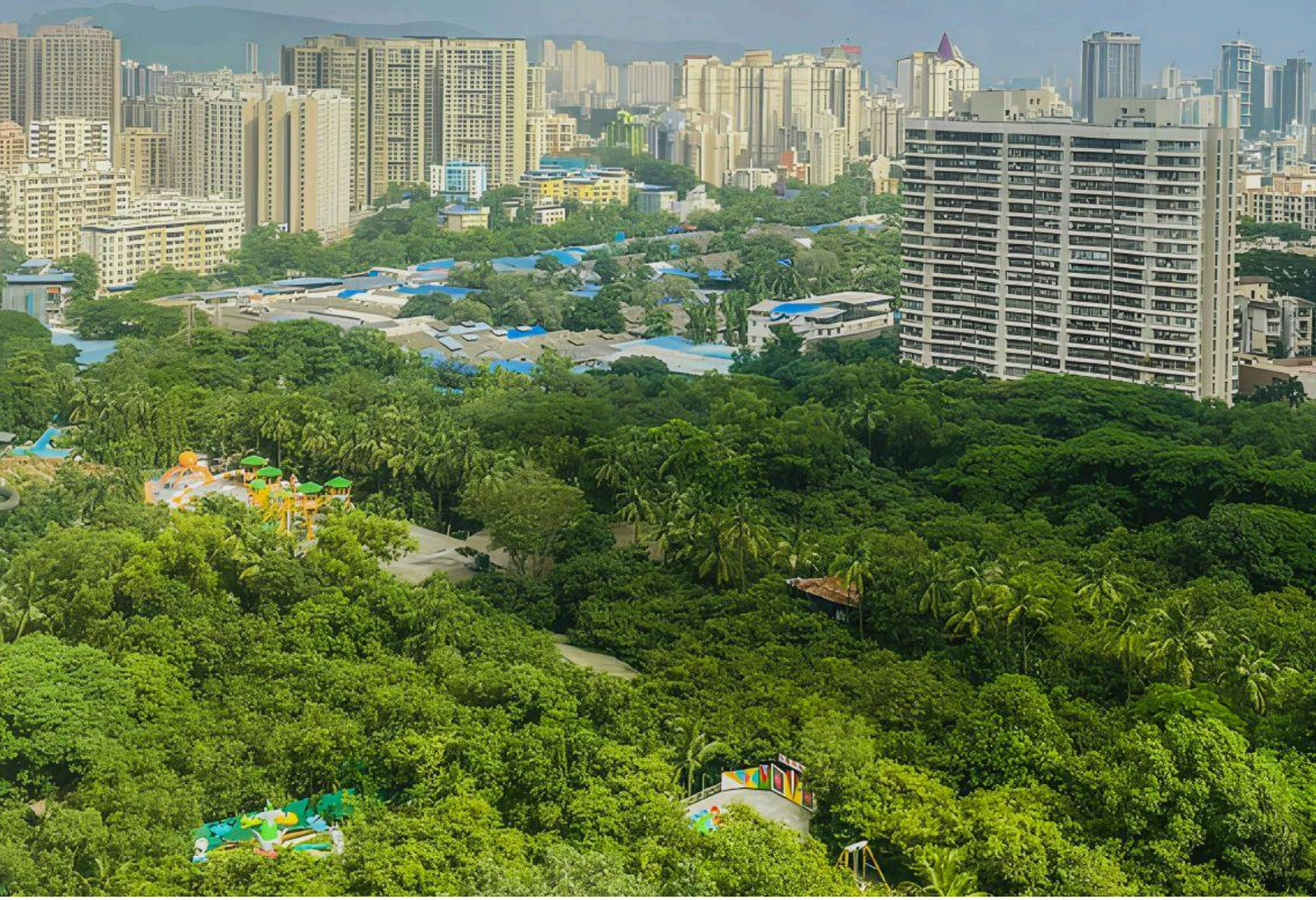
LiFE Lifestyle for Environment

माझी वसुंधरा

C40 CITIES

Knowledge Products on Scaling Urban Rooftop Solar and Green Municipal Procurements in Maharashtra



Technical Partner: eds environmental design solutions

Disclaimer

This report and the compilations has been prepared as part of the Maharashtra City Decarbonisation Roadmap implementation support and is intended to provide strategic insights, technical analysis, and illustrative recommendations to support urban climate action planning and implementation in the participating cities.

The findings, interpretations, and conclusions expressed in this document are based on information available at the time of preparation, including data provided by city governments, stakeholders, and secondary sources. While reasonable efforts have been made to ensure the accuracy of the information presented, C40 Cities Climate Leadership Group and its partners make no representations or warranties, whether express or implied, as to the completeness or ongoing accuracy of the data and accept no liability for any errors, omissions, or changes in circumstances after publication.

The recommendations outlined in this report are indicative and advisory in nature. Their applicability and implementation are subject to local conditions, institutional arrangements, regulatory approvals, financial feasibility, and policy decisions taken by the respective city and state authorities. This document does not constitute legal, financial, or investment advice, nor does it create any binding obligations on the part of C40, partner organisations, or participating cities.

Message

Smt. Pankaja Gopinath Munde
Honourable Minister for Environment and Climate Change,
Animal Husbandry, Government of Maharashtra

Maharashtra has set a clear and ambitious vision for its future—one that balances economic growth, social equity, and environmental sustainability. Under the state's long-term development agenda, including Vikasit Maharashtra 2047 and the State Action Plan on Climate Change, the Government of Maharashtra is committed to building climate-resilient cities, strengthening energy security, improving quality of life for citizens, and positioning the state as a national and global leader in low-carbon development.

Cities lie at the heart of this vision. As engines of growth and innovation, Maharashtra's urban centres also account for a significant share of energy demand and greenhouse gas emissions, particularly from the buildings and energy sectors. Addressing these challenges is not only essential for meeting climate goals, but also for reducing energy costs, improving thermal comfort, enhancing public health, and ensuring inclusive urban development—especially for communities vulnerable to heat.

The report presented here represents a meaningful step in translating the state's climate and development vision into city-level action. Developed through close collaboration between the Environment and Climate Change Department, the State Climate Action Cell, urban local bodies, and C40 Cities, this work focuses on moving decisively from planning to implementation. By advancing High Impact Actions on decarbonisation through net-zero municipal buildings, rooftop solar deployment, cool and green roofs, behavioural energy efficiency and green municipal procurement, the programme supports Maharashtra's priorities on clean energy transition, climate adaptation, and sustainable urban infrastructure.

The successful notification and implementation of Cool Roof Bye-laws in Amravati stands as a strong example of how evidence-based planning, sustained technical support, and effective state–city coordination can translate climate priorities into enforceable urban policy aligned with Maharashtra's goals on heat resilience and low-carbon growth. This leadership is further reinforced by parallel successes in other cities, including the development of Net Zero Municipal Buildings Action Plans in Mumbai and Panvel, behavioural energy efficiency and rooftop solar programmes in Navi Mumbai and Thane, and household-level cooling pilots in Chandrapur demonstrating measurable reductions in indoor temperatures and energy demand. Together, these implementation-ready roadmaps highlight Maharashtra's ability to move from pilots to policy, and position the state as a national leader in delivering scalable, replicable urban climate solutions for cities across India and the Global South.

I commend the Environment and Climate Change Department, the State Climate Action Cell, the Urban Development Department, the Energy Department participating municipal corporations, and our technical partners for their commitment and collaborative spirit. These reports are not an end in themselves, but practical tools to support cities as they deliver on Maharashtra's broader vision of resilient, energy-efficient, and people-centred urban development. I am confident that the learnings from this initiative will inform future policies and inspire cities across India and the Global South.

Message

Smt. Jayashree Bhoj
Secretary, Department of Environment and Climate Change
Government of Maharashtra

The Government of Maharashtra's climate and development agenda recognises that effective implementation of climate actions at the city level is critical to achieving the state's long-term goals on sustainability, resilience, and economic competitiveness. As articulated through Vikasit Maharashtra 2047, the State Action Plan on Climate Change, and sectoral policies on energy and urban development, the state is committed to enabling cities to adopt low-carbon pathways while strengthening institutions, improving service delivery, and safeguarding vulnerable communities.

This set of project reports reflects a deliberate effort to operationalise that vision. Built upon the Maharashtra City Decarbonisation Roadmap, in partnership with C40 Cities, the work moves beyond aspirational targets to provide cities with implementable High Impact Actions, institutional arrangements, and monitoring frameworks in the energy and buildings sector. The emphasis throughout has been on alignment—between city priorities and state policy levers, between climate objectives and development outcomes, and between technical ambition and administrative feasibility.

Four cities—Mumbai, Panvel, Nashik, and Amravati—now have implementation-ready roadmaps of selected high impact actions that support state priorities such as scaling renewable energy, improving energy efficiency in public assets, enhancing thermal comfort, and strengthening procurement systems. Three additional cities—Thane, Navi Mumbai, and Chandrapur—have been supported on immediate actions that build readiness while drawing on the tools and learnings from the deep-dive cities. This tiered model reflects a scalable pathway for extending climate action across Maharashtra's diverse urban landscape.

Equally significant is the strengthening of institutional capacity at both city and state levels. Through sustained consultations, knowledge-sharing sessions, and thematic discussions, officials have been better equipped to integrate climate considerations into budgeting, planning, procurement, and regulatory processes. The development of state-level knowledge products on rooftop solar and green municipal procurement, as well as formal policy inputs to the Urban Development Department, further embeds these learnings within government systems.

Anchored by the State Climate Action Cell, this initiative has also fostered a collaborative ecosystem—bringing together cities, state agencies, utilities, financial institutions, and knowledge partners—to support coordinated action and continuous learning. This foundation will be critical as Maharashtra advances its clean energy transition, explores innovative financing mechanisms, and engages with national and international climate initiatives, including Just Energy Transition frameworks.

These reports are intended as living documents that support ongoing implementation and policy refinement. They reflect Maharashtra's commitment to evidence-based decision-making and climate action that delivers tangible benefits for citizens while advancing the state's long-term development vision.

Message

Shri Abhijit Ghorpade
Director, State Climate Action Cell (SCAC)
Department of Environment and Climate Change
Government of Maharashtra

Maharashtra, India's one of the most industrialised and urbanised states, has drafted its Viksit Maharashtra 2047 vision to achieve a USD 5-trillion economy through a sustainable and inclusive approach, while managing rapid infrastructure and construction expansion. Reflecting its leadership and commitment, Maharashtra has mobilised climate action across cities, with 43 AMRUT cities formally committing to the global Race to Zero initiative. The buildings sector accounts for nearly 37 percent of India's annual primary energy consumption, a share that is projected to increase substantially in the absence of timely and effective interventions.

Cities assume a critical role in shaping the trajectory of climate action, particularly as building stock is expected to grow significantly by 2030. In response, the Department of Environment and Climate Change, in collaboration with C40 Cities and with technical support from Environmental Design Solutions (EDS), developed the Maharashtra City Decarbonization Roadmap for the Energy and Building Sector in 2023, covering 43 AMRUT cities across the State, supporting cities in achieving net-zero emissions by 2050. As part of the roadmap's implementation, seven cities were supported on high-impact actions aligned with local priorities, while remaining consistent with state and national objectives.

This resulted in the development of: 'Net-zero energy action plans for public buildings in Mumbai and Panvel cities', 'Roadmap for accelerating rooftop solar deployment in Nashik city', 'Cool / Green roof policy roadmap for Amravati city', 'Identification of cooling pathways for low-income settlements in Chandrapur city', 'Development of behavioural energy efficiency and renewable energy adoption programmes for municipal buildings in Navi Mumbai and Thane cities.'

In addition, policy notes and guidance documents addressing cross-cutting challenges were also developed. This included 'Road to Renewable Cities', a knowledge product supporting cities in their clean energy transition and 'Greening Municipal Procurement', a step-by-step guide for urban local bodies, that centres "procurement" in the climate action dialogue.

This body of work has been undertaken through close coordination with urban local bodies, relevant state departments and agencies, technical experts, and partner organisations. It reflects an evolving approach towards action-oriented and implementation-focused climate planning, grounded in local realities, informed by analytical evidence, and designed to support scalability and replication across the State.

The Maharashtra State Climate Action Cell remains committed to supporting cities in mainstreaming climate considerations within the urban built environment and strengthening institutional capacities for sustained climate action. The roadmaps, action plans, policy recommendations and knowledge products presented herein are expected to facilitate accelerated implementation, promote innovation, and contribute meaningfully to Maharashtra's transition towards a low-carbon and climate-resilient future.

Foreword

Naim Keruwala
Regional Director, South and West Asia
C40 Cities

Maharashtra's cities are at the forefront of India's urban climate transition. Through the Maharashtra City Decarbonisation Roadmap for the Energy and Buildings Sector, 43 cities across the state have committed to ambitious, city-led pathways that align with India's long-term climate goals and demonstrate how subnational leadership can drive climate action at scale. This collective approach positions Maharashtra as a model for other states accelerating India's clean energy transition.

Rapid urbanisation, rising energy demand, and increasing exposure to extreme heat and climate risks underscore the urgency of accelerating urban climate action that delivers tangible benefits for residents while supporting long-term economic growth. C40's support to seven cities (Mumbai, Panvel, Nashik, Amravati, Thane, Navi Mumbai and Chandrapur) through development of high impact action roadmaps and critical actions on energy transition and knowledge products are aimed at advancing implementation, and providing cities with the necessary tools and frameworks. .

This suite of reports marks an important milestone in Maharashtra's urban decarbonisation journey. Developed in collaboration with the Government of Maharashtra, seven municipal corporations, and technical experts; these roadmaps demonstrate how cities can use their regulatory, operational, and purchasing power to drive systemic change at scale. Together, they outline practical and implementable pathways to reduce emissions, improve energy efficiency, and strengthen resilience across the energy and buildings sector; one of the most critical and cost-effective areas for urban climate action. The reports focus on key levers available to cities today, including cool and green roofs, rooftop solar, net-zero municipal buildings, behavioral change, and sustainable procurement, translating ambition into clear, actionable steps.

I commend the Environment and Climate Change Department of Government of Maharashtra, Climate Action Cell on its efforts in achieving this significant milestone and collaboration. C40 also acknowledges the engagements and support extended by the Departments of Urban Development, Energy Department along with the Maharashtra Institution for Transformation (MITRA) and seven cities in developing these roadmaps.

C40 looks forward to further supporting Maharashtra's cities to implement and mainstream climate actions supporting objectives of Vikasit Maharashtra 2047 and State Action Plan on Climate Change.

Acknowledgements

This report has been developed as part of the Maharashtra City Decarbonisation Roadmap, with the aim of supporting cities in advancing high-impact action in the energy and buildings sector. The preparation of this compilation would not have been possible without the collective efforts, insights, and collaboration of multiple institutions and individuals across city, state, and national levels.

We would like to express our sincere appreciation to the Environment and Climate Change Department, through the State Climate Action Cell (SCAC), the Urban Development Department, the Energy Department of Government of Maharashtra, and the Maharashtra Institution for Transformation (MITRA) for their leadership, guidance, and continued support throughout the programme. Their commitment has been instrumental in enabling cities to translate climate ambition into actionable and implementable pathways.

We also extend our sincere appreciation to the technical partners and subject-matter experts Environmental Design Solutions (EDS) for their valuable contributions to analysis, stakeholder engagement, and the development of the knowledge products.

Finally, we thank all stakeholders; public institutions, practitioners, and partners for contributing their time and perspectives. This report reflects a shared commitment to advancing clean energy, low-carbon buildings, and climate-resilient urban development across Maharashtra.

Preface

C40's prior engagement on structuring Mumbai's Paris Agreement aligned Climate Action Plan (MCAP) highlighted the Energy and Buildings sector as one of the major contributors of GHG emissions in the city. Taking cues from MCAP and building on the commitment by 43 cities in Maharashtra to prepare and implement city-level decarbonization roadmap; C40 supported development of a roadmap for transition of the energy and building sector. Launched by the Environment and Climate Change Department of Maharashtra in December. 2023 this Decarbonization Roadmap is a city-level template that outlines a pathway to decarbonisation supporting the energy transition, upscaling energy efficiency, reducing GHG emissions, and reliance on fossil fuels, and lowering energy operation costs.

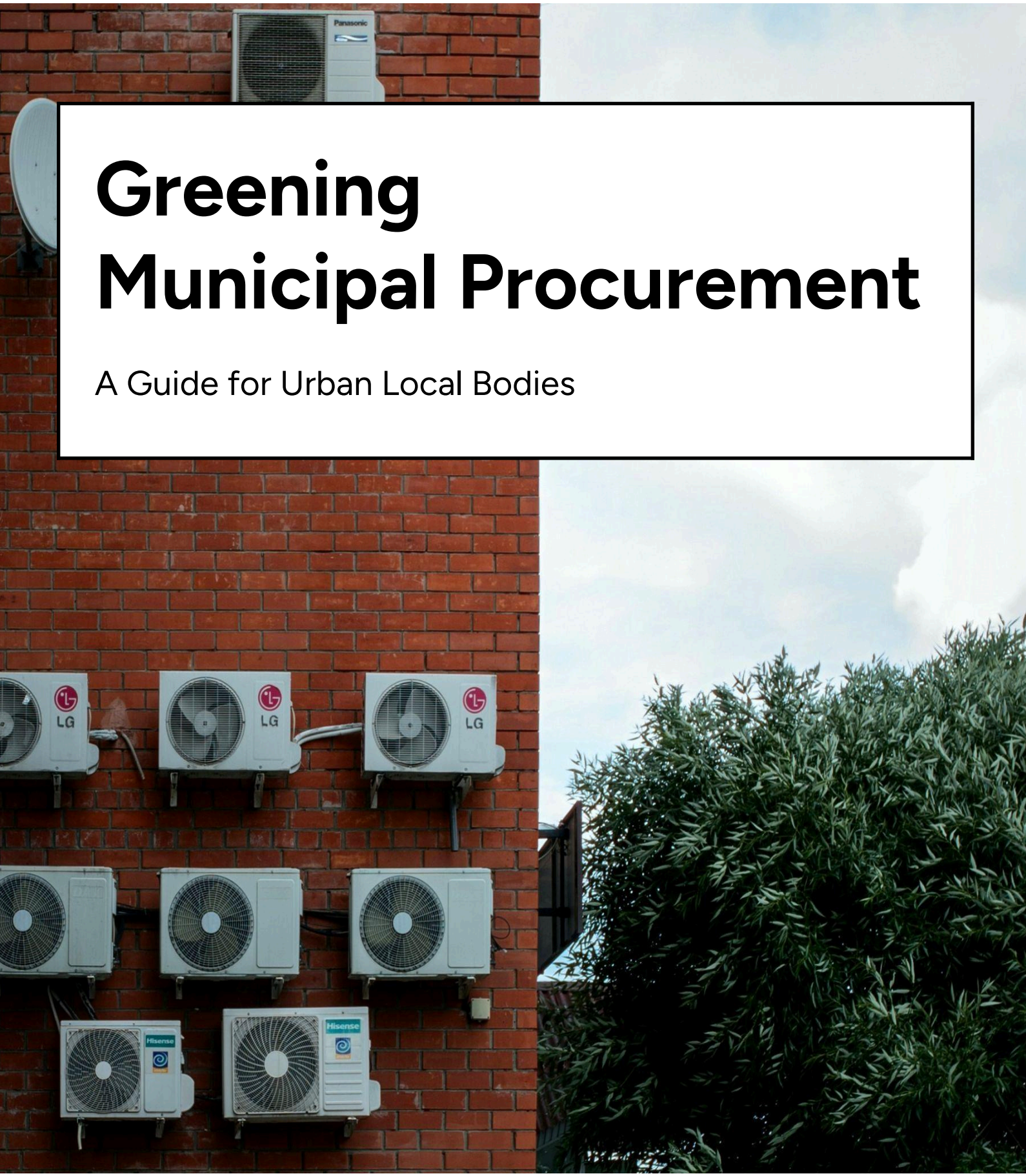
Building on the Maharashtra City Decarbonisation Roadmap, C40 supported seven (Mumbai, Amravati, Panvel, Nashik, Chandrapur, Navi Mumbai, Thane) out of the 43 cities included in the first phase of this work which was focused on developing implementation frameworks for clean energy and low-carbon buildings during 2024-25. These roadmaps focus on identifying priority actions with the greatest mitigation and co-benefits potential, grounded in local data, institutional realities, and market conditions, while embedding considerations related to governance, financing, and delivery.

