepts in new building design and construction inline with ECBC and Eco Niwas Samhita | Yes | |



| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | Yes | Yes | High |
| | Yes | Yes | Yes | Yes | Very High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| | Promote and mandate high-energy efficiency appliances – LED Lighting | Yes | |
| | Promote high-energy efficiency appliances – Ceiling Fans | Yes | |
| | appliances – Refrigerators | Yes | |
| | Promote high-energy efficiency appliances – HVAC | Yes | |
| | Promote high-energy efficiency appliances – Energy Efficient Water Pumps in large apartments and residential societies | Yes | |
| | Encourage hotels and hospitals with roof space to install solar water heaters. | Yes | |
| | Scale up use of renewable energy through:<br>• Solar energy through decentralized and grid-connected deployment<br>• Captive Solar<br>• Utilization of wind-based power<br>Purchase of green power from DISCOM | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | Yes | Yes | Very High |
| | Yes | Yes | Yes | Yes | Very High |
| | Yes | Yes | Yes | Yes | Very High |
| | Yes | No | No | Yes | Medium |
| | No | No | Yes | Yes | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Transport | | Yes | |
| | Policy and implement strategies to promote use of non-motorised mobility especially for shorter trips. | No | |
| | Promote public transpowrt by providing high quality buses with information systems and BRT | No | |
| | Electrification of public and private vehicles | Yes | |
| | 00% electrification of SETC, Trichy's Region public bus fleet and RE integration in E-bus charging | Yes | |
| | Encourage the electrification of E-commerce delivery vehicles and goods. | Yes | |
| | Improve road infrastructure and implement traffic control measures. | | |
| Water supply | Implement energy efficiency in water pumping | Yes | |
| | Utilize solar and wind power in water supply facilities with electricity connections | Yes | |
| | Reduce non-revenue water and leakages to reduce energy usage in water networks. | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | Yes | High |
| | Yes | No | Yes | Yes | Medium |
| | Yes | Yes | Yes | Yes | High |
| | Yes | Yes | Yes | Yes | Very High |
| | Yes | Yes | No | Yes | High |
| | Yes | Yes | Yes | No | High |
| | | | | | |
| | No | Yes | Yes | Yes | High |
| | Yes | Yes | No | Yes | High |
| | Yes | Yes | No | Yes | High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Wastewater | Implement energy efficiency in wastewater pumping. All new STPs use anaerobic technology with biogas capture | Yes | |
| | Improve performance and wastewater treatment efficiency of aerobic STPs | No | |
| | Adopt solar and wind power with net metering in wastewater treatment facilities with electricity connections | Yes | |
| | All new wastewater treatment plants to use anaerobic treatment systems with dual membrane technology for biogas capture | Yes | |
| | Improve the efficiency of treatment and the operating performance of aerobic treatment facilities. | Yes | |
| | Action plan for faecal sludge management to review baseline and make suggestions | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | No | Yes | Yes | High |
| | Yes | No | Yes | Yes | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Solid waste management | 100% segregation of waste and enhance primary and secondary collection systems | No | |
| | Develop an updated comprehensive solid waste management strategy. | Yes | |
| | Increase composting capacity by utilising both centralised and distributed facilities. | Yes | |
| | Deploy waste to bio-CNG plants for wet waste and produce renewable fuel from waste | Yes | |
| | Develop an updated comprehensive solid waste management strategy. | Yes | |
| | Increase composting capacity by utilising both centralised and distributed facilities. | Yes | |
| | Deploy waste to bio-CNG plants for wet waste and produce renewable fuel from waste | Yes | |
| | Bio-Methanation | Yes | |
| | Sanitary landfill for the scientific disposal of inert materials and industrial rejects. A landfill gas collecting system to be installed at the dump. | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | Yes | Yes | High |
| | Yes | No | Yes | Yes | High |
| | Yes | Yes | No | Yes | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |

*Prioritisation for Adaptation Actions*

| Sector | Action | Redundancy | |
|---|---|---|---|
| Built Environment and Energy | Design and implement a Heat-Reflective Roofing initiative for Trichy, prioritizing regions that experience urban heat, with a specific focus on improving conditions in slum areas. | Yes | |
| | Facilitate the adoption of sustainable architectural practices, particularly those outlined in the ECBC 2017, including within affordable housing projects.<br>**Sub-Action:** Enable mass training on green building principles, especially for relevant professionals and artisans by leveraging academic institutions, state training institutions, and builders associations. | Yes | |
| | Develop innovative cooling strategies for streets and vending zones, integrating them into localized street vending development plans. | Yes | |
| | Support vertical gardening and roof-top gardening to reduce heat stress on built environment . | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | Yes | High |
| | Yes | No | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Water supply | Create an Action Plan for sustainable water balance that will maximize water recharge and help achieve self sufficiency. | Yes | |
| | 24X7 water supply with Water metering policy (Target to reduce 20% NRW by 2024-25 and reach 10% by 2070) | Yes | |
| | Implement regulations that encourage the reuse of treated wastewater by restricting ground water extraction and rationalizing water tariffs for industrial and commercial customers. | Yes | |
| | Increase water treatment capacity to satisfy rising demand from new growth regions. | Yes | |
| | Conduct a robust NRW study | Yes | |
| | Improve the water delivery systems through SCADA and smart meter-based monitoring | Yes | |
| | Promote rainwater harvesting and ground water recharge.<br><br>**Sub-actions:**<br>• Awareness generation on benefits<br>• Approach organizations to implement such initiatives under CSR/CER | Yes | |
| | Monitoring of RWH structures implemented by builders as per TNCDBR - 2019. | | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | No | Medium |
| | No | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | No | Yes | No | Medium |
| | Yes | No | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |
| | | | | | |

| Sector | Action | Redundancy | |
|---|---|---|---|
| | Rejuvenation and ecological restoration of lakes<br><br>**Sub-actions:**<br>• Build STP before lakes entry points or DEWATS systems<br>• Removing encroachments.<br>• Desilting of lakes.<br>• Establishment of bird islands.<br>• Developing constructed/floating wetlands to treat water | | |
| Wastewater | Comprehensive Action Plan and Wastewater Reuse and Recycling Strategies (including a Wastewater Reuse and Recycling Policy) | Yes | |
| | Replace aging sewerage network | No | |
| | Construct Tertiary Treatment Plants for recycling and reuse of water | No | |
| | Promote decentralized wastewater treatment and dual plumbing system as indicated in in TNDBCR for projects with 2500m$^2$ built up area or more | Yes | |
| | Fecal sludge management action plan | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | | | | | |
| | No | Yes | No | No | Average |
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | No | Yes | Yes | Medium |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Storm water | Watershed evaluation and development of a conservation and augmentation strategy for water resources | Yes | |
| | Protect and improve natural drains | | |
| | Capture surface runoff through recharge pits / natural swales / hybrid ditches | | |
| | Build Tree Box Filters and Permeable Pavement on Footpaths | Yes | |
| | Desiltation and Maintenance of Existing Water Bodies | Yes | |
| | Construct percolation wells in areas susceptible to urban flooding and in lake beds | No | |
| | Improve the coverage of storm water drainage networks in areas prone to flooding.<br><br>**Sub-actions:**<br>• Augment storm water drainage network and pumping stations<br>• Construct and maintain culverts and outfalls.<br><br>Deployment of flood sensors and developing an early warning system for urban floods | Yes | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | No | Medium |
| | | | | | |
| | | | | | |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | No | No | Medium |
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | High |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Solid Waste Management | Towards Zero waste wards:<br><br>**Sub-actions:**<br>• IEC to popularize circular economy principles and source segregation.<br>• Waste Reduction strategies: lifestyle changes and related IEC<br>• Prevention of littering<br><br>Decentralized dry waste collection centers: recyclables, C&D waste, and e-waste | No | |
| | Towards zero plastic waste<br>• Plastic value chain analysis,<br>• Ban Single Use Plastics and promote alternatives,<br>• Maximise recovery and recycling of plastic and other dry waste,<br><br>Incentivise private/cooperative buy-back initiatives | No | |
| | Promote eco-parks:<br><br>MRFs, manufacturers of alternate material, and recyclers. | Yes | |
| | Legacy waste management | | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | No | Medium |
| | Yes | Yes | Yes | Yes | Very High |
| | | | | | |

| Sector | Action | Redundancy | |
|---|---|---|---|
| Urban Green Cover and Biodiversity | Increase additional plantation in wards that are exposed to urban heats. | Yes | |
| | Prepare Local Biodiversity Strategies and Action Plan (LBSAP)<br><br>**Sub-actions:**<br>• City wide assessment to document the critical ecosystems, their present health status and the threats faced by them. Risk assessment study of invasive alien species in major natural ecosystems of the city (including river, lake and ponds).<br><br>Development of a strategy and action plan (including water bodies & lake ecosystems) to improve the health of the critical ecosystems. targeted action plans for identified species and risks | Yes | |
| | Develop micro-habitats in existing urban green spaces such as pollinator gardens, grasslands/scrublands | Yes | |
| | Partnering with institutions to develop green corridors that link the city's green ecosystems | No | |

| | Flexibility | Responsiveness | Access to information | Energy saving and GHG emissions mitigation potential | Overall resilience score Overall resilience score 5/5: Very high 4/5: High 3/5: Medium 2/5: Average 1/5: Low |
|---|---|---|---|---|---|
| | Yes | Yes | No | No | Medium |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | High |
| | Yes | Yes | Yes | No | Medium |