This compilation brings together pivotal knowledge products—"Road to Renewable Cities: Unlocking Maharashtra's Urban Rooftop Solar Potential" (August 2025) and "Greening Municipal Procurement: A Guide for Urban Local Bodies" (December 2025). Emerging from the City Decarbonisation Roadmap for the Energy and Building Sector (December 2023) and extensive stakeholder engagements including webinars, focus group discussions, and convenings with 43 AMRUT cities, these resources address critical implementation barriers to high-impact actions like rooftop solar deployment, energy efficiency retrofits, and sustainable procurement. Tailored for urban local bodies (ULBs), state departments (Energy, Urban Development, Environment), and partners (MEDA, MSEDCL), they provide actionable policy recommendations, regulatory alignments (e.g., UDCPR, ECBC), financing models (RESCO, municipal bonds), and step-by-step tools such as checklists, tender clauses, and monitoring frameworks to scale net-zero transitions equitably across Maharashtra's cities.

LiFE Lifestyle for Environment

माझी वसुंधरा

C40 CITIES



Greening Municipal Procurement

A Guide for Urban Local Bodies

Technical Partner: eds environmental design solutions

Executive Summary

Municipal procurement is a powerful lever for India's climate and development goals. With public procurement accounting for nearly **30% of India's GDP**, Urban Local Bodies (ULBs) have a unique opportunity to drive market transformation, reduce operational costs, and reduce greenhouse gas (GHG) emissions. The building and energy sectors—responsible for a significant share of municipal spending and long-term operating costs—present the most immediate potential for impact.

This knowledge product, **Greening Municipal Procurement: A Guide for Urban Local Bodies**, provides municipal corporations with a **practical, step-by-step framework** to integrate Green Public Procurement (GPP) into existing procurement systems without requiring new legal structures. It outlines how cities can shift from lowest-cost purchasing to **value-based procurement** using lifecycle cost (LCC) and total cost of ownership (TCO) - enabling long-term budget savings.

Based on consultations with Maharashtra's state and city representatives, the guide identifies key implementation barriers—limited awareness, perceptions of higher costs, inadequate specifications, and gaps in SSR/DSR—and offers actionable tools, checklists, sample criteria, and model tender clauses to address them. It contextualises GPP within India's national policies, Maharashtra's city decarbonisation roadmap, and global best practices, demonstrating how targeted green procurement can reduce emissions and significantly lower electricity bills from municipal assets such as lighting, cooling, and water systems.

Structured across the three stages of the procurement cycle—**Pre-procurement & Planning, Tendering & Evaluation, and Contracting & Post-Award Management**—the guide details the roles and responsibilities of the key stakeholders and offers practical entry points for integrating green specifications and performance-linked payments.

By adopting green municipal procurement, ULBs can:

a) Lower operational expenditures and reduce budget pressures
b) Improve transparency and accountability
c) Signal demand for sustainable products and accelerate market readiness
d) Support city- and state-level net-zero commitments

This guide equips municipalities with the knowledge, tools, and confidence to begin with mechanical and electrical categories—such as lighting, HVAC systems, pumps, motors, and solar—before scaling to broader works and services. It positions GPP not merely as an environmental initiative but as a **governance reform** that enhances municipal efficiency, financial sustainability, and long-term resilience.

1. Introduction

With public procurement contributing to approximately 15% of global greenhouse gas (GHG) emissions and representing 13-20% of global GDP on an average[1] procurement practices have a substantial impact on climate change mitigation efforts. In India, public procurement accounts for almost 30% of GDP[2], making it a powerful lever to advance climate goals.

The building sector alone is responsible for nearly a quarter of emissions[3], highlighting its critical role in climate action. Approximately 40% of all public procurement-related emissions can be abated. The efforts by the world's governments to reach net-zero emissions will likely increase procurement costs by 3-6%[4]. As India prepares for rapid urbanisation, procurement decisions taken today by the government and urban local bodies (ULBs) will play a pivotal role in driving market transformation, mainstreaming sustainable consumption, and reducing GHG emissions.

In Maharashtra, India's second most industrialized state, and aspiring for a USD 5-trillion economy by 2047[5], the demand for construction is expected to surge. Without a shift in procurement practices, ULBs risk locking in high-cost, high-emission systems for decades to come. Already, the ULBs face mounting financial pressures in managing essential services. Rising electricity costs from offices, streetlights, and public infrastructure consume a large share of budgets. Inefficient assets also contribute to high operations and maintenance (O&M) expenses. At the same time, growing infrastructure demand is straining the already limited municipal resources, leaving little room for investment in sustainability.

Green Public Procurement (GPP) addresses these challenges by enabling ULBs to:

1. Reduce electricity bills and emissions resulting from operating buildings and public services
2. Improve transparency and accountability in procurement decisions.
3. Provide a signal to the market on demand for sustainable products and services.
4. Enhance service quality and reliability for citizens.

Greening public procurement in the building sector can reduce up to 42% GHG emissions across the design, construction, and operational phases of new buildings[6]. For ULBs, green municipal procurement is not just a climate action tool, but a governance strategy. By leveraging their purchasing power, cities can accelerate adoption of energy-efficient technologies and reduce operational expenses.

India's commitment to achieve Net Zero Emissions by 2070, Maharashtra's 43 AMRUT cities pledging net-zero by 2050 through a roadmap for decarbonising the energy and building sectors and city climate action plans; provide an overarching direction for greening municipal procurement.

---

[1] A Global Procurement Partnership for Sustainable Development: An International Stocktaking of Developments in Public Procurement, World Bank, 2022

[2] Green Public Procurement in India Progress, challenges, and opportunities, IISD, 2024

[3] Impact of India's building sector over country's carbon budget

[4] Green Public Procurement: Catalysing the Net-Zero Economy. Whitepaper, January 2022

[5] Maharashtra 2047 Vision

[6] Green Public Procurement: Building Sector in India, The World Bank. EDS, 2024

1.1 Purpose of this document

This guide has been designed as an action-oriented resource to support ULBs systematically green their procurement process. Despite its potential, green public procurement is often constrained by limited awareness, perceptions of higher upfront costs, lack of access to qualified vendors, and the absence of clear guidance tailored for municipal workflows. Existing systems prioritize the lowest-cost approach (L1), with little emphasis on lifecycle costing or sustainability criteria[7]. This document is a step-by-step guide supported with tools, and best practices to support ULBs in their journey towards greening procurement. It aims to:

1. Introduce the concept of green public procurement; and illustrate its benefits and applications in context of the ULB.
2. Provide an understanding of the key overarching national and state policies, mandates and guidelines that enable or influence GPP.
3. Outline the approach to integrate green in the standard municipal procurement system, and provide ready to use resources such as checklists, sample tender clauses.

Considering the focus on decarbonisation of building and energy sectors, this guide focuses on procurement of electrical and mechanical components, such as lighting, and cooling systems, to enable ULBs to reduce operational costs, enhance service delivery, and accelerate their contribution to state and national climate goals.

[7] Insights from Knowledge Sharing Session and Focus Group Discussion on Greening Municipal Procurement held in September and October 2025.

2. Understanding Green Municipal Procurement

This chapter presents the fundamentals of Green Public Procurement (GPP), compares it with conventional practices, and highlights its benefits and co-benefits. Based on stakeholder consultations, it outlines common challenges and debunks misconceptions, showcasing GPP as a practical, value-adding tool for Urban Local Bodies (ULBs).

2.1 WHAT it is and WHY it matters

Public procurement is a powerful tool for sustainable development, as it represents a significant share of GDP and market demand. The European Union refers to **Green Public Procurement (GPP)** as "Public procurement for a better environment", defining it as the approach whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle, compared to those with the same primary function that would otherwise be procured[8]. While GPP focuses mainly on environmental (such as cutting emissions, improving energy efficiency, and minimizing waste) and economic (such as life cycle cost) aspects; Sustainable Public Procurement (SPP) extends this scope to include the social dimension as well. This guide is focused on GPP.

To better understand the concept in practice, Table 1 provides a comparative between conventional and green public procurement:

Table 1: Key Differences Between Conventional and Green Public Procurement

Aspect	**Conventional Procurement**	**Green Public Procurement**
Technical specifications	Based on functional and quality requirements	Functional + Quality + Environmental Performance
Cost	Value for money considers lowest upfront cost (Only CAPEX)	Value for money considers life-cycle cost, Total Cost of Ownership (CAPEX + OPEX)
Evaluation	Compliance with basic criteria.	Compliance considers environmental criteria in addition to basic criteria.
Environmental View	Often not prioritised	Reduces resource use and emissions
Market Impact	Maintains status quo.	Drives innovation towards green products.
Illustration[9]	Sodium vapor / CFL streetlights	LED streetlights with smart controls (timers, dimming, sensors)
	CFL / T12 fluorescent tubes/bulbs	LED tubes/bulbs with occupant and/or daylight sensors

[8] Green Public Procurement, European Union

[9] Please note that the specifications provided in the examples are only illustrative (indicating comparable products that have better energy performance). It does not indicate the product / appliance is green.

Aspect	Conventional Procurement	Green Public Procurement
	BEE star labelled air-conditioners (1-3 star)	Air-conditioners with ISEER[10] equal to or greater than 5 star label benchmark.

The adoption of GPP goes beyond compliance- it actively reduces environmental impacts, enhances resource efficiency, and supports market transformation.

GPP's benefits extend across governance, economic performance, public health, and social outcomes. It strengthens institutional capacity, improves fiscal efficiency, fosters local economic development, and encourages innovation that builds long-term resilience. By integrating sustainability into purchasing decisions, cities can realise not only cost savings, but also broader systemic value, enabling strategic transformation across the entire procurement ecosystem.

Case Study:

City of Regensburg, Germany[11]

The City of Regensburg started implementing an Eco School Programme in 1999 to reduce water usage and waste production through an adaptation programme for climate change. It introduced SPP in energy, office supplies and construction products. The sustainable procurement activities have saved 10 million Euros in energy and water costs over a 15-year period.

2.2 Breaking Through Challenges and Misconceptions

Despite its long-term benefits, ULBs face persistent challenges in adopting GPP. To better understand these barriers, a series of convening activities - including a knowledge-sharing session, a focused group discussion (FGD), and follow-up consultations with cities such as Mumbai, Nashik, Amravati, and Navi Mumbai – was conducted.

These discussions showed that nearly half of the participants were unfamiliar with GPP and carried misconceptions about its feasibility and cost implications. The FGD further highlighted that the barriers extend beyond awareness, rooted in regulatory processes, limited market readiness and insufficient technical capacity to assess green premiums or evaluate lifecycle benefits, as outlined in Table 2.

Table 2: Key Challenges in Mainstreaming Green Municipal Procurement

[10] ISEER, or Indian Seasonal Energy Efficiency Ratio, is a rating system that measures the energy efficiency of air conditioners in India by considering seasonal and regional variations in temperature. A higher ISEER rating signifies a more energy-efficient appliance, leading to lower electricity bills.

[11] The Procura+ Manual: A Guide to Implementing Sustainable Procurement (3rd Edition). ICLEI European Secretariat. 2016

Challenge Area	Inputs and Insights from Consultations
Regulatory / Policy	1. Lack of mandates or guidelines – No binding national or state requirements. 2. Complex approval processes - Concerns about delays or disputes when introducing performance-based or LCC-based evaluation. 3. Green products absent in SSR/DSR* - Green items not listed in SSR/DSR. A 10% cost deviation cap restricts procurement of higher-efficiency options. ** SSR: State Scheduled Rates, DSR: District Scheduled Rates*
Technical	1. Lack of tools and specifications - No standard templates, list of green products (ecolabels), or lifecycle costing methods to guide procurement.
Capacity Building	1. Low awareness and training - 43% of ULBs are unfamiliar and 57% are somewhat aware of GPP. 2. Lack of dedicated expertise - Procurement managed by general staff without sustainability-focused roles or accountability. 3. Difficulty evaluating performance – Limited understanding of lifecycle costing, lack of data / tools to compare conventional and green products.
Financial	1. Perceived high upfront costs – Procurement decisions prioritize lowest capital cost over lifecycle cost and operational savings 2. Budget and audit constraints - Limited fiscal space to pilot projects, difficulty in justifying higher capital expenditure without state directives/measurable payback data.
Market	1. Concerns about reliability - Doubts regarding quality, compliance, and long-term performance of green products and technologies. 2. Limited vendor competition - Vendors hesitant to bid for green tenders due to uncertainty in specifications, cost approvals, or scoring on green criteria

Table 3 identifies common myths on GPP and provides guidance with case studies for municipal procurement teams.

Table 3: Myths and Facts about Green Public Procurement (GPP)

Myths	Facts
GPP is too costly.	Green products save money over time through lower operational costs. **Case study:** **Paris:** Implemented energy performance contracts to retrofit schools and swimming pools for energy efficiency, with investments re-paid through savings and no upfront costs to the city.[12] **Melbourne:** Aggregated procurement of renewables (for 14 shopping centres, 9 office buildings, 7 educational campuses, and 4 manufacturing facilities) reduced costs via economies of scale.[13]
GPP needs a new legal framework / special tenders.	Targeted interventions are needed at specific procurement stages, in alignment with current procurement policies. **Case Study:** **United Kingdom:** Embedded climate requirements into existing procurement rules by issuing Procurement Policy Notes (PPNs).[14] **Oslo:** Embedded environmental criteria into procurement strategy under existing legal framework.[15]
GPP is complicated and resource-intensive.	It can start with easy, smarter purchase decisions and gradually expand as skills and markets develop. **Case Study:** **London:** Introduced climate budgeting to simplify and align procurement decisions across departments.[16] **France:** National Plan for Sustainable Procurement (Plan National pour des Achats Durables - PNAD) set common objectives and tools, easing adoption by local buyers.[17]
GPP is only for big cities.	Any ULB can start small (streetlights, fans, ACs) and then scale up. **Case Study:**[18] **Gauteng:** Department of Infrastructure Development incorporated life-cycle cost evaluation for design of new and existing municipal buildings.

[12] How Paris used energy performance contracts to retrofit schools, C40 Cities Climate Leadership Group, C40 Knowledge Hub, 2020
[13] Melbourne Renewable Energy Project (Phase 2)
[14] Procurement Policy Notes, Government of United Kingdom
[15] City of Oslo, Procurement Strategy, 2017
[16] London Environment Strategy, Greater London Authority, 2018
[17] Promoting Strategic and Green Public Procurement in France: Professionalising the State Procurement Function, OECD Public Governance Reviews, OECD Publishing, Paris, OECD, 2025
[18] Advancing Green Public Procurement in South Africa: Challenges, opportunities, and strategic pathways, IISD, 2025

Myths	Facts
	Tshwane: Committed to apply SAN 204 – energy efficiency standard for new and refurbished municipal buildings.
Markets are not ready.	The market evolves in response to buyer signals. When cities request green products and services - suppliers invest, innovate, and expand capacity. **Case Study:** **Cascais, Portugal:** The Municipal Council organised an energy efficient lighting seminar to connect suppliers and buyers, signal procurement needs, and enhance buyers' technical knowledge.[19] **Norway:** Mandated life-cycle cost assessments in construction, nudging suppliers to deliver sustainable solutions.[20]

Case Study:

Energy Efficiency Services Limited (EESL)'s Street Lighting National Programme

The Energy Efficiency Services Limited (EESL)[21] launched the Street Lighting National Programme (SLNP) in 2015 with a target to replace 14 million streetlights with energy-efficient LEDs across India.

Impact[22]:

a. Over 13 million LED streetlights have been installed across India (as of 2025), including approximately 1 million in Maharashtra.
b. Estimated energy savings of about 8,806 million Units (MU) per year.
c. In Visakhapatnam, connected load was reduced by 50% resulting in annual cost saving of approx. USD 4.7 million for the municipality.[23]

Lessons Learnt:

1. **Use case for ESCO model:** EESL bore upfront costs and recovered investments via shared savings model, making LEDs cheaper than conventional fixtures.
2. **Use of standard procurement frameworks:** Standard contracts and templates enabled quick adoption.
3. **Process standardisation:** Pre-defined steps for audits, monitoring, and payments; simplified implementation for municipalities.
4. **Demand aggregation:** Pooling demand allowed for municipalities to realise cost benefit through economy of scale.
5. **Market transformation:** Large-scale procurement stimulated domestic LED manufacturing,

[19] The Procura+ Manual: A Guide to Implementing Sustainable Procurement (3rd Edition), ICLEI European Secretariat, 2016
[20] Nordic view on data needs and scenario settings for full life cycle building environmental assessment, Nordic Innovation, 2024
[21] Street Lighting National Programme, by Energy Efficiency Services Limited (EESL)
[22] Street Lighting National Programme, Ministry of Power, Press Information Bureau (PIB), Delhi, 2024
[23] SNLP Visakhapatnam Case Study, Energy Efficiency Services Limited (EESL)

increased supplier participation, and reduced costs.

2.3 HOW to Prioritise Products for Green Procurement

Public procurement accounts for about 15% of global GHG emissions, with nearly 70% of these emissions concentrated in six sectors: defence and security, transport, waste management, construction, industrial products, and utilities[24]. To maximise environmental and economic impact, prioritising products/ sectors for initiating GPP is essential. This requires a **systematic, evidence-based approach** that balances ambition with practicality. Based on global and national experience, the following principles can guide selection of products/sectors for initiating GPP.

2.3.1 High Environmental Impact

Products/sectors that contribute significantly to resource use or GHG emissions. For example,

- **Paris[25]:** Prioritised buildings sector since they account for 64% of the city's energy consumption.
- **New York[26]:** Incentivised and mandated use of low-carbon materials and construction equipment, as the construction sector is responsible for 23% of global GHG emissions, with cement and steel alone contributing 8% and 7% respectively.

2.3.2 Large Public Spending Share

Products/sectors with big procurement budgets to maximise impact of GPP. For example,[27]

- **Italy:** Included a broad list (furniture, lighting, catering, vehicles, green spaces, cleaning) of high-volume spend categories across all levels of the government.
- **Portugal:** Prioritised infrastructure, street lighting, office buildings, catering, cleaning since these dominate annual government spending.

2.3.3 Market Readiness

Products/sectors where energy labels, eco-labels, certifications, already exist. For example,

- **Japan[28]:** Prioritises product categories based on market readiness guided by Green Purchasing Network (GPN) and Eco-mark Program.
- **Ireland[29]:** Selecting product categories by early market engagement, assessing readiness technologies, standards and supplier capacity.

2.3.4 Policy & Climate Goals Alignment

Products / sectors tied to national or city-level climate commitments. For example,

[24] Green Public Procurement: Catalysing the Net-Zero Economy, World Economic Forum, 2022

[25] How Paris used energy performance contracts to retrofit schools, C40 Cities Climate Leadership Group, C40 Knowledge Hub, 2020

[26] Executive Order on Clean Construction, Mayor's Office of Climate & Environmental Justice, NYC, 2022

[27] Harnessing Public Procurement for the Green Transition: Good Practices in OECD Countries, OECD Public Governance Reviews, OECD Publishing, Paris, 2024

[28] Green Purchasing Legislation, Ministry of Environment, Japan

[29] Green Public Procurement: Guidance for the Public Sector, Environmental Protection Agency, Ireland, 2024

- **United Kingdom[30]:** Contracts above £5 million must align with national net-zero by 2050 target, so procurement prioritised suppliers' carbon reduction plans.
- **France[31]:** Linked product categories (construction, clean vehicles, catering, ICT) with Climate & Resilience Law and Circular Economy Strategy.

2.3.5 Demonstration & Market Transformation Potential

Products / sectors specifically selected / piloted to push markets forward and create demand. These are often aligned with national climate priorities. For example,

- **Los Angeles[32]:** Joint procurement of zero-emission buses and chargers with California to accelerate the EV market.
- **Amsterdam[33]:** Requires all renovations and building maintenance tenders to follow circular construction principles, driving the market for circular materials.

2.3.6 Ease of Implementation & Monitoring

Products / sectors that are easy to track in terms of implementation and performance.

- **Sydney[34]:** Phasing out single-use plastics by prioritising readily available reusable or compostable alternatives, supported by the enforceable guidance provided in the City of Sydney's toolkit.
- **Lisbon[35]:** Developed a Procurement Planning Platform (PPP) to track and monitor progress across product categories like municipal buildings, road infrastructure, school meals.

2.4 Prioritisation for Energy-Intensive Products & Services

Municipal corporations annually procure a wide range of goods and services, from routine operational supplies to major infrastructure projects - all of which influence energy use and long-term environmental outcome. Prioritisation of procurement categories is therefore essential to ensure that municipal investments deliver maximum environmental benefits while remaining practical and cost-effective. Broadly, municipal procurement falls into three categories, outlined below in accordance with the Manual for Procurement of Goods, 2024[36]:

Goods:

Must be purchased or otherwise acquired for government use and includes:

a. All types of articles, materials, commodities, consumables, and raw materials
b. Furniture, fixtures, instruments, hardware, spare parts, and accessories
c. Machinery, equipment, industrial plants, vehicles, aircraft, ships, and railway rolling stock
d. Assemblies, sub-assemblies, and integrated groups of machinery used for production

[30] Procurement Policy Note 06/21: Taking account of Carbon Reduction Plans in the procurement of major government contracts, Government of United Kingdom, 2021
[31] Promoting Strategic and Green Public Procurement in France: Professionalising the State Procurement Function, OECD Public Governance Reviews, OECD Publishing, Paris, OECD, 2025
[32] How cities can use procurement to create and shape markets, C40 Cities Climate Leadership Group, C40 Knowledge Hub, 2024
[33] Amsterdam Circular 2020-2025 Strategy, Government of Amsterdam
[34] Reducing waste from events and services: guidelines for single-use items, City of Sydney, 2022
[35] Case studies, Circular Public Procurement, Ellen Macarthur Foundation, 2023
[36] Manual for Procurement of Goods, Ministry of Finance, Department of Expenditure, 2024

e. Intangible products such as software, technology transfer, licences, patents, and other intellectual property

Also cover services that are incidental or consequential to their supply such as - Transportation, Insurance, Installation and commissioning. Goods exclude books, publications, periodicals, etc., meant for libraries.

Works:

Refer to any activity that results in a tangible and physical output sufficient to fulfil an economic or technical function. These activities may involve:

a. Construction, fabrication, repair, overhaul, renovation, decoration
b. Installation, erection, excavation, dredging, and similar activities

Typically requiring a combination of engineering design, architectural design, material and technology, labour, machinery, and equipment. Certain materials or services may also be incidental or consequential to and form part of such works. Works include:

a. Civil works for roads, railways, airports, shipping ports, bridges, buildings, irrigation systems, water supply, sewerage facilities, dams, tunnels, earthworks and so on.
b. Mechanical and electrical works involving fabrication, installation, erection, repair, and maintenance of a mechanical or electrical nature relating to machinery and plants.

Services:

Refers to any procurement subject matter with non-tangible outputs, as distinct from goods or works (except those incidental or consequential to the service). It includes consultancy and other (non-consultancy) services such as:

a. Physical services
b. Maintenance services
c. Professional and intellectual services
d. Training services
e. Consultancy services
f. Advisory services
g. Any other service classified or declared as such by the procuring entity

It excludes appointments of an individual made under any law, rules, regulations, or orders issued for that purpose.

Table 4 illustrates examples of goods, works and services procured by municipal authorities with focus on the building and energy sectors.

Table 4: Examples of Municipal Procurement under Goods, Works and Services with focus on Buildings and Energy Sectors.

Goods	Works	Services
M&E equipment, streetlights	Roads, footpaths, bridges	Technical & project consultancy
Buildings & infrastructure materials	Municipal buildings, schools, hospitals	Smart city & IT system maintenance
Solid waste bins, trucks, compost units	Electrical installations (solar, DG)	IEC & community awareness programs
Water meters, pipes, pumps	Public toilets, sanitation plants	Waste collection & O&M

Goods	Works	Services
Garden tools, seeds, Playground equipment	Water pipelines, sewer lines, STP/WTP	Admin, legal, HR & grievance services
Government and Public transport vehicles, Office stationery/ furniture	Parks, playgrounds, boundary walls	App/portal development & surveillance

Procuring green **M&E goods and services** will help in reducing long-term operational costs. This aligns with operational cost reduction targets set by municipal corporations, such as BMC's target to reduce municipal consumption by 10%.

Case Study:

Indian Railways[37]

Indian Railways has developed and adopted the Energy-Efficiency Action Plan and Policy for reducing non-traction energy use. As per the policy, it has prioritised procurement of BEE 5-star rated appliances.

Impact:

1. Energy-efficiency measures in existing and new buildings can reduce energy use by 20–25%, achieving energy savings of 0.63 billion units and 0.51 million tons of CO_2e emissions (for FY 2029-30).
2. Adoption of Super ECBC (Energy Conservation Building Code) for new buildings can lower energy use by 50% with only 3-5% additional upfront cost.
3. Cloud-based data monitoring and management systems will improve real-time tracking, data quality, and decision-making.

Lessons Learnt:

1. Clear action points, targets, and defined roles strengthen accountability.
2. Continuous capacity building programmes are essential for sustaining efficiency gains.
3. Regular monitoring ensures course correction and long-term effectiveness.
4. Reliable data infrastructure (smart meters, IoT) is critical for optimising and scaling energy-efficiency initiatives.

[37] Indian Railways Energy-Efficiency Action Plan and Policy (IREAP), Indian Railways, Ministry of Railways, Government of India, 2022

3. Policy Landscape

This chapter outlines the evolution of the policy ecosystem shaping green public procurement. It presents the global, national and state level context, highlighting key policies, programmes and best practices from a public procurement perspective that have driven the transition toward low-carbon cities.

3.1 Global to Local Policy Context

As of June 2024, 107 countries, responsible for approximately 82% of global GHG emissions, had adopted net-zero pledges either in law, in policy such as national climate action plan or a long-term strategy, or through high-level official announcements. More than 9000 companies, 1000 + cities, 1000 + educational institutions and over 600 financial institutions have joined the Race to Zero, pledging to take actions to halve global emissions by 2030[38]. Governments across the world are advancing decarbonisation of their economies through measures such as regulations, taxation, direct funding, incentive programmes. Green Public Procurement (GPP) can be a powerful policy tool to meet climate targets, enhance resource efficiency and shape markets.

For Example,

a. In the **European Union (EU)**, GPP is within the framework of Strategic Public Procurement, together with Socially Responsible Public Procurement (SRPP) and Innovation Procurement. The European Commission has been developing voluntary GPP criteria for several product groups. Furthermore, following the adoption of the 2020 Circular Economy Action Plan, the Commission is proposing minimum mandatory GPP criteria and targets in sectoral legislation and phase in compulsory reporting to monitor its uptake.[39].

b. **Germany's** GPP policy mandates undertaking life cycle costing for energy related products and services, giving preference to climate friendly products.[40].

c. **France** developed a National Plan for Sustainable Purchases (2022-2025) with the goal of advancing sustainable public procurement, setting a voluntary target of 100% public procurement to involve environmental criteria[41].

d. Through robust annual review process of GPP Policy framework, **Japan** has prioritised 270 products in 21 categories and requires all government agencies and public institutions to develop annual eco-product procurement targets, report to the ministry and develop GPP policies[42].

The shift towards green procurement will not only enable cost savings but also support India's commitment under the updated Nationally Determined Contribution (NDC) to reduce the emission intensity of GDP by

[38] Net Zero Coalition, United Nations
[39] Green Public Procurement, European Commission
[40] Green Public Procurement: Eco-friendly and cost-saving, German Environment Agency, 2024
[41] Promoting Strategic and Green Public Procurement in France: Professionalising the State Procurement Function, OECD Public Governance Reviews, OECD Publishing, Paris, OECD, 2025
[42] Green Purchasing Legislation, Ministry of Environment, Japan

45% from 2005 levels by 2030. Figure 1 presents a timeline of key national and state policies, guidelines, and initiatives that have shaped the current GPP landscape in India and Maharashtra.

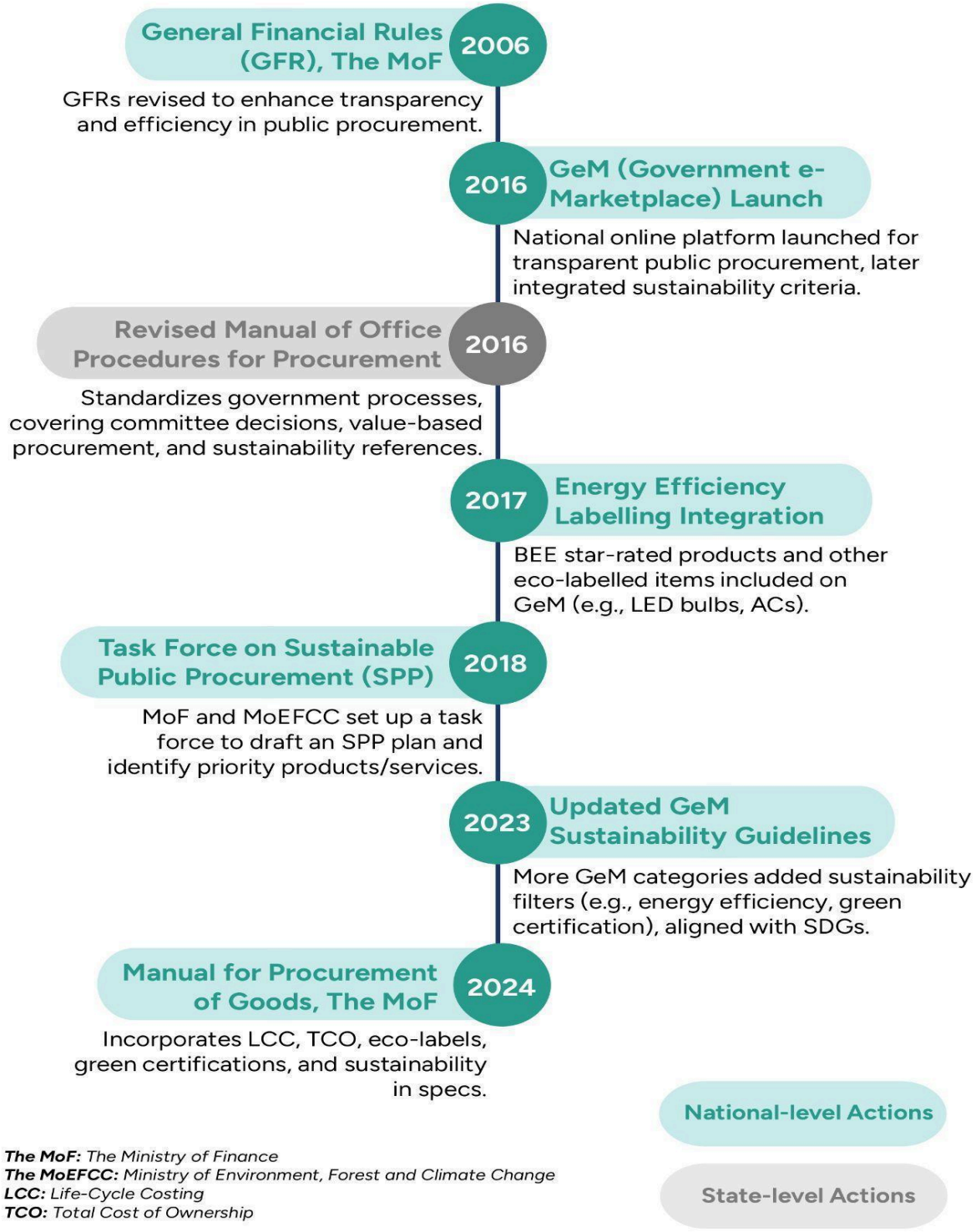


Figure 1: Evolution of Green Public Procurement Policies and Initiatives in India and Maharashtra

3.2 Stakeholders Driving Policy and Implementation

Implementation of GPP relies on effective coordination amongst policy instruments and stakeholders across national, state, and local levels. This section highlights the key agencies, departments, and institutions that formulate, regulate, and facilitate GPP initiatives.

3.2.1 National Policy Drivers

Key central ministries and agencies play a crucial role in advancing sustainability and transparency in public expenditure through fiscal directives, policy guidance, and technical standards. These instruments drive the integration of sustainability and energy efficiency measures into public spending. An overview of key actors and initiatives has been presented below.

a. Ministry of Finance (MoF)

The MoF provides an overarching guidance on fiscal policy, management of public expenditure, and procurement reforms across government departments. It also leads the national Task force on Sustainable Public Procurement (SPP)[43]. Through instruments such as the General Financial Rules (2017)[44], Outcome-based-Budget[45] and Government e-Marketplace (GeM)[46], the MoF has created an enabling ecosystem for sustainable public procurement. Simultaneously, the Central Vigilance Commission (CVC) has strengthened procurement integrity and accountability through measures focused on preventive vigilance and transparency[47].

b. Ministry of Environment, Forest and Climate Change (MoEFCC)

The MoEFCC anchors India's climate commitments by promoting the integration of sustainability into sectoral policies. India's EcoMark Scheme, introduced in 1991, is an environmental labelling programme for 16+ product categories, including and not limited to textiles, paper and paper products, electrical and electronic goods, paints, etc. In December 2024, the MoEFCC issued an updated notification for the EcoMark Certification Rules[48]. Additionally, the National Resource Efficiency Policy (2019)[49], highlights the role of public procurement in promoting resource efficiency and recommends targets for using C&D (construction and demolition) waste and recycled materials in civil works.

c. Bureau of Energy Efficiency (BEE)

The BEE, under the Ministry of Power, is responsible for promoting energy efficiency and conservation across India[50]. In 2006, it launched the Standards and Labelling (S&L) Programme[51] for electrical appliances, beginning with air conditioners and refrigerators, to help consumers make informed choices based on

[43] Task force on Sustainable Public Procurement constituted, Press Information Bureau (PIB), Ministry of Finance, Delhi, 2020
[44] General Financial Rules 2017, Department of Expenditure, Ministry of Finance, 2024
[45] Outcome Budget 2025-2026, Ministry of Finance, 2025
[46] Government e Marketplace (GeM), Department of Commerce
[47] Preventive Vigilance Initiatives, Central Vigilance Commission (CVC)
[48] Ministry of Environment, Forest and Climate Change notifies Ecomark Rules under Lifestyle for Environment initiative, Press Information Bureau (PIB), MoEFCC, 2024
[49] National Resource Efficiency Policy, MoEFCC, 2019
[50] The Energy Conservation Act, 2001
[51] Standards & Labeling (S&L) Program, Bureau of Energy Efficiency (BEE)

energy performance. The programme now covers 34 appliances, of which 11 are mandatory and 23 are voluntary. BEE is also promoting the adoption of energy-efficient appliances through the implementation of Energy Conservation & Sustainable Building Code (ECSBC)[52].

3.2.2 State Coordination Bodies

As per the Award of Contract (AOC) values in FY 2023–24, Maharashtra was the second-highest spending state, highlighting the significant potential for the state to integrate green procurement practices[53]. Most of the state agencies and ULBs in Maharashtra rely on the Public Works Department's (PWD) State Schedule of Rate (SSR)[54]. The Brihanmumbai Municipal Corporation (BMC), however, follows its own procurement manual[55], in addition to using department-specific SSRs. State procurement is conducted through manual tendering below INR 0.5 million and e-tendering above INR 0.5 million[56].

At present, Maharashtra does not have a dedicated green procurement policy or framework. **The Revised Manual of Office Procedures for Procurement, 2016**[57] by the Department of Energy, Industry and Labour; refers to "sustainable procurement policy" as a general principle for undertaking procurement activities. However, guidance on application and implementation is missing. This creates both a gap and an opportunity for mainstreaming GPP within the state.

The following state departments and agencies will play a pivotal role in driving GPP in the state:

a. Public Works Department (PWD)

The state PWD is responsible for constructing, maintaining, and repairing government buildings and other state infrastructure. It issues the **State Schedule of Rates (SSR)** and **District Schedule of Rates (DSR)**, which includes technical specifications, and standard rates, serving as a reference for Urban Local Bodies (ULBs), as well as other state departments and agencies. In recent years, the SSR has integrated provisions for about 40 innovative technologies and introduced ECBC- and GRIHA-aligned standards. Many ULBs are yet to adopt these provisions. Some ULBs when procuring greener products not listed in the SSR/DSR, are faced with defending cost deviations, since they are capped at 10% for products not listed[58]. PWD plays a crucial role in regularly updating the SSR to enable wider adoption of sustainable materials, appliances and equipment.

b. Maharashtra Institution for Transformation (MITRA)

MITRA, as the nodal agency providing strategic, technical and functional guidance for Maharashtra's development in alignment with NITI Aayog's policies[59], holds a key role in shaping procurement practices across key sectors. Through the Maharashtra Strengthen Institutional Capabilities in Districts for Enabling

[52] The Energy Conservation (Amendment) Act, 2022

[53] Green Public Procurement for Advancing Sustainable Development in India: Policy Nudges for Promoting Sustainable Consumption and Production, The Energy and Resources Institute, 2024

[54] State Schedule of Rates (SSR), Public Works Department, Maharashtra

[55] Manual of Procurement, Municipal Corporation of Greater Mumbai (MCGM)

[56] Maharashtra Government Tenders Information System, MAHA Tenders Portal

[57] Revised Manual of Office Procedures for Procurement, Department of Industry, Energy and Labour, Government of Maharashtra, 2016

[58] Insights from Knowledge Sharing Session and Focus Group Discussion on Greening Municipal Procurement held in September and October 2025.