*Table H6: Lakes in TCC Administrative Area*
*Soure : Tiruchirappalli City Municipal Corporation*

| Sl.No | Name of Tank | Locations | Ayacut (HA) | Fed By |
|---|---|---|---|---|
| 1 | Pirattiyur Tank | Located along NH 45 | 116.13 | Distributary No. 2 of New Kattalai High Level Channel (NKHLC) |
| 2 | Kothamangalam Chinna Kulam | Located in Ramji Nagar NH 45 | 12.1 | Distributary No. 2 of New Kattalai High Level Channel (NKHLC) |
| 3 | Kothamangalam Periya Kulam | Located along railway track towards Dindigul in Ramji Nagar | 139.6 | Distributary No. 4 of New Kattalai High Level Channel (NKHLC) |
| 4 | Mela Panjappur Tank | Located along Madurai Road | 29.6 | Distributary No. 6 of New Kattalai High Level Channel (NKHLC) |
| 5 | Sengurichi Tank | Located along Madurai Road in Panjappur | 41.67 | Distributary No. 6 of New Kattalai High Level Channel (NKHLC) |
| 6 | Kallan Kulam | Located between NH 45 & NH 45B in Karumandapam | 36.4 | Distributary No. 14 of New Kattalai High Level Channel (NKHLC) |
| 7 | Chetti Tank | Located along Pudukottai Railway Line | | Distributary No. 14 of New Kattalai High Level Channel (NKHLC) after passing through Sengulam Tank |

| Sl.No | Name of Tank | Locations | Ayacut (HA) | Fed By |
|---|---|---|---|---|
| 8 | Sengulam Tank | Located near crossing of Pudukottai railway line & sathanur main road | 30.97 | Distributary No. 14 of New Kattalai High Level Channel (NKHLC) after passing through Kanakkan Tank |
| 9 | Sathanur Periya Kulam | Located in K. Sathanur | 110.85 | Distributary Io. 14A New Kattalai High Level Channel (NKHLC) |
| 10 | Kanakkan Tank | Lovated eastern of K. Sathanur Road | 32.33 | Distributary Io. 14A New Kattalai High Level Channel (NKHLC) |
| 11 | Sengulam Tank | Lovated along Pudukottai Road | | Receives Water from Kallukuzhi, circuit house colony, highways colony & subramaniyapuram and passess to Uyyakondan Channel |
| 12 | Periya Kulam | Located along Putukottai Road Near National Dairy Development Board | | Distributary No. 15A of New Kattalai High Level Channel (NKHLC) |
| 13 | Parai Tank | Located Near Kottappatu Village | 3m Depth | Storm Water from airpot area outfalls in to this tank |
| 14 | Rayappa Udhaiyan Tank | Located along Pudukottai Road Near Sembattu Area | 14.23 | Distributary No. 15 of New Kattalai High Level Channel (NKHLC) |

| Sl.No | Name of Tank | Locations | Ayacut (HA) | Fed By |
|---|---|---|---|---|
| 15 | Sembattu Periya Kulam | Located in sembattu village near Pudukottai Road | 78.5 | Distributary No. 15 of New Kattalai High Level Channel (NKHLC) |
| 16 | Ammankulam | Located northern side of Tanjore Road | | Storm Water from Surya Colony, Nehruji Nagar, and Jagannathapuram area enters in this. |
| 17 | Vanivan Kulam | Located near Swaminathan St. | 14.9 | Storm Water from Tanjore road, Mallyappa Nagar & Kamaraj Nagar Outfalls in this tank |
| 18 | Valathivar Tank | Located across Tanjore railway line near Ambikapuram Road | 29.55 | Rainfed Tank |
| 19 | Vadakku Mulli Tank | Located South of Tanjore Railway Line Near Ambikapuram Rd | 4.45 | Rainfed Tank |
| 20 | Teru Tank | Located Near Kamaraj Road | 2.67 | Raifend tank and receives sewage/ strom water from nearby residential areas |
| 21 | Thattan Tank | Located Near Kamaraj Road | 2.55 | Rainfed Tank |
| 22 | Mavadi Kulam | Located Near Poneripuram Main Road | 48.12 | Distributary No. 15 of New Kattalai High Level Channel (NKHLC) |

**ICLEI - Local Governments for Sustainability, South Asia**

C-3 Lower Ground Floor,
Green Park Extension,
New Delhi – 110016, India

Email: iclei-southasia@iclei.org

91–11–4974 7200