[59] Establishment of Maharashtra Institution for Transformation (MITRA), Government Resolution, Planning Department, 2022

Growth (MAHASTRIDE) initiative, MITRA is advancing efforts to integrate environmental and social priorities into procurement processes, strengthening the state's commitment to sustainable procurement[60].

c. State Climate Action Cell (SCAC)

The Department of Environment and Climate Change has established SCAC to coordinate and advance climate action across Maharashtra[61]. SCAC leads state's adaptation and mitigation efforts, and guides the development and implementation of state, district and city level climate action plans. It has mandated formation of district and city climate action cells to monitor and mainstream local climate action. SCAC works with cross-sectoral public and private stakeholders driving key initiatives, such as Maharashtra State Action Plan on Climate Change (MH – SAPCC), City Decarbonisation Roadmap, and city climate action plans, ensuring effective inter-departmental coordination. In addition, SCAC can contribute to advancing GPP by aligning procurement priorities with broader climate and decarbonisation goals.

d. Maharashtra Energy Development Agency (MahaUrja)

Maharashtra's state designated agency for energy conservation[62], MahaUrja oversees renewable energy and efficiency initiatives, manages incentives and approvals, and ensures alignment with central and state energy policies. Following the introduction of the Maharashtra Energy Conservation Building Code (ECBC) Rules, 2025, MahaUrja assumes a central role in driving the implementation of energy efficiency measures across the state's building sector.

Case Study

Government of Punjab's Department of Finance (India) issued a guidance note on sustainable and green public procurement[63]. This has the provisions for consideration of procuring entities. Some of the provisions related to buildings and appliance sector are:

a. Comply with sustainability and legal requirements of environment or pollution control and other mandatory and statutory regulations as applicable.

b. Lay emphasis on factors such as efficiency, optimum fuel and power consumption, use of environment-friendly materials, reduced noise/emission levels, and lower maintenance costs, etc.

c. Lay emphasis on BEE star labelled electrical appliances.

   In collaboration with the PWD, introduced a dedicated chapter on Green Buildings (including items pertaining to energy efficient materials) in Punjab Common Schedule of Rates (CSR), 2020[64], for implementation of the Punjab Energy Conservation Building Code (PECBC).

d. Comply with guidelines on environmental management of construction and demolition (C&D) waste management in line with central pollution control board (CPCB)'s C&D Waste management rules, 2016.

[60] Operational Manual V1, Maharashtra Strengthening Institutional Capabilities in Districts For Enabling Growth (MahaSTRIDE), MITRA, World Bank, 2024

[61] Establishing "State Climate Action Cell (SCAC)", Government Resolution, Environment and Climate Change Department, Government of Maharashtra, 2023

[62] Maharashtra Energy Development Agency (MahaUrja)

[63] Guidance note on Sustainable and Green Public Procurement, Department of Finance, Government of Punjab, 2023

[64] Common schedule of rates (CSR), Public Works Department, Government of Punjab, India, 2020

e. Lay emphasis on minimal packaging or use of environment-friendly material and restrict use of hazardous/toxic substances.

f. Promote optimized logistics, local sourcing, circular economic principles and use of government-e-marketplace (GeM) portal for procurement.

3.2.3 Local Implementing Agencies

ULBs are the primary implementing agencies for public procurement, translating state and central directives into on-ground action. The Pimpri Chinchwad Municipal Corporation (PCMC) have initiated development of Sustainable Procurement Guidelines[65]. Pilot RFPs issued by PCMC to test market response revealed key challenges, including the lack of state-level guidance, limited vendor readiness, and the exclusion of sustainable items from DSR/SSR frameworks, highlighting the need for enabling state provisions to scale such efforts across municipalities. While a few cities have started procuring energy-efficient appliances and equipment, these efforts remain isolated and fragmented[66].

a. Urban Local Bodies[67]

Procurement is carried out within departments, with approvals based on annual departmental budget allocations. ULBs are responsible for developing tender documents, evaluating bids, and ensuring compliance with procurement and technical standards. To move towards green municipal procurement, actors within the ULBs will play distinct roles:

i. Municipal Commissioner
Approves projects, oversees budgets and procurement, manages services, and is accountable for ULB decisions. An overarching green procurement policy guidance from the municipal commissioner's office (such as issuing specific goals or targets for green procurement) will create an enabling environment for departments to operate.

ii. Finance Department
Manages budgeting, fund allocation, and sanctions. Guidance for evaluation on the basis of life-cycle costs alongside upfront costs can be provided.

iii. Environment Department
Aligns procurement with climate commitments and city action plans, and reviews procurement plans for sustainability impacts.

iv. Technical experts
These experts can advise on framing of green specifications and criteria, evaluation of bids, and procedures for ensuring compliance. They can validate performance and assist in training staff on GPP.

[65] Inputs from Focus Group Discussion on Greening Municipal Procurement held in October 2025.
[66] Insights based on ULB consultations held from 2022-2025, for development and implementation of the Maharashtra City Decarbonisation Roadmap.
[67] ULB consultations and Focus Group Discussion held in September and October 2025.

b. Vendors / Suppliers

They serve as the last mile connect for enabling city-wide green procurement by participating in tenders, supplying goods and services, and providing post-procurement project assistance. As critical market intermediaries, they can support ULBs align procurement specifications with both technical and environmental requirements during pre-tender consultations. The market now offers a growing range of energy efficiency labelled and eco-labelled products suitable for public procurement (including MoEFCC's EcoMark, BEE's star label for appliances, Confederation of Indian Industry (CII)'s GreenPro label[68], as well as sector-specific ecolabels).

[68] Confederation of Indian Industry (CII). GreenPro Ecolabel

4. Green Municipal Procurement

There already are several entry points for integrating sustainability considerations into the existing municipal procurement process. The current workflows can be strengthened by embedding green interventions at key decision stages. A typical procurement process followed by ULBs has been mapped in Figure 2. The three main stages of procurement are: **Pre-Procurement and Planning, Tendering and Evaluation**, and **Award, Contract and Post-Award Management.**

Guidance for integration of green considerations in each stage has been provided in the following section. This considers:

a. **Stakeholder mapping** outlining key actors and their responsibilities.
b. **A self-assessment green checklist** for ULBs to assess their readiness to integrate green into their procurement.
c. **Tools** for green procurement.

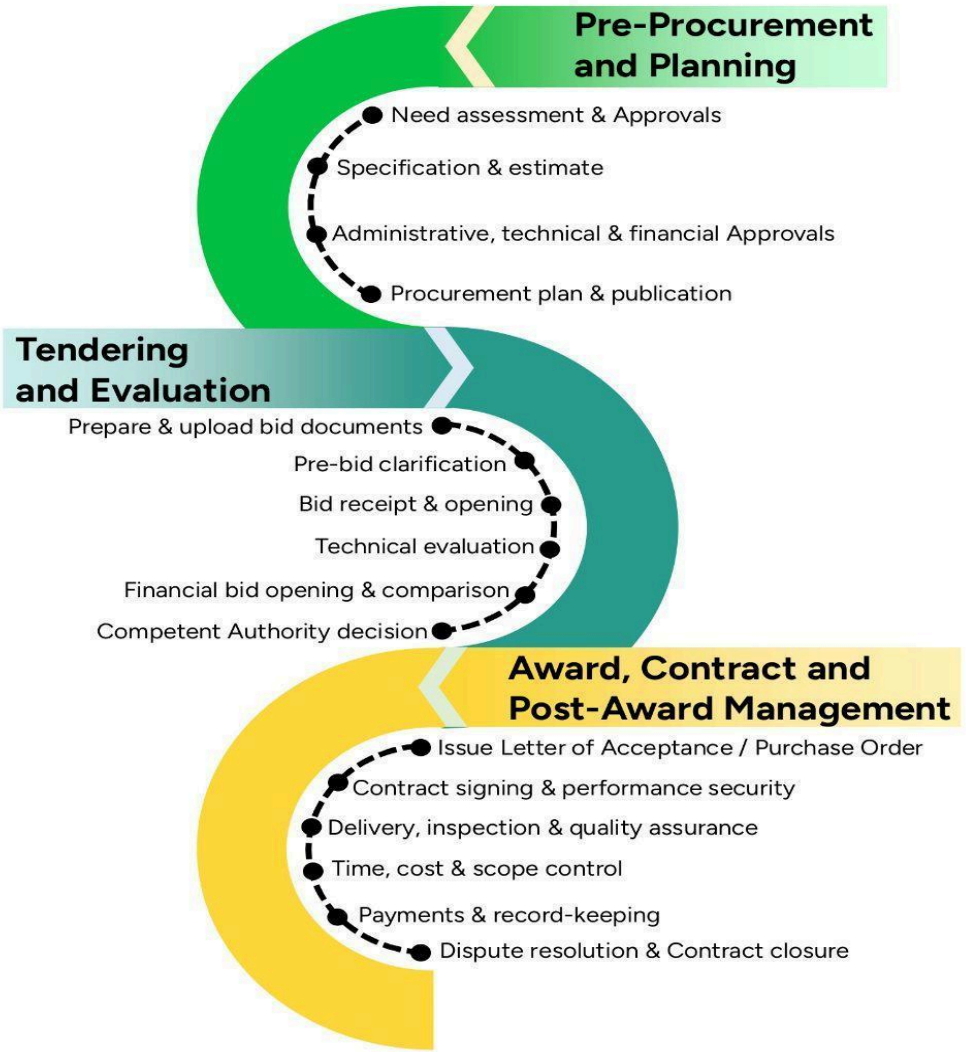


Figure 2: Typical Municipal Procurement Cycle (Source: State and Municipal Procurement Manuals)

4.1 STAGE 1: Pre-Procurement and Planning

In this stage, the aim is to define what to buy, how, and when with sufficient foresight. Embedding green interventions early in budgeting, estimation and development of specifications; ensures it is central to decision-making and not an afterthought. The responsible officers typically include the technical/design engineers from the procurement team, finance officers and senior administrative authorities. At this stage, responsibilities are centred on identifying needs, developing sustainability criteria, and budgeting, as outlined in Table 5.

Table 5: Stage 1 - Departmental Roles and Responsibilities

Steps	Lead	Role
Need assessment & approval	Procuring Department	Identify requirements, justify needs, prepare project requests.
Specification & estimate	Technical Experts / Engineers	Draft technical specifications, prepare cost estimates with green criteria.
Administrative approval	Municipal Commissioner	Approve project initiation and confirm alignment with municipal priorities.
Technical approval	Public Works Department	Review specs/standards, ensure compliance with codes and GPP standards.
Financial approval	Finance Department	Approve budget, check life-cycle cost implications.
Procurement plan & publication	Procuring Department	Prepare procurement schedule, publish procurement plan in line with GR/manual.

Responsible authorities can use **the self-assessment checklist** provided in Table 6 to determine their readiness for GPP (for M&E), set realistic goals and prioritise actions. The progress can be marked as "*Yes*", "*Partially*" or "*No*" in the Status column.

Table 6: Stage 1 - Self-Assessment Checklist

SN.	List	Status	If "*No*" or "*Partially Ready*" **Take the following Next Steps**	Documentation
1	Identification of product / service categories to be prioritised for green procurement		• Determine the current and future requirements for procurement of M&E products / services based on energy use of the previous 2 years (from electricity bills or energy audits). • List the energy and capital-intensive M&E equipment used by ULBs Identify priority products / services for undertaking green procurement (such as lights, fans, cooling systems, pumps, motors, IT equipment, etc)	• List of priority products

SN.	List	Status	If "*No*" or "*Partially Ready*" **Take the following Next Steps**	**Documentation**
2	Energy efficiency / environmental performance criteria (or references) for the M&E products. *(Refer to guidance provided in 4.1.1)*		• Check BEE's website to determine if the product falls under mandatory / voluntary labelling scheme. • Check the schedules of the products to determine the energy performance criteria and star label range. • Determine any other environmental parameters to be considered. • Conduct desktop research to determine availability of vendors and products.	• Energy and /or environmental performance criteria and requirements for products.
3	Pre-tender market consultation *(Refer guidance provided in 4.1.2)*		• Issue pre-tender market questionnaire / Request for Information (RfI) amongst suppliers / vendors for model specifications, performance (energy) and costs. • Hold pre-tender market consultations to address any queries and inform the vendors / suppliers on the upcoming tender requirements.	• Request for Information (RfI) Minutes from the stakeholder Consultation • Specifications related to energy performance • List of requirements from evaluation purpose.
4	Initial Life Cycle Cost (LCC) / Total Cost of Ownership (TCO) calculations for selected products. *(Refer to guidance provided in 4.1.3)*		• Calculate the LCC / TCO of different models (with same functional specifications) based on the initial details provided by vendors. OR • Request vendors / suppliers with TCO calculations after pre-tender consultations, in a standardised template. • Determine the energy-performance specifications / criteria for the tender.	• LCC/TCO calculations
5	Budget / green allocation identified		• Estimate incremental CAPEX (if applicable, based on LCC / TCO evaluation) and seek prior approval. • Dedicate green budget head/allocation Explore opportunities for pooled funding	• Budget note
6	GPP circular for M&E procurement		• Draft a short note • Get legal/finance sign-off • Publish internal circular & upload to procurement portal • Training / Orientation of procurement team • Prepare an annual GPP plan for selected products / services.	• Signed policy / procurement circular • Annual GPP plan

In addition, institutional capacity building on GPP circular, development of specifications and evaluation criteria will be essential for continued implementation and expansion of green procurement to other products and services.

4.1.1 Guidance on Determining Environmental Performance Criteria

Life cycle assessments typically assist in determining the critical hot spots (for environmental impact) of products from cradle to grave. However, in absence of detailed life cycle assessments, Environmental Product Declarations, Ecolabels and Energy Labels can provide evidence for performance of the product on environmental and/or energy as required. For M&E equipment, typically energy labels are referred to – in India BEE star labels determine the energy performance criteria for appliances / equipment under the scheme.

Examples of energy performance criteria for few appliances / equipment:

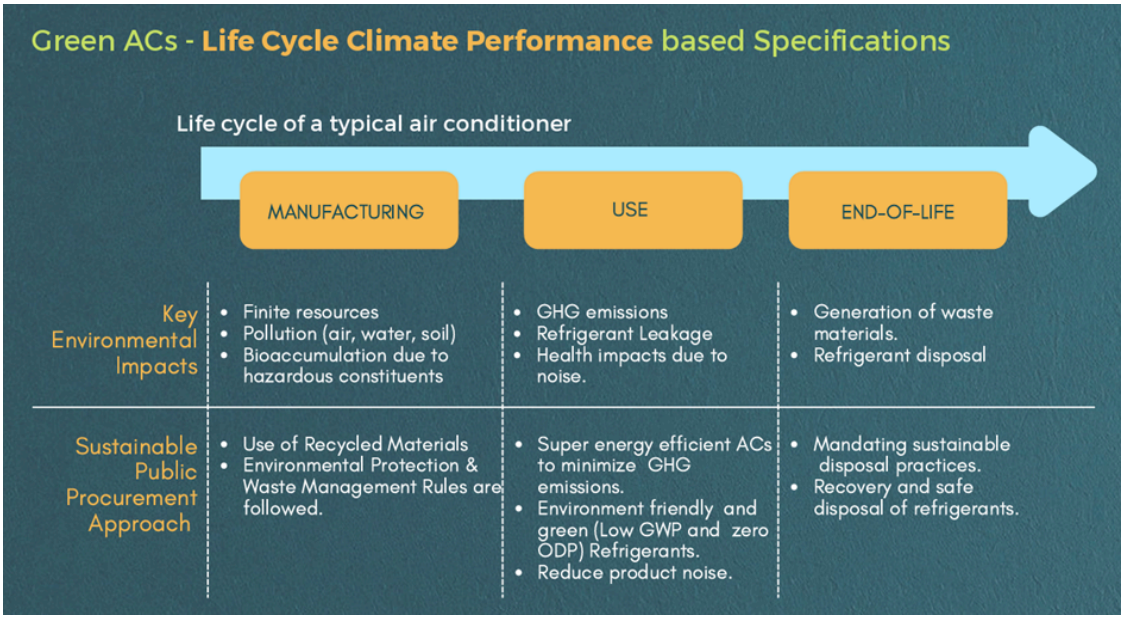
a) Air conditioners - ISEER (Indian Seasonal Energy Efficiency Ratio)
b) LED lamps - Luminous efficacy (Lumens/watt)
c) Storage water heaters - Standing loss
d) Refrigerators - Annual energy consumption (kWh/year)
e) Ceiling fans - Service value

In addition to the energy performance criteria, other parameters may also be included, based on environmental impact. For example, green room air-conditioner specifications[69] launched on the Government e-marketplace in June 2021 are shown in Figure 3. Here, in addition to safety, quality, noise and energy performance, other parameters highlighted were:

a. Refrigerant type - Low global warming potential (GWP) and zero ozone depletion potential (ODP) refrigerants to be given preference considering loss of refrigerant during operation and end-of-life disposal.
b. Percentage of recycled plastic components in the product.
c. Paint (to avoid use of heavy metals)
d. Packaging type (to avoid use of virgin materials)
e. Buy-back option provided by the supplier / vendor (while this will not feature in product specification, it is an important consideration, to divert waste from landfill).

These specifications can be developed for all M&E products through review of global and national benchmarks, industry consultations and supply chain assessment. It is important to note that the green specifications developed will need to be updated periodically, to account for technology innovation and upgrades.

[69] Green room air conditioner criteria developed by Environmental Design Solutions under the UNEP Partnership for Advancing Green Economy's (PAGE) and USAID's Market Integration and Transformation for Energy Efficiency (MAITREE) for government e-marketplace. This was launched in June 2021.



Green Room Air Conditioner Specifications on GeM

Compressor Type	Variable speed
Safety and Performance	Conform to the requirements for quality, safety and performance prescribed in IS 1391 Revised /IEC 60335-2-40 (under preparation) and all requirements specified as under.
Product Noise	Air conditioner noise levels shall be as notified under the Environment (Protection) Act, 1986, and as per BIS (IS 1391 Revised).
Energy Performance	• 3517 W to 5240 W (1-1.49 TR) - ISEER greater than or equal to 5.8 • 5275 W to 6682 W (1.5-1.99 TR) - ISEER greater than or equal to 5.4
Refrigerants	Refrigerant should have Zero ODP. Global warming potential (GWP) not exceeding 700 (100 years)
Recycled Plastic Components	Product shall be designed to promote recycling Utilizing at least 80% by weight of plastics for recycled plastic components
Paint	Paints used in the product shall not contain heavy metals or their compounds include mercury (Hg), lead (Pb), cadmium (Cd) and hexavalent chromium (Cr).
Packaging	The air conditioner packaging shall be made of recycled or biodegradable materials. Plastic packaging shall not contain halogenated hydrocarbon.
Green Disposal	Take-back or buy-back option is available with the manufacturer.

Figure 3: Green Room Air Conditioner Specifications (Source : GEM Brochure, developed by the Author)

4.1.2 Guidance on Preliminary Market Consultation

Engaging with vendors and/or service providers before launching a tender allows the procuring entity to understand market readiness, availability of green alternatives, and emerging technologies. This not only reduces the risk of re-tendering due to specification of unrealistic requirements, but also, provides a signal to the market on direction of future procurement. Indicative guiding questions for market consultations are as follows:

a. Specifications of the product with respect to environmental performance criteria identified.
b. Certifications, labels, or test reports demonstrate compliance with environmental and/or energy performance standards.
c. Precedence of implementation.
d. Initial and total cost of ownership (TCO) for the product
e. Delivery timelines (based on volume)
f. After-sales services, warranties, and maintenance practices
g. Options for contracting models (e.g. performance-based, leasing, ESCO)
h. Supporting documentation or methods (third-party tests, declarations, labels) to verify environmental claims.

In addition, the procurement team should also discuss the tender specifications, selection criteria and methodology for tender evaluation, to encourage transparency and gather feedback from the industry.

4.1.3 Total Cost of Ownership (TCO) and Life Cycle Costing (LCC)

Currently, goods and services are procured based solely on their purchase or capital cost, which represents only a fraction of their true cost. **Total Cost of Ownership (TCO)** goes beyond the initial price to include all expenses a municipal corporation will incur over the asset's life - such as operation, maintenance, disposal, and end-of-life management, along with indirect costs like taxes or regulatory charges.

Life Cycle Costing (LCC) builds on TCO by further considering costs borne by society because of environmental and social externalities. These may include greenhouse gas emissions, resource depletion, ecosystem damage, and pollution.

While LCC is the most comprehensive approach, it can be complex and less standardized in developing economies. In such cases, TCO serves as a practical starting point, enabling ULBs to evaluate the full cost of electrical appliances or equipment, such as the room air conditioner (AC) example shown in Figure 4:

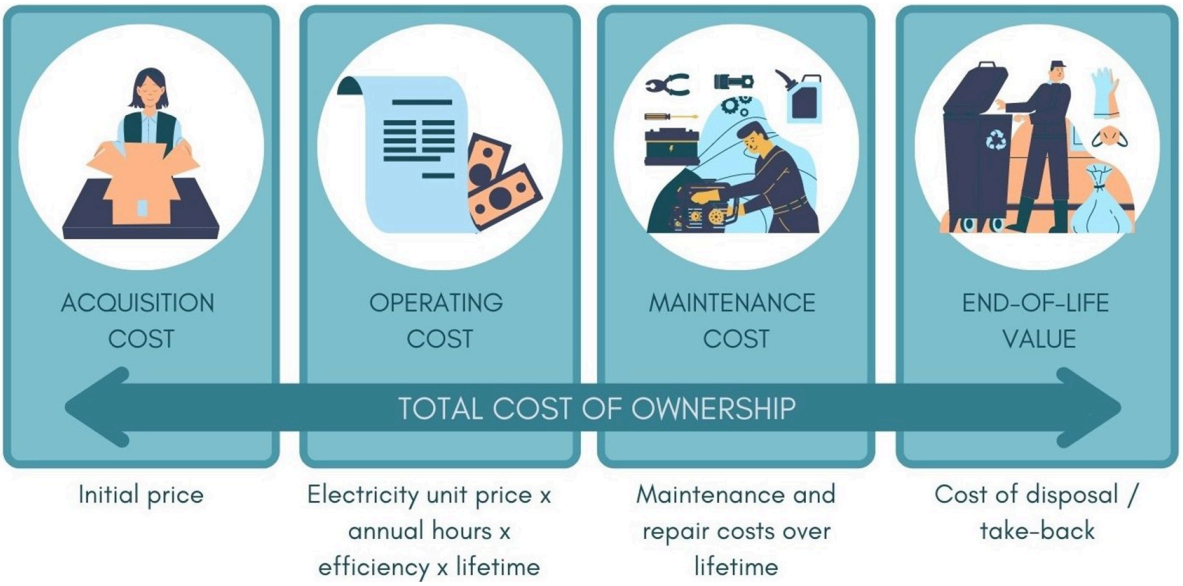


Figure 4: Breakdown of Total Cost of Ownership across Appliance/Equipment Lifecycle

To demonstrate the practical application of TCO, Table 7 presents a comparative assessment of four BEE Star-rated RAC (Room air-conditioner) options over a 10-year period, breaking down each lifecycle cost component. The highlighted TCO values show that, despite the lower initial cost of 1-Star AC, its lifetime expenditure is significantly higher. The super-efficient model shows a substantially lower TCO, reaffirming the long-term financial advantages of procuring equipment with higher energy-efficiency performance.

Table 7: TCO-Based Evaluation of Room air conditioner Models (1.5 TR)

Room air conditioner	**Initial Cost**	**Annual Electricity Consumption** (kWh/ year)	**Annual Cost of Electricity**	**Annual Maintenance Costs**	**Total Operational Cost**	**End of Life Disposal Costs**	**Total Cost of Ownership** (TCO)
	A	*B*	*C = B x Cost of electricity*	*D*	*E = C+D x No. of years (10)*	*F*	*G = A+E+F*
1 Star (2.7 ISEER)	₹29,000	1,633	₹16,330	₹1,500	₹178,300	₹2,500	**₹209,800**
3 Star (3.5 ISEER)	₹34,600	1,125	₹11,250	₹1,500	₹127,500	₹2,500	₹164,600
5 Star (4.5 ISEER)	₹45,734	880	₹8,800	₹1,500	₹103,000	₹2,500	₹151,234
Super-Efficient (5.4 ISEER)*	₹39,990	757	₹7,567	₹1,500	₹90,667	-2,500 (buy-back)	**₹133,157**

*Price that was being offered by EESL (May 2024) due to bulk procurement and demand aggregation.

4.2 STAGE 2: Tendering and Evaluation

At this stage, ULBs translate specifications into tenders and typically assess proposals primarily on cost. ULB responsibilities include drafting green specifications, managing supplier queries, and applying fair evaluation criteria, as outlined in Table 8. Integrating green criteria at this stage strengthens environmental compliance and ensures fair competition. Clear weightages and transparent processes help vendors understand requirements and enable the market to respond effectively.

Table 8: Stage 2 - Departmental Roles and Responsibilities

Steps	**Lead**	**Role**
Prepare & upload bid documents	Technical Experts + Procuring Department	Draft tender documents with green clauses, upload on e-procurement portal.
Pre-bid clarification	Procuring Department	Conduct pre-bid meetings, issue clarifications/addenda.
Bid receipt & opening	Procuring Department	Receive bids electronically, open as per procedure.
Technical evaluation	Technical Experts	Evaluate technical compliance with specifications & GPP criteria.
Financial bid opening & comparison	Finance Department	Open/comparison of qualified bids, verify cost reasonableness.
Competent Authority decision	Municipal Commissioner	Approve final evaluation report and selection of vendors.

Responsible authorities can use **the self-assessment checklist** provided in Table 9 to understand where they stand, allowing them to set realistic goals and prioritise actions. The progress can be marked as "*Yes*", "*Partially*" or "*No*" in the Status column.

Table 9: Stage 2 - Self-Assessment Checklist

SN.	**List**	**Status**	If "*No*" or "*Partially Ready*" **Take the following Next Steps**	**Documentation**
1	Documentation Requirements from vendors		• Add compliance checklist for vendors as a part of bid documents. • List documentation requirements from vendors (label / certificate/ datasheets /TCO calculations) *(Guidance provided in section 4.2.1)*	• Compliance checklist

SN.	List	Status	If "*No*" or "*Partially Ready*" **Take the following Next Steps**	Documentation
2	Evaluation criteria developed. *(Guidance provided in 4.2.2)*		• Establish evaluation criteria and methodology. For example, evaluation on environmental specifications can be: a. Mandatory - Pass / Fail OR b. Weightage (score based on higher performance) (e.g. 10% for each star above minimum, 70-20-10 for Technical, financial and environmental) or based on LCC/ TCO.	• Updated tender evaluation sheet
3	Green tender published as pilot or Pilot Implementation before awarding tender		• Publish tender including bid queries and responses from market consultations. In case of large-scale procurement, pilot implementation can also be considered. In that case - • Define pilot implementation & performance testing requirements. • Approval on meeting performance test.	• Tender Or • Pilot definition and requirements

4.2.1 Supporting Documentation for Evaluation

Table 10 presents examples of supporting documentation that bidders could submit for goods related to building mechanical and electrical systems.

Table 10: Supporting documentation (indicative as an example)

Product	Requirement	Environmental Performance Criteria	Documentation
Air Conditioners (ACs)	Energy efficiency	BEE star number (or ISEER)	Label
	Refrigerant	GWP (_____)	Manufacturer's datasheet
	Noise control	≤ __ dB at standard operation	Test report
	Recycled plastic content	%	Declaration
LED Lights	Energy performance	≥ __ lumens/watt	Label / Product data sheet
	Lifetime	≥ __ hours/years	Warranty document
Streetlights	Energy performance	≥ __ lumens/watt	Label / Product data sheet

Product	Requirement	Environmental Performance Criteria	Documentation
	Technology	Dimming/timer controls	Datasheet
	Lifetime	≥ __ hours/years	Warranty document
	Smart-readiness	Compatible with remote monitoring	Datasheet
Fans	Energy efficiency	BEE star number (or service value)	Label
	Durability	Warranty ≥ 5 years	Warranty document
Solar Panels	Efficiency	≥ __% module efficiency	Label / Datasheet
	Lifetime	≥ __ hours/years	Certificate
	End-of-life	Use of recyclable modules	Declaration
Electrical Systems (Wires, Panels)	Safety	IS/IEC certified	ISI/IEC mark
	End-of-life	Recyclable metal parts	Declaration

4.2.2 Weighted Evaluation

Weighted evaluation is a structured approach that assigns pre-defined weight to technical, financial, and sustainability criteria. This approach ensures that performance on product quality, total cost of ownership, and environmental benefits, are reflected in the final score. Weighted evaluation considers -

a. **Technical criteria:** Product specifications, compliance with quality standards, performance efficiency, durability, service capability, and after-sales support
b. **Financial criteria:** Initial price, installation cost, and operating expenses.
c. **Sustainability criteria:** Energy efficiency rating, energy or environmental certification, eco labels, emissions reduction estimates, recyclable content, packaging, etc.

Method of scoring:
Option 1: Each bid can be scored against defined criteria, multiplied by the assigned weight, and aggregated into a final weighted score to determine the most advantageous offer.

Option 2:

a. Performance on technical criteria can be made mandatory. Only bids that meet the technical criteria would be taken forward for evaluation against financial criteria. Here the financial evaluation would be based on Total Cost of Ownership (TCO). Since TCO already factors in efficiency and operational costs, the most advantageous bid can be considered. Here a separate scoring for sustainability criteria may not be needed.
b. Sustainability criteria can be considered as additional points for aspects not considered in TCO. (For example, low GWP of refrigerant, or recyclable content in product, etc)

Case study:

Tender Evaluation method for Tasmanian Government

For Example, tender guidelines by Tasmanian Government suggest weight brackets such as[70]:

a. Price/Quantitative Criteria: 30–60%
b. Non-Price/Qualitative Criteria: 10–40% (split across relevant sub-criteria such as past performance, technical skills, management skills)
c. Economic and Social Benefits (optional category): 30% wherever applicable.

[70] Guidelines on Tender Evaluation using Weighted Criteria for Building Works and Services, Department of Treasury and Finance, Tasmanian Government, 2025

4.3 STAGE 3: Award, Contract & Post-Award Management

This stage ensures, what was promised gets delivered, measured, and accounted for. Without rigorous post-award management, even well-specified green tenders can drift back to business-as-usual. This stage lays emphasis on monitoring supplier performance, enforcement of green clauses, and learnings for future tenders. The department roles are outlined in Table 11.

Table 11: Stage 3 - Departmental Roles and Responsibilities

Steps	**Lead**	**Role**
Issue LoA / Purchase Order	Procuring Dept.	Release LoA / PO to selected bidder.
Contract signing & performance security	Municipal Commissioner	Sign contract, ensure performance security submission.
Delivery, inspection & Quality Assurance	Third-Party Auditor	Inspect delivery, certify quality and compliance.
Time, cost & scope control	Municipal Commissioner	Oversee progress, manage deviations in cost/time/scope.
Payments & record-keeping	Finance Dept.	Process payments against milestones, maintain records.
Dispute resolution & contract closure	Municipal Commissioner	Resolve disputes, ensure proper closure and final documentation.

Responsible authorities can use **the self-assessment checklist** provided in Table 12 to understand where they stand, allowing them to set realistic goals and prioritise actions. The progress can be marked as "*Yes*", "*Partially*" or "*No*" in the Status column.

Table 12: Stage 3 - Self-Assessment Checklist

SN.	**List**	**Status**	If "*No*" or "*Partially Ready*" **Take the following Next Steps**	**Documentation**
1	Performance/warranty clauses in contract included. *(Refer guidance provided in 4.3.1)*		• Draft warranty / service Level Agreement (SLA) clauses (min 2–5 yrs depending on product) • Include performance KPIs (e.g., pump efficiency, UPS availability) • Link final payment to energy performance over defined period • Monitor compliance	• Contract excerpts with warranty / SLA clause

SN.	List	Status	If "*No*" or "*Partially Ready*" **Take the following Next Steps**	Documentation
2	Monitoring & verification (M&V) for post-installation performance developed.		• Develop M&V plan and templates • Identify metering needs (energy meters/logs). Install submeters where needed • Conduct periodic checks and implement corrective actions	• M&V plan • Meter logs • Periodic reports
3	Vendors pre-qualification based on environmental credentials/performance		Update the vendor registration and database to include • Green credential fields. • Shortlist vendors with proven records • Annual update of lists Pre-qualified lists can be used for future procurement.	• Vendor registration with green credentials.
4	GPP Performance Reporting *(Refer guidance in section 4.3.2)*		• Identify KPIs for GPP. • Create one-page annual report template (items procured, savings, CO_2 avoided) Publish on portal / ULB website Use reports to refine policy, allocate budget and secure external fundings.	• Annual report • Published link

4.3.1 Performance-linked payments and contracting

Performance-linked payments tie payment structures to environmental outcomes, ensuring supplier accountability throughout the contract period. This approach helps ULBs secure long-term value and reduces risks such as contractors disengaging before completion or commissioning. Longer contract durations further enable suppliers to maintain and improve efficiency over time. Parameters for developing performance-linked contracts:

a. Defined and measurable targets (e.g., annual energy savings, peak demand reduction, GHG emission reduction)
b. Stages for measuring performance
    - Performance verification at commissioning stage
    - Verified energy savings after a year
    - Equipment operational efficiency (pre-determined test conditions)

c. Methods of verifying performance: Metering, utility bills, commissioning report, third-party Monitoring and Verification (M&V), or data from Building Management System (BMS).
d. Roles and responsibilities and obligations of both the vendor & procuring entity
e. Details of performance risk to suppliers, with shared accountability for factors outside their control.
f. Payment structure linking payments to verified outcomes or performance milestones.
g. Rewards for exceeding targets and deductions or corrective actions for under-performance.

4.3.2 Key Performance Indicators (KPI)

Effective monitoring of GPP requires a clear set of KPIs that track both implementation progress and outcomes achieved. These KPIs help ULBs assess the extent to which green criteria are integrated into procurement processes, measure the resulting environmental and financial benefits; and evaluate how markets respond to increased demand for sustainable products and services. The following KPIs can be adapted based on local priorities:

1. Uptake & Coverage
    - % of tenders that included green criterion
    - % of procurement spend subject to GPP criteria (by value)
2. Environmental Outcomes
    - Annual energy saved from GPP interventions
    - Annual GHG emissions avoided
3. Financial & Value Metrics
    - Average lifecycle cost savings realised (INR or %)
    - Average payback period for green investments (years)
4. Market Development
    - Number of suppliers meeting stated green eligibility criteria (annual)
    - Share of bids received that include green solutions
    - Green jobs created
5. Compliance & Verification
    - % of contracts with post-installation M&V completed
    - % of projects with documented end-of-life disposal / recycling evidence

For each of the KPIs identified, a standard methodology will need to be developed to support ULBs calculate and report performance.

5. Way Forward

The transition to green procurement requires a systemic shift from short-term, cost-driven decisions to long-term, performance-based and sustainability-oriented approaches. For urban local bodies (ULBs), this transition involves updating tendering practices and engaging with the market. Insights from the focus group discussion on "*Advancing Green Municipal Procurement*" reaffirm that while awareness of green public procurement (GPP) is growing, implementation has taken a backseat. This chapter outlines the way forward to strengthen Green Municipal Procurement across Maharashtra's ULBs.

5.1 Strengthening Procurement Frameworks

Lowest-cost procurement often overlooks long-term efficiency and environmental performance. This could lead to a higher lifecycle cost due to higher costs (energy bills) during operations. Procurement systems must shift from cost-based to value-based approach using Life Cycle Costing (LCC) and/or Total Cost of Ownership (TCO) principles, guided by clear direction rather than isolated efforts.

Recommendations for the State:

a. Identify products and services to be prioritised for "green procurement". Define "green" for the products and services identified; to ensure uniform interpretation across tenders, budgets and audit systems

b. Develop and issue a Green Procurement Guidance Document and Model Bid Templates (for identified products and services), with standard clauses and evaluation criteria.

c. Integrate Green Criteria into State Schedule Rates (SSRs) and District Schedule Rates (DSRs), in consultation with the Public Works Department (PWD), and Maharashtra Energy Development Agency (MEDA).

d. Support early adopters through incentives or facilities including viability gap funding (VGF), concessional finance, or additional budget allocations to cover green premiums.

e. Minimum energy standard compliance can be mandated for procurement of electrical goods/works/services through E-tenders (For projects above ₹5 Lakhs), in line with Maharashtra Energy Conservation Building Codes (ECBC).

f. Initiate phasing out for products with higher environmental impacts.

Recommendations for Vendors and Suppliers:

g. Engage in pre-bid dialogues to communicate market readiness and cost-benefit advantages of green alternatives.

h. Provide product-level datasheets, certifications, TCO and LCC calculations.

i. Provide recommendations on specifications for non-DSR listed items.

5.2 Building Institutional Capacity

The shift towards GPP depends heavily on institutional capacity within ULBs, particularly among engineering, finance and procurement officials, to interpret specifications, evaluate LCC-based proposals, and justify higher-efficiency investments. Without systematic capacity building and internal coordination, even well-intentioned guidelines risk remaining underutilized.

Recommendations for the State:

a. Establish a state-level GPP Coordination Committee, including the Environment Department, Public Works Department, Energy Department, Urban Development Department, Maharashtra Institute for Transformation (MITRA) and Maharashtra Energy Development Agency (MEDA).

b. Partner with training institutions to roll out statewide GPP training modules.

c. Develop a centralised GPP monitoring framework with indicators linked to energy savings and emission reduction. Integrate this with ULB reporting systems.

Recommendations for Vendors and Suppliers:

a. Provide orientation sessions for municipal officials on product performance, maintenance, and end-of-life management.

b. Share case studies / success stories on cost-benefit of green materials and technologies suitable for municipal applications.

5.3 Fostering Market Development

To mainstream GPP across cities, market development must complement policy and institutional readiness. Vendors need to be encouraged to certify products, and engage in pre-bid consultations, while state agencies can enable pooled procurement, benchmark rates, and transparent price discovery. A responsive market will enhance competition and make sustainable choices the norm rather than the exception.

Recommendations for the State:

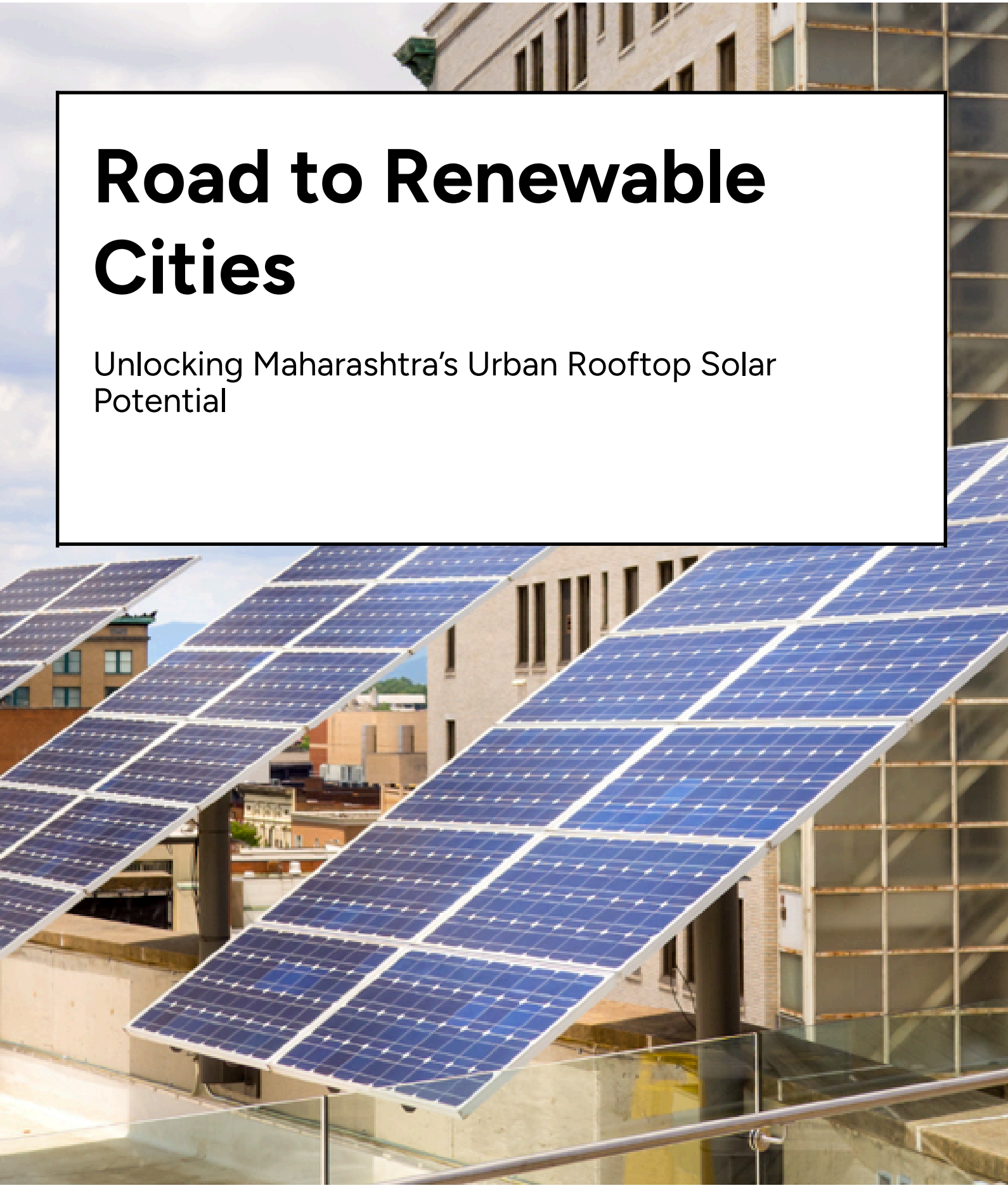
a. Establish pooled procurement or rate contracts for common green items (e.g., solar streetlights, BEE-star rated fans,) to ensure price uniformity and simplify audit processes.

b. Create and maintain a Green Vendor Directory, in collaboration with BEE, MEDA, and industry bodies.

c. Promote public-private partnerships and innovation challenges for developing low-cost, resource-efficient municipal solutions.

Road to Renewable Cities

Unlocking Maharashtra's Urban Rooftop Solar Potential



Technical Partner:

Executive Summary

India's cities are rapidly urbanizing, leading to increased energy demand and rising greenhouse gas (GHG) emissions from buildings, which already contribute ~40% of urban GHGs. Rooftop solar (RTS) presents a transformative solution to decarbonize the urban power sector, enhance energy security, and make cities more resilient. This knowledge product—developed jointly by C40 Cities and Environmental Design Solutions (EDS), lays out a practical pathway for accelerating RTS adoption across Maharashtra's urban centres.

Why this matters now: Despite Maharashtra's leadership in renewable energy and its ambitious net zero goals, RTS adoption remains modest due to persistent regulatory, financial, technical, and awareness-related challenges. As of June 2025, only 18.8 GW[1] RTS capacity has been achieved nationwide against a 40 GW target by 2026. Maharashtra has installed approximately 3.6 GW RTS under central schemes like PM Surya Ghar: Muft Bijli Yojana, yet most cities are still far from realizing their full solar potential.

Approach to Development of Road to Renewable Cities: This approach adopts a stepwise methodology to identify opportunities and unlock the potential of RTS in urban Maharashtra, as shown in Figure 1. It begins with examining the clean energy landscape and identifying key barriers to adoption of RTS. Relevant best practices both global and local are then studied to shift the narrative from barriers to enabling drivers. Focus group and expert consultations held, helped in developing tailored recommendations. These stakeholder dialogues played a critical role in shaping the "Road to Renewable Cities" knowledge product, ensuring the recommendations are grounded in local realities and aligned with Maharashtra's urban governance and energy context. The report consolidates key insights from this participatory process and presents practical strategies to unlock the full potential of rooftop solar across the state's cities, supporting the broader vision of climate-resilient, equitable, and economically sustainable urban development. It will also inform development of the roadmap for accelerating RTS for the city of Nashik.

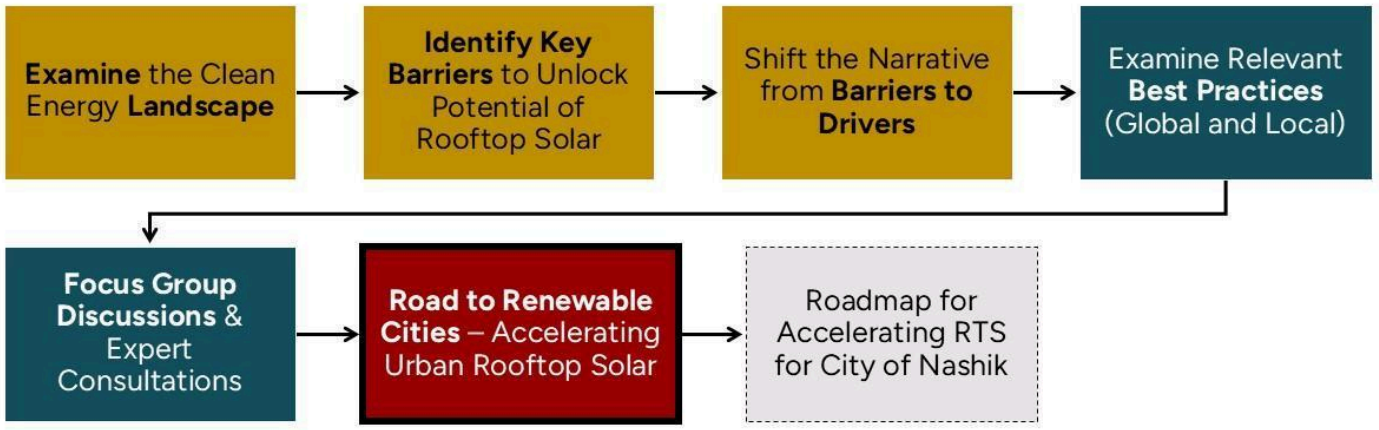


Figure 1: Stepwise Approach to Developing Rooftop Solar Insights and Recommendations

[1] State-wise (Location based) installed capacity of Renewable Power as on 30.06.2025, Ministry of New & Renewable Energy (MNRE)

Key findings

1. Persistent barriers are slowing down RTS adoption
    a. Regulatory hurdles, such as inconsistent net metering policies and weak mandate enforcement.
    b. Financial constraints, including high upfront costs, limited access to credit, and DISCOM resistance.
    c. Urban design and infrastructure challenges—particularly in dense, high-rise cities.
    d. Low consumer awareness and trust in vendors and systems.

2. High potential exists, but needs structured, city-level action
    a. Maharashtra's cities have immense untapped rooftop solar potential, especially in residential and public building segments.
    b. Technical, market, and rooftop potential assessments are largely missing at the local level.
    c. City dialogues and focus group discussions point to a strong need for urban local bodies (ULBs) to lead planning, implementation, and outreach.

3. A four-pillar framework can accelerate RTS
    a. Policy & regulatory reforms: Align central and state instruments (e.g., UDCPR, ECBC, MNRE schemes), strengthen net metering (especially for virtual models), and set performance-based targets.
    b. Innovative financing & business models: Promote community solar, utility-led aggregation, RESCO, and municipal bonds to reduce capital barriers.
    c. Digital & technical enablement: Use smart metering, IoT platforms, and city-level RTS dashboards to drive transparency and performance monitoring.
    d. Consumer engagement: Launch mass awareness drives, train solar ambassadors, and streamline support through facilitation centres.

Recommended next steps

1. Develop city-level RTS action plans with sector-specific targets, pilot programs, and monitoring frameworks.
2. Establish city committees linked to climate action cells for accountability and tracking.
3. Launch RTS programs in public buildings integrated with energy efficiency retrofits.
4. Explore feasibility of municipal green bonds for RTS financing.
5. Institutionalize virtual net metering for high-rise housing and promote digital solar marketplaces.

1. The Urban Energy Shift: A Call to Action for Rooftop Solar

Cities are urbanising at an unprecedented rate, accounting for more than 70% of global energy consumption and contributing to 70% of greenhouse gas (GHG) emissions worldwide[2]. Among urban contributors, buildings play a significant role, responsible for approximately 40% of GHG emissions due to their heavy reliance on fossil fuel-based electricity[3]. With building stock in India expected to double in the next fifteen years, buildings are being positioned as the largest electricity-consuming sector in the country[4]. To reduce GHG emissions and meet the growing electricity demand from buildings, Indian cities must transition to low-carbon and clean energy solutions. This shift is essential for India's energy security and environmental sustainability, both of which will be impacted by urban growth.

The Government of India has pledged to achieve Net Zero Emissions by 2070 at the COP26 and committed to meet 50% of its electricity needs from renewable sources by 2030. As of January 2025, India reached a significant milestone of 217GW[5] against the target of 500GW by 2030, out of which solar energy accounted for 47% of the total installed capacity. Accelerating rooftop solar (RTS) is an opportunity to contribute towards this goal and reduce the burden on the grid to supply clean energy. The Ministry of New and Renewable Energy (MNRE) had set a target of 100 GW of solar energy by 2022[6], of which 40 GW was from rooftop solar. Till the end of 2024, 11.87 GW RTS has been installed. Central-level financial programs such as PM Surya Ghar: Muft Bijli Yojana, are creating an enabling environment for accelerating rooftop solar. States such as Gujarat, Karnataka, and Maharashtra have been leading in implementing this program. However, given that only ~29% MNRE's target has been achieved, there is a need to focus on accelerating adoption of RTS.

The State of Maharashtra in September 2021, announced net zero carbon emissions achievement in 43 cities[7]. With 32% of its energy mix from renewables, Maharashtra aims to add 12.9 GW of solar capacity by 2027[8]. As of June 2025, 3595 MW (23% of households in India) has been achieved under the PM Surya Ghar: Muft Bijli Yojana[9]. Cities in Maharashtra have started implementing rooftop solar (RTS) on existing public buildings, with some mandating RTS for all new buildings. However, large-scale adoption remains slow due to regulatory, financial, and technical challenges. To address the barriers and unlock RTS's full potential, this policy brief—Road to Renewable Cities: Accelerating Urban Rooftop Solar — presents targeted recommendations on policy and regulatory reforms and shares best practices for Maharashtra's urban areas. Learnings from this knowledge product are applicable to all cities across the country and globe.

[2] Empowering Urban Energy Transitions, IEA, IEA (2024)
[3] Built environment, Climate Group
[4] Maharashtra city decarbonisation roadmap: Energy and building sector, C40 Cities & EDS, 2023
[5] Growth in India's renewable energy capacity, ET World, 2024
[6] Year End Review - Solar Power Target Reset, MNRE, PIB
[7] 43 Maharashtra Cities of Maharashtra joined "Race to Zero"
[8] Unconventional Energy Generation Policy-2020, Department of Industry, Energy and Labor
[9] Physical Progress as on June 2025, MNRE

2. Evolving Clean Energy Landscape

The Ministries of Power and New and Renewable Energy are the governing authorities responsible for the clean energy transition of the country. The programs and schemes rolled out by the Ministry of New and Renewable Energy (MNRE) are implemented by the state governments. In Maharashtra this responsibility is shared amongst Maharashtra Electricity Regulatory Commission (MERC), state utilities (including MSEDCL) and Maharashtra Electricity Development Agency (MEDA).

2.1 National Initiatives

The two current initiatives on RTS are the PM Surya Ghar Yojana (which is a more consumer-centric and incentive-driven scheme specifically for households) and the Grid-Connected RTS Program (which is a broader initiative covering all consumer categories with a focus on net metering and grid integration). The smart cities mission (being implemented by MoHUA), and the Solar City Programme (launched in 2011) are also complementary initiatives. Refer Table 1 for a detailed comparison of key national programs geared towards accelerating rooftop solar adoption.

Table 1: Comparison of National Schemes and Programs geared towards accelerating solar rooftop adoption in the country.

	PM Surya Ghar: Muft Bijli Yojana (2024)	**Grid-Connected Solar Rooftop Programme (2019)**	**Smart Cities Mission – Solar Integration (2015)**	**Solar City Programme (2011)**
Objective	To light up 10 million households by providing up to 300 units of free electricity every month.	To achieve an installed capacity of 40 GW from Grid Connected Rooftop Solar (RTS) projects till Mar' 2026.	Integrate solar energy, including RTS, into smart city planning.	Develop at least one solar city per state to reduce conventional power consumption.
Target Segment	Primarily residential households	Residential, commercial, industrial, institutional	Residential, transport hubs, public buildings and infrastructure - EV charging stations, street-lighting	All building types and Infrastructure
Key Features	➢ Target: 10 million household solar rooftops by March 2027. ➢ Subsidies: Up to INR 78,000 per household. ➢ Interest-free loans for installation.	➢ CFA (Central Financial Assistance). ➢ DISCOM-driven implementation. ➢ Urban focus on RTS expansion.	➢ Target: 100 cities Implementation by a special purpose vehicle (SPV) at a cities level. ➢ The SPV will convert the Smart City Proposal into	➢ Solar Master Plans for cities. ➢ Awareness programs & incentives to promote solar adoption. ➢ Implementation through state nodal agencies & ULBs.

	PM Surya Ghar: Muft Bijli Yojana (2024)	Grid-Connected Solar Rooftop Programme (2019)	Smart Cities Mission – Solar Integration (2015)	Solar City Programme (2011)
	➢ Free electricity (up to 300 units/month).		projects through PMUs for implementation.	
Implementation Model	Centralized Union Government-led implementation.	Implemented through state DISCOMs and state nodal agencies.	Led by the Ministry of Housing and Urban Affairs (MoHUA) in collaboration with state governments & ULBs.	Implemented through state nodal agencies & urban local bodies (ULBs).
Status	Launched Feb 2024, 1 million homes are solar powered (till March 10, 2025)	As of March 2025, 16.66 GW of rooftop solar capacity was installed.	Progress varies by city. Pune, Bhopal, Bhubaneshwar and Varanasi have developed projects. (676 projects on energy completed)	Coimbatore, Imphal, Nagpur, Rajkot, Gurgaon, Cochin, Howrah, had initiated development of master plans.

To operationalise the scheme, guidelines published by MNRE include

a. Operational Guidelines for Implementation of PM Surya Ghar Muft Bijli Yojana for the components.
   i. Central Financial Assistance to residential consumer
   ii. Separate guidelines have also been issued for implementation of Innovative Projects, Service Charge, awareness and outreach, capacity building, incentives to local bodies, incentives to Discoms, Saturation of government buildings with rooftop solar.
b. Operational Guidelines for Implementation of Payment Security Mechanism Component & Central Financial Assistance Component for RESCO/Utility Led Aggregation Models.
c. Framework for Vendor Rating Programme
d. Virtual Net Metering – Establishes implementation guidelines for virtual net metering, enabling collective solar energy accounting for multiple consumers.
e. Benchmark Costs – Lists benchmark installation costs for different financial years (FY 2018-19 onwards) to guide subsidy calculation and project pricing.

2.2 Maharashtra State Initiatives

The overall technical potential of RTS is approximately 796 GW[10] in India, with a potential of 274 GW[11] in urban areas. The RTS capacity in Maharashtra has grown 15x from 2020 to 2025 Figure 2[12] .

[10] STAAI
[11] Mapping India's Residential Rooftop Solar Potential A Bottom-up Assessment Using Primary Data Sachin Zachariah, Bhawna Tyagi, and Neeraj Kuldeep November 2023
[12] EDS Analysis, Data Source: Ministry of New & Renewable Energy (MNRE)

The state agencies such as Maharashtra Electricity Regulatory Commission (MERC), Maharashtra Energy Development Agency (MEDA) and Maharashtra State Electricity Distribution Company Limited (MSEDCL), and utilities such as BEST undertaking, Adani power, Tata power have a shared responsibility for implementation of the national schemes.

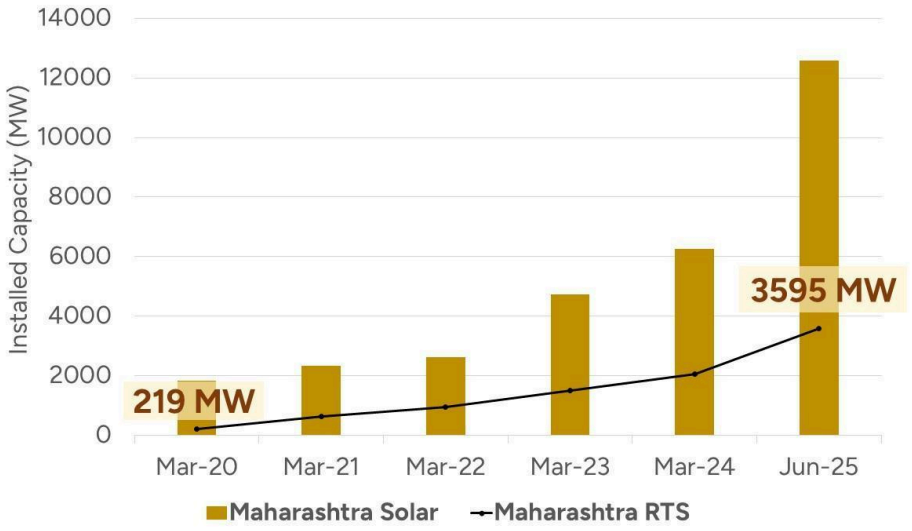


Figure 2: Maharashtra's RTS Capacity (2020 - 2025)

MERC is required to set-up the regulatory framework, policies, and tariffs for RTS installations and ensure compliance by stakeholders. MERC has especially issued regulations on Virtual net-metering and Group Virtual Net-metering for RTS. MEDA is acting as the state's nodal agency for promoting renewable energy, conducting awareness, and facilitating the implementation of RTS projects. The Non-Conventional Energy Generation Policy 2020 by the Department of Industry, Energy and Labor, Government of Maharashtra, has an overall renewable energy target of 17.4 GW (solar is 12.9 GW) by 2027.

Utilities such as MSEDCL oversee grid integration, net metering, inspection, and approval of RTS installations, providing consumer support and ensuring project compliance. MSEDCL has issued Standard Operating Procedures (SOP) for installation and commissioning of RTS. It is also conducting consumer awareness programs to scale RTS installation.

The Urban Development Department (UDD) has also mandated roof top photovoltaic (RTPV) and Solar water heater (SWH) for all building types on plot areas of more than 4000 sq.m in the Unified Development Control and Planning Regulations (UDCPR). Maharashtra State Action Plan on Climate Change (MSAPCC) highlights Solapur, Satara, Nagpur, Latur, and Nanded as the top five districts with the highest solar potential in the state.

2.3 Key Barriers in Unlocking the Potential of Rooftop Solar in Maharashtra

The key barriers that emerged from focus group discussions have been mapped under four key themes in Table 2. While a range of challenges were discussed, including implementation hurdles in the PM Suryaghar scheme, inefficiencies in RTS operations, inadequate monitoring and reporting frameworks, and weak enforcement of building regulations. However, participants consistently emphasized the critical importance of enabling policy interventions and improved access to finance. Regulatory clarity was considered essential for facilitating mechanisms such as Virtual Net Metering and ensuring adherence to building

codes, while financial accessibility emerged as a necessary enabler for adoption across residential and public sectors. These two areas were prioritized, as they are central to enhancing the scalability, bankability, and effective integration of RTS into urban decarbonisation.

Table 2: Barriers to accelerating RTS adoption

Regulatory	Technical	Financial	Awareness
Limited Enforcement of Solar Mandates: Some cities mandate RTS, but enforcement remains weak. **Inconsistent Net Metering Policies:** Frequent changes in net metering regulations create uncertainty for consumers & investors. **Lengthy Approval & Compliance Processes:** Delays in permissions, inspections, and approvals slow down adoption of RTS.	**Urban Density:** Lack of roof area, especially in high-density cities. **Roof Suitability Issues**: Many buildings have structural constraints and are shaded due to dense neighbourhoods. **Pollution:** Air pollution (PM) affects RTS performance. **Grid Integration Challenges:** Capacity constraints & lack of advanced grid infrastructure hinder smooth integration of RTS.	**DISCOM Resistance:** Distribution companies view RTS as a revenue loss. **High Upfront Costs:** Despite subsidies, the initial investment required is a deterrent. **Limited Access to Financing:** Banks hesitate to finance RTS due to lack of awareness and collateral issues. **Lack of Innovative Business Models:** Limited adoption of third-party models (like RESCO and utility-led aggregation).	**Low Consumer Awareness:** Many consumers are unaware of the technology, benefits, and financial incentives available. **Limited Vendor Credibility:** Consumers struggle to identify reliable vendors. **Lack of Performance Assurance:** Concerns over long-term maintenance, efficiency & service reliability. **Lack of digitized data:** Absence of assessment of RTS potential & real-time success stories.

3. Key Recommendations: Scaling Urban Rooftop Solar in Maharashtra

Maharashtra's cities, as engines of economic growth and major hubs of electricity consumption, are pivotal to advancing the state's clean energy transition. RTS presents a high-impact opportunity to decarbonize urban energy use, enhance resilience, and lower electricity costs for both municipalities and citizens. While Maharashtra has made strides in expanding its renewable energy footprint, RTS deployment in urban areas remains significantly underutilized due to persistent regulatory, financial, and institutional bottlenecks. Addressing these challenges requires a targeted, city-led approach that integrates robust policy frameworks, regulatory reforms, ULB-driven implementation models, innovative financing mechanisms like RESCOs, and community-level awareness and participation. This section outlines key recommendations to accelerate RTS adoption across Maharashtra's urban centres, drawing on best practices from India and globally, with select examples illustrated in Figure 3. The recommendations in Table 3 are structured around critical drivers for scaling RTS and are aimed at catalysing the transition toward renewable cities.

Table 3: Key Drivers for scaling RTS

Enabling Policies and Robust Regulatory Frameworks	Technology Advancements and Supporting Infrastructure	Innovative Financial Mechanisms and Business Models	Enhanced Consumer Engagement and Awareness
Effective policies, mandates, and regulatory mechanisms that have driven RTS adoption.	Advances in technology, grid integration and innovative implementation models.	Successful financing strategies, incentives, and market-driven solutions	Awareness campaigns, stakeholder training, and community-driven solar adoption.

Figure 3: Best practices from India and around the world

3.1 Enabling Policies and Robust Regulatory Framework

A well-defined policy and regulatory framework are essential for scaling RTS adoption in cities. Clear net metering regulations, streamlined approval processes, and financial incentives such as capital subsidies and generation-based incentives can significantly enhance adoption rates. Policies that mandate RTS installations on new buildings, integrate solar provisions into building codes, and promote virtual net metering for collective ownership models can expand access to solar energy. Additionally, regulatory certainty—such as stable tariff structures and long-term power purchase agreements—encourages private sector participation and investment.

Maharashtra, like other states, requires clear, supportive, and adaptive policies to streamline RTS implementation and ensure long-term sustainability. Some **key policy recommendations** are outlined in Table 4:

Table 4: Key recommendations for policy and regulatory framework

S.No.	Recommendations	Description
a.	**Alignment of Policy Instruments & Recommendations** (Responsible Actors: UDD, MEDA)	Integration of initiatives of line ministries including Ministries of Housing and Urban Affairs, New and Renewable Energy and of Power (MoHUA, MNRE). Subsequently better alignment and integration of initiatives at State level between the Energy and Urban Development Departments (in the case of Maharashtra, that would imply MEDA and UDD). Especially, alignment between the following policy instruments; ● PM Surya Ghar Yojana ● Unified Development Control and Promotion Regulations (UDCPR) ● Maharashtra Energy Conservation Building Code Rules, 2025 ● Energy Conservation and Sustainable Building Code (ECSBC) - Residential and Commercial. Remove minimum kW restrictions and recognize <1 kW systems in policies - This will enable households with lesser loads to also participate. Specific recommendation to the UDCPR include: ● Define minimum RTPV installed capacity criteria based on roof area, energy demand or connected load. (Currently the UDCPR mandates SWH or RTPV systems in all buildings constructed on a plot area of more than 4000 sq.m. In this case, projects that have plot sizes less than 4000 sqm are exempted) The criteria are recommended to be aligned with requirements under ECBC 2017. Under section 7.2.8 of ECBC 2017, "A dedicated RE generation zone[13] equivalent to at least 25% of roof area or area required for generation of energy equivalent to 1% of total peak demand or connected load of the building, whichever is less, shall be provided in all buildings." This will be subject to amendment of the codes.

[13] Renewable Energy Generation Zones (REGZ) is area with RTPV and solar water heater systems, ECBC 2017

S.No.	Recommendations	Description
		• Make provision to incorporate and align with existing mandates for public buildings, such as the MNRE directive to ensure saturation of all central government buildings with RTS by December 2025[14], as well as any future initiatives taken by the central government. • Integrate and update the requirements of Maharashtra ECBC rules. Further, include empanelled ECBC Assessors/ Energy Auditors (Building) as technical personnel and add their qualification requirements. • To address space constraints, permit RTS over roof shades without counting the covered terrace area as part of Floor Space Index (FSI), and revise the current restriction on panel height above 1.8m that limits rooftop usage.
b.	**Performance-based Targets** (Responsible Actors: Energy Dept, UDD)	For all new buildings, forward planning for renewable energy capacity will enable accelerated RTS adoption. Setting performance targets for high energy intensity buildings as a part of building approvals / sanctioned loads. For example, Kuala Lumpur requires 30% of energy for all new commercial and residential buildings to be sourced from renewable energy, that includes solar.[15]
c.	**Net Metering and Virtual Net Metering (VNM)** (Responsible Actors: MERC, DISCOMs)	Strengthening net metering regulations and expanding VNM especially for group housing societies and community solar projects - Maharashtra has an urban population share of 45.2%, higher than the national average of 31.1%. With 27 municipal corporations witnessing rapid vertical growth, consumers are mainly residing in multi-storied buildings. These multi-storeyed buildings lack adequate roof space to generate renewable energy. Enabling virtual net metering or group net-metering could accelerate the adoption of RTS. While the Maharashtra Electricity Regulatory Commission (MERC) has issued an amendment to the net-metering regulations, introducing the option of virtual net-metering[16], the Standard Operating Procedure (SOP) has not defined the application process, timelines for virtual net-metering or group net-metering in line with the amendment.
d.	**Incentives and Subsidies** (Responsible Actors: Energy dept, UDD)	Further enhance financial incentives under PM Surya Ghar: Muft Bijli Yojana and explore state-specific additional subsidies. (For example: UPNEDA)

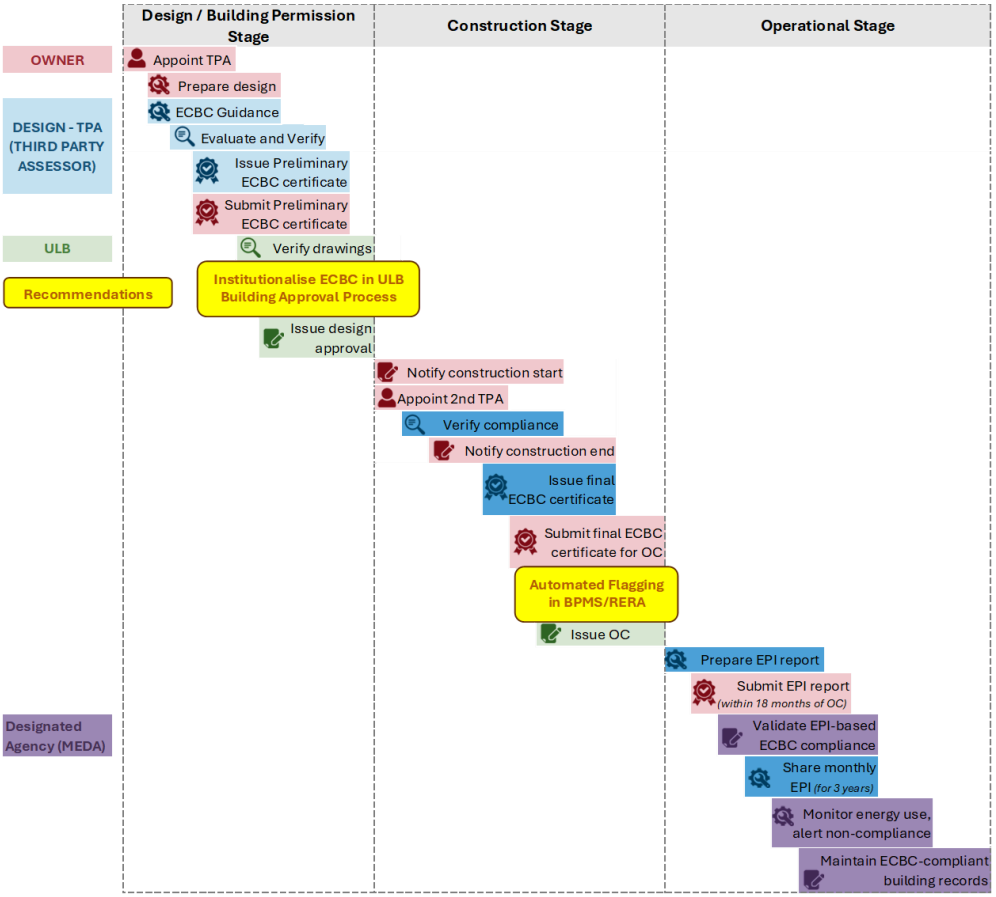
[14] Operational guidelines for "Saturation of Government Buildings with Rooftop Solar under PM-Surya Ghar: Muft Bijli Yojana", Ministry of New and Renewable Energy, July 2024.
[15] KL Mayor's Bold 30% Renewable Energy Mandate Fastens Nation's Energy Future - SolarQuarter
[16] Grid Interactive Rooftop Renewable Energy Generating Systems (Second Amendment) Regulations, Maharashtra Electricity Regulatory Commission, 2024

S.No.	Recommendations	Description
e.	**Accountability & Reporting Mechanism** (Responsible Actors: ULBs)	Establish city-level committees (linked to city climate action cells) to ensure accountability at the local level, ensuring regular monthly reporting to District and State Committees.

Municipal Corporations / Urban Local Bodies play a crucial role in integrating RTS into the urban energy mix through planning, enforcement, and facilitation. Key steps towards **structuring implementation through Urban Local Bodies / Municipal Corporations are outlined in Table 5:**

Table 5: Key steps for integrating RTS at local level

S.No.	Steps	Description
a.	**Municipal Rooftop Solar Action Plans / Roadmaps**	Developing city-level RTS action plans for all 43 cities. Key elements of this roadmap / action plan could include: ● Technical potential of RTS as per building typologies / sub-sectors → Develop targeted programs for each sub-sector. ● Market Assessment - Consumers and Vendors ● Assessment of existing RTS installations and recommendations. ● Pipeline of bankable projects for RTS installation. ● Budget, Implementation timeline, targets and monitoring, evaluation and reporting frameworks. ● Pilot projects on Grid-Interactive and Community Solar Models (Technology Advancement) (Example: Chennai, Nashik is underway on development of its roadmap; UPNEDA has also estimated technical potential for all cities in Uttar Pradesh)
b.	**RTS Installations in Building Approval Process for all new buildings**	While the UDCPR incorporates a selective mandate on RTS, there is an opportunity to further strengthen compliance mechanisms at the local level. Similarly, the recently notified Maharashtra ECBC, which mandates renewable energy systems, outlines a robust compliance process. The process requires ULBs to give design approval only after verifying the certificate. Building on this, Figure 4 maps the existing process and highlights potential areas where ULBs and the state agencies can play an enabling role to enhance the effectiveness and efficiency of ECBC compliance governance.

S.No.	Steps	Description
		 *Figure 4: Mapped Roles and Interventions for ECBC Implementation in Maharashtra*
c.	**RTS Implementation in Public Buildings and Integration with Energy-Efficiency Retrofits**	Dedicated programs for scaling RTS adoption in municipal offices, schools, and hospitals. Since 2017, MEDA has completed installations totalling up to 47 MW RTS on public buildings[17]. MEDA has also coordinated with MSEDCL to estimate the overall number and load of Public Buildings in Maharashtra. A state-level Net Zero Public Buildings initiative can be undertaken.
d.	**Public-Private Partnership (PPP)**	Engage private sector players to deploy RTS for municipal and community spaces.

Best Practices:

Internationally, countries with strong regulatory frameworks have successfully scaled RTS. Germany's Energiewende policy (targeting 80% renewable electricity by 2030) offers long-term feed-in tariffs, ensuring financial viability for solar investments. In the United States, net metering policies and tax credits, such as the Investment Tax Credit (ITC), have driven widespread adoption, with states like California implementing mandates for solar installations on new buildings. Australia's Small-scale Renewable Energy

[17] Insights shared by MEDA during stakeholder consultations in February 2025.

Scheme (SRES) has provided rebates and interest-free loans to accelerate residential solar adoption. Table 6 outlines key global and local case studies that illustrate approaches to overcoming these barriers.

Table 6: Case studies for Enabling Policies and Robust Regulatory Framework

Case Study	Description	Barriers Addressed
Berlin's Solar Act	The Act covers all new buildings and major renovations of roofs in existing buildings with usable areas of more than 50 m2 and mandates the installation and use of solar PVs. As from 2023, at least 30% of new buildings' roof areas need to be covered with solar.	Enforcement of Mandates
Delhi Solar Policy 2023[18]	To simplify RTS applications, Delhi Solar Policy, mandates standardized procedures across DISCOMs through the establishment of a state solar portal. This portal serves as a single-window system for customers to access information and track their net-metering applications. Additionally, BSES has released a detailed application form outlining the required documents for virtual net metering[19]	Slow Approval Process Inconsistent Net Metering Policies
Tamil Nadu Solar Policy[20]	The policy states that any building type that requires ECBC compliance will follow ECBC guidelines for the installation of Solar PV and solar thermal energy systems. The Directorate of Town and Country Planning in collaboration with local bodies and Chennai Metropolitan Development Authority shall amend their building by-laws to mandate ECBC.	Enforcement of Mandates Alignment of building and renewable energy related policies.
West Bengal's Policy on Co-generation and Generation of Electricity from Renewable Sources of Energy, 2012[21]	Mandates all the public buildings to have solar devices. All existing and upcoming commercial and business establishments having more than 1.5 MW of contract demand are required to install solar rooftop systems to meet at least 2% of their total electrical load. Further, all the existing and upcoming schools and colleges, hospitals, large housing societies, and government establishments having a total contract demand of more than 500 KW are required to install solar rooftop systems to meet at least 1.5% of their total electrical load.	Enforcement of Mandates Alignment of building and renewable energy related policies.
City of New York's Clean Energy Programme[22] **as per Local Law 99 (2024)**	Targeted to install 100 MW of solar PV on public buildings by 2030. As of 2024, 28.3 MW of solar PV panels have been installed across 175 facilities, fulfilling 28% of the City's goal.	Limited Enforcement of Solar Mandates

[18] Delhi Solar Energy Policy, 2023
[19] Virtual net metering forms and checklists
[20] Tamil Nadu Solar Policy, 2019
[21] Policy on Co-generation and Generation of Electricity from Renewable Sources of Energy, Government of West Bengal, 2012
[22] Clean Energy Generation - Department of Citywide Administrative Services

Case Study	Description	Barriers Addressed
Delhi's Unified Building Bye-Laws[23]	Eliminated height restrictions for RTS installations. The maximum allowable height is governed by zonal height regulations.	Rooftop Suitability Issues & Urban Densities

3.2 Leveraging Technology Advancements and Infrastructure

To scale RTS adoption effectively, cities in Maharashtra must harness emerging technologies and build robust digital and physical infrastructure. Advancements in high-efficiency photovoltaic (PV) panels—including bifacial and perovskite-silicon tandem modules—are enhancing energy output even in space-constrained environments. Smart inverters and battery storage systems enable better grid interaction and increased self-consumption, while lightweight, flexible, and building-integrated PV solutions are expanding deployment possibilities in dense urban settings.

To systematically integrate these advancements, the following technology-driven initiatives are recommended for city-level action:

a. **Establish a Statewide RTS Monitoring Dashboard:** Create a centralized digital portal that aggregates data from DISCOMs and urban local bodies (ULBs) to monitor installation progress, energy generation, and policy implementation across cities.
b. **Enable Smart Metering and IoT Integration:** Deploy real-time energy tracking systems, predictive analytics, and remote monitoring technologies to improve performance, detect anomalies, and inform grid management.
c. **Implement RTS Performance Benchmarking:** Develop a state-wide framework for benchmarking solar system performance, including standardized metrics for generation efficiency, downtime, and return on investment. This will guide data-driven decision-making for both consumers and utilities.
d. **Use AI-Based Rooftop Potential Mapping:** Leverage geospatial analytics and artificial intelligence to assess the technical potential for RTS at the city and neighbourhood levels, helping prioritize high-impact zones and target policy or financial incentives more effectively.

Best Practices:

Table 7 summarises key global and local case studies addressing barriers in technology integration.

Table 7: Case studies for Leveraging Technology Advancements and Infrastructure

Case Study	Description	Barriers Addressed
Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA)[24]	Rooftop Solar Application Portal: Connects DISCOMs, vendors, and consumers to monitor all stages of the RTS process.	Delays in communicating installation and activation timelines

[23] Revisions in height norms in Delhi
[24] UPNEDA - Solar Rooftop Portal

Case Study	Description	Barriers Addressed
Uttar Haryana Bijli Vitran Nigam (UHBVN) Solar Rooftop Dashboard[25] **BSES Rajdhani Power Limited (BRPL)**[26]		
Surat Diamond Bourse, India	Has utilised bifacial solar panels to maximize energy generation. Total onsite production with renewables: 900 MWh/year; Capacity of solar installation: 600 kWp	Technology Advancements
CSTEP's Rooftop Evaluation for Solar Tool (CREST)[27]	To identify precise locations for installing rooftop photovoltaic (RTPV) systems on buildings	Prioritization of high-impact zones
"Healthway" - Solar Roof Cycle Track, Hyderabad	"Healthway" is India's first solar-roofed cycling track, inaugurated in October 2023 along Hyderabad's Outer Ring Road. Spanning 23 kilometres, the track features 16,000 solar panels installed on its roof, capable of generating up to 16 megawatts of electricity.	Land Availability Constraints
SolShare rooftop solar technology[28]**, Allume, Australia**	Allows multiple apartments in the same building to share a single RTS system. This behind-the-meter solution splits the electricity from the solar system via a hardware device and its 'dynamic sharing algorithm' allocates it fairly to residents over the course of a month.	Technology Advancements Urban density
Solar pyramid project, Curitiba[29]	This is the first solar plant to be built on a former landfill in Latin America. Launched in 2023, the project will contribute to the overall goal to solarize 43% of the city's energy consumption needs.	Land Availability Constraints

3.3 Mobilising Innovative Financial Mechanisms and Business Models

The transition to RTS in India—and particularly in Maharashtra's cities—requires around ₹4 crores per MW investment[30]. While the private sector has traditionally driven renewable energy growth, unlocking the full potential of RTS will depend on well-designed business models backed by fiscal and financial incentives that address upfront costs, investor risk, and consumer affordability.

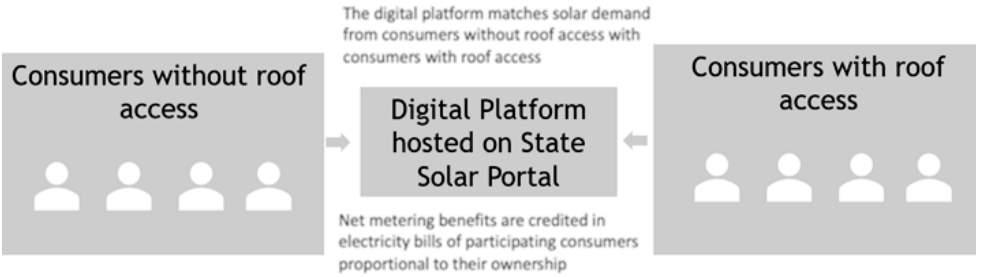
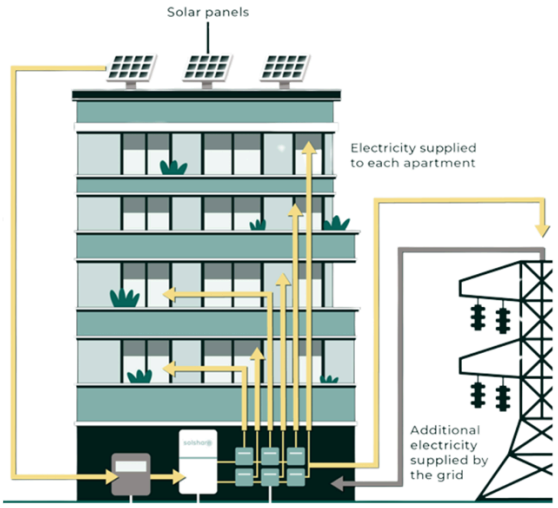
[25] Uttar Haryana Bijli Vitran Nigam Solar Rooftop Dashboard
[26] BSES - Delhi Solar Portal
[27] Center for Study of Science, Technology and Policy (CSTEP)
[28] SolShare technology, Australia
[29] Curitiba: From landfill to solar revolution - C40 Cities
[30] Indian Technology Catalogue Generation and Storage of Electricity, Central Electricity Authority, 2022

Cities in Maharashtra must adopt a diversified portfolio of implementation approaches to meet varying needs across building types and consumer segments. Business models such as CAPEX, OPEX/RESCO, rent-a-roof / lease, community based solar, utility-scale aggregation, and plug-in RTS have been deployed to varying degrees in various states throughout India. For utility led initiatives, two approaches are possible[31]:

1. Facilitation approach: The utility aggregates projects and facilitates procurement of systems or solar power services, paid for by the end consumer or the RESCO. Here the utility charges for facilitation services, creating an additional source of revenue for itself.
2. Investment Approach: The utility aggregates projects and invests in developing those projects. Here they play a key role in financing these systems through linkages with financial institutions either as on-lenders or as collection agencies.

To enable large-scale and inclusive adoption across Maharashtra's cities, the **recommended actions are summarised in** Table 8**:**

Table 8: Key recommendations for mobilising finance for RTS

S.No.	Recommendations	Description
a.	**Community Solar Model**	ULBs to identify pilot projects for implementation of community solar models (especially amongst high energy-consuming societies / group housing).  Develop an investment strategy for Community Rooftop Solar: a. A single, larger RTS system to serve multiple homes (e.g., in a high-rise complex), reducing capital and operational costs compared to individual RTS installations. 

[31] Utility-Centric Business Models for Rooftop Solar Projects, PACE-D program, USAID & MNRE

S.No.	Recommendations	Description
		b. Investment can be phased over time, allowing adjustments based on evolving technology costs and grid prices. c. The community can also start with a smaller system and scale up based on demand and market conditions d. Explore technology advancements (such as the benefits of RTS distribution amongst high-rise residential units)
b.	**Feasibility for Municipal Bonds for Rooftop Solar Installation**	A dedicated **Solar Municipal Bond Program** can reduce financing barriers, lower borrowing costs, and attract private investors while ensuring long-term sustainability in RTS adoption. While this has been applied for solar parks, the feasibility of applying it for RTS is yet to be explored. This will include securing approval from SEBI and Maharashtra State Government for green bond issuance aligned with sustainability goals and identifying municipal buildings, affordable housing complexes, and community spaces for RTS installation. (This can be part of the Municipal RTS action plans).
c.	**CAPEX Model**	Develop and implement programs between utilities and banks to enable low-interest loans for consumers. This will enable direct ownership by residential and commercial consumers.
d.	**OPEX / RESCO Models**	Develop and implement programs considering third-party ownership models where developers install and maintain RTS while consumers pay for power generated.

Best Practices:

Table 9 outlines case studies demonstrating effective financial innovations and business models that support wider RTS adoption.

Table 9: Case studies for Mobilising Innovative Financial Mechanisms and Business Models

Case Study	Description	Barriers Addressed
Delhi's Solar Energy Policy 2023 - Community Solar Model[32]	Consumers without suitable roof space—such as tenants, apartment dwellers, or those with small or shaded rooftops—can participate in community solar by purchasing a share in a third-party-owned solar PV system. Alternatively, multiple consumers can jointly install a solar plant on a participating consumer's rooftop. The generated electricity, exported to the grid, will be credited to each participant's bill based on ownership share through Virtual Net Metering (VNM) as approved by Delhi Electricity Regulatory Commission. A digital platform to connect consumers without rooftop access with those willing to host solar installations will be developed.	Urban density and lack of availability of roof area

[32] Delhi Solar Energy Policy, 2023

Case Study	Description	Barriers Addressed
Business Models by Kerala State Electricity Board (KSEB) [33]	a. **Model-1:** Kerala State Electricity Board Limited (KSEBL) will utilize the rooftops of consumers for installing and maintenance of solar plants for 25 years, incurring full cost. The energy generated will be fed into the grid for 25 years and a fixed percentage of generation (10%) will be given to the consumer, free of cost for utilizing his / her / their roof. b. **Model-2:** KSEBL will install RTS at consumer premises and the energy generated will be sold to the consumer at a fixed price for 25 years through PPA. KSEBL will install and maintain the plant for 25 years, incurring the entire installation cost. c. **Model-3:** KSEBL will set up the solar plant after collecting the cost of the plant from the consumer. Excess energy, if any, after the consumption of the consumer will be settled at the APPC (Average Power Purchase Cost) at the rate approved by the Kerala State Electricity Regulatory Commission (KSERC) at the end of the settlement period.	Lack of Innovative Business Models High Upfront Costs
Vishakhapatnam Solar Rooftop Pilot Scheme[34], Andhra Pradesh, India	Andhra Pradesh Eastern Power Distribution Company Ltd. (APEPDCL), and NREDCAP with Andhra Bank acting as the financial partner developed a scheme targeting domestic consumers with less than 200kWh/month. As per the scheme, APEPDCL will facilitate the setting up of 1 kW RTS systems at the premises of domestic consumers, financed with the help of Andhra Bank. Consumers do not incur any up-front costs with CAPEX required for the system split into three tranches: a. 50% of the total is paid in the form of subsidy by MNRE (30%) and the Government of Andhra Pradesh (20%) b. The remaining 50% is provided as a long-term loan from Andhra Bank. c. Consumer repays the loan as equated monthly instalments (EMI) to APEPDCL.	Limited Access to Financing High Upfront Costs
UP New Energy Development Agency (UPNEDA) Solar Cities	For the residential sector, the Uttar Pradesh Government will provide a subsidy of 15,000/kW to a maximum of 30,000/kW, which will be over and above the central finance assistance under the PM Surya Ghar Yojana	High Upfront Costs
City of San Francisco's Sunshare[35]	Pools the buying power of all 9 Bay Area counties to negotiate significant discounts on solar (15% off) and storage (10% off).	Lack of Innovative Business Models High Upfront Costs

[33] Kerala State Electricity Board, Newsletter, Volume I, Issue 5, 2023
[34] Case study Vishakhapatnam – APEPDCL solar rooftop consumer financing scheme, USAID & MNRE, 2018
[35] Bay Area SunShares

Case Study	Description	Barriers Addressed
London's Solar Together London[36]	This is a group-buying programme facilitated by the city where households and small businesses register their interest and are then aggregated in competitive processes.	Lack of Innovative Business Models High Upfront Costs
City of New York's Solar Electric Generating System (SEGS) Tax Abatement[37]	This is offered to residential or commercial properties that use solar power. The amount of the benefit depends on the installation date	High Upfront Costs
Tokyo Metropolitan Government (TMG)'s subsidy	TMG pays a part of the installation cost of solar PV (approximately 940 USD/kW) to private companies who install solar PV on the rooftops of private buildings and building owners do not pay any initial cost.	High Upfront Costs
Tamil Nadu, India	a. Operational Framework to enforce Tamil Nadu Combined Development and Building Rules (TNCDBR) 2019 b. By owning RTS modules, TANGEDCO can scale up RTS systems without losing revenue. c. TNERC's draft (Grid Interactive Solar Photovoltaic [PV] Energy Generating Systems) Regulations, 2024, includes provisions for group net metering.	Discom Resistance

Gujarat solar rooftop Public Private Partnership (PPP) model[38]

Gujarat's Public-Private Partnership (PPP) model (as illustrated in Figure 5) for RTS began with a 5 MW pilot in Gandhinagar, where private developers installed solar panels on government and residential buildings under a 25-year concession. Building on this success, a similar 5 MW project was implemented in Vadodara, allowing developers to lease rooftops from private property owners. This model attracted private investment, increased solar adoption, and reduced greenhouse gas emissions, making it a replicable approach for other cities.

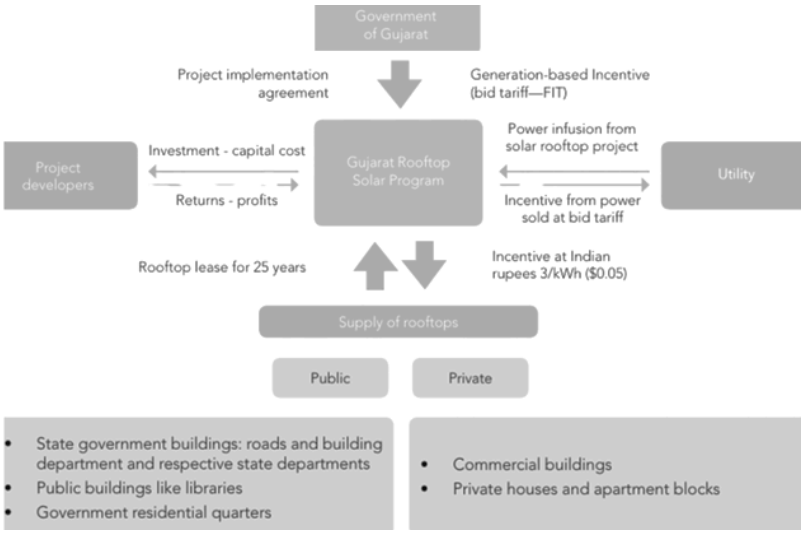


Figure 5: Public-Private Partnership (PPP) structure of the Gandhinagar Rooftop Solar Programme in Gujarat[39]

[36] Solar Together London | London City Hall
[37] Solar Electric Generating System (SEGS) Tax Abatement
[38] Rooftop Solar Public-Private Partnerships: Lessons from Gujarat Solar, Partnerships IQ, the World Bank PPP Group & the energy and resource efficiency group.
[39] Public-Private Partnerships: Lessons from Gujarat Solar

3.4 Enhanced Consumer Engagement and Awareness

Consumer engagement is a cornerstone of successful RTS adoption. In Maharashtra's cities, where awareness, trust, and decision-making support remain limited[40], proactive outreach is essential to unlock the potential of residential and institutional sectors. Building public trust requires more than just technical options—it calls for clear communication of benefits, visible success stories, and easily accessible support mechanisms. Targeted awareness campaigns, community-based advocacy, and digitally enabled tools can simplify the adoption journey for consumers, while also boosting the credibility of vendors and service providers.

To catalyse consumer-driven adoption, cities should implement the following initiatives, with Urban Local Bodies (ULBs) serving as key facilitators:

a. **Citywide Mass Outreach Campaigns:** Launch RTS awareness drives across digital and traditional platforms—social media, local newspapers, radio, and city events—tailored to different consumer segments and languages.
b. **Solar Ambassadors and Community Champions:** Train Resident Welfare Associations (RWAs), local leaders, and youth volunteers to act as peer advocates, addressing myths, facilitating vendor connections, and sharing testimonials.
c. **One-Stop Solar Facilitation Centres:** Establish dedicated helpdesks within municipal offices to guide consumers on system sizing, vendor selection, application processes, and financing options.
d. Financial Literacy and Capacity Building Programs: Equip consumers with knowledge about subsidies, loan schemes, payback periods, and long-term savings. Partner with banks and DISCOMs to conduct workshops and roadshows.
e. **Recognition and Incentive Programs:** Celebrate high-performing housing societies, institutions, and businesses through city-level awards, certifications, and showcase stories to drive aspirational adoption.

In parallel, digital tools such as solar potential calculators, virtual assessments, vendor rating platforms, and real-time monitoring dashboards can empower consumers to make informed decisions and track their savings and system performance over time.

Best Practices:

Table 10 highlights case studies that enhance consumer awareness and participation in RTS uptake.

Table 10: Case studies for Enhanced Consumer Engagement and Awareness

Case Study	Description	Barriers Addressed
City of Sydney's Renewable Energy Help Centre[41]	This is a knowledge sharing platform, initiated by the city, that provides renewable energy information and help to Sydney residents.	Consumer Awareness
Initiatives by Indian Discoms	**Surat Municipal Corporation (SMC)** [42] launched the 'Solar Revolution' program in 2016, using the #SuratSolarbrand.	Consumer Awareness Vendor Credibility Capacity Building

[40] Based on insights from stakeholder engagements and consumer surveys conducted in Nashik under the "Roadmap for Accelerating Rooftop Solar Deployment in Nashik City" project.
[41] Renewable energy help centre - City of Sydney
[42] Solar rooftop: Perspective of DISCOMs, Shakti Foundation & TERI, 2019

Case Study	Description	Barriers Addressed
	This program utilises channels such as e-media, newspapers, and solar camps. **BSES Rajdhani Power Ltd. (BRPL)**[43] launched a "Utility-Anchored Rooftop Programme" Vishakhapatnam Pilot Scheme[44] included consumer outreach and awareness programs using print media. **Goa Solar Portal**[45] streamlined application and approval process, connected consumers with empanelled RTS installers and used the portal to raise awareness about incentives among consumers. This is being also implemented by other utilities in India such as those in **Maharashtra and Uttar Pradesh**.	
City of Lisbon's SILOS platform[46]	The platform aims to promote a wider acceptance and massive adoption of PV systems in the city. The platform provides the solar exposure, the solar electricity map and the registration of photovoltaic systems in the SOLIS community and Lisbon residents.	Consumer Awareness Digitization of Data
UPNEDA Solar Portal[47]	The portal includes access to both city-wise RTS potential as well as detailed segment-wise information. This enables the state to monitor and report progress on RTS.	City-wise assessment of technical potential Digitization of Data

[43] Solar rooftop: Perspective of DISCOMs. Shakti Foundation & TERI. 2019
[44] Case study Vishakhapatnam – APEPDCL solar rooftop consumer financing scheme, USAID & MNRE, 2018
[45] Goa Solar Portal
[46] Case study - Lisbon Solar Platform
[47] UPNEDA Solar Cities Portal

Way Forward

This document serves as a foundational resource for two parallel and complementary next steps.

The recommendations from this document will contribute to shaping **state-level regulatory reforms**. Proposed amendments aim to strengthen the alignment of urban development regulations with RTS potential and adoption. These include revisions to the Unified Development Control and Promotion Regulations (UDCPR) and the incorporation of the Maharashtra Energy Conservation Building Codes, 2025 within the building approval process. The policy recommendations from this knowledge product aim to support these reforms and will inform engagement with the relevant departments to advance an enabling environment for RTS deployment in cities across the state.

At urban level, this document has informed the **development of a RTS Deployment Roadmap for Nashik city**, envisioned as a pilot to guide city-level clean energy transition. The roadmap is based on a detailed assessment of Nashik's technical, economic, and market potential for RTS adoption. It has detailed roadmap pathways, outlined phased mandate recommendations for building typologies, identified institutional anchors, proposed financing frameworks, and suggested alignment of building codes, tendering, and procurement practices to enable effective implementation. The outcomes from this pilot initiative can be adapted and replicated across other urban local bodies in Maharashtra.

Building on these parallel pathways, Phase 3 of the engagement will focus on supporting cities to transition from planning to execution through the identification and structuring of a prioritised project pipeline. This will include working with select cities to translate roadmap recommendations into investment-ready projects by defining project scopes, estimating capital requirements, identifying suitable delivery and financing models, and aligning projects with state and national funding programmes. Targeted technical assistance will be provided to help cities sequence projects, engage relevant departments and utilities, and connect with implementation partners and financiers. This pipeline-led approach is intended to accelerate on-ground deployment, crowd in public and private investment, and create a replicable model that can be scaled across Maharashtra's cities over subsequent phases.