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Whitepaper on

State Energy Efficiency Action Plan for MAHARASHTRA

Prepared by

CONFEDERATION OF INDIAN INDUSTRY

CII
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Background

The increasing demand for energy puts a strain on the country's resources and has negative environmental impacts. Therefore, it is necessary to separate the country's economic growth from its energy demand. This objective is also reflected in India's Intended Nationally Determined Contribution submitted before the Paris Climate Conference, where the government emphasized energy conservation as a crucial mitigation strategy.

During the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2021, the Government of India presented India's climate action plan, which included five essential elements known as Panchamrit. These elements include the target of achieving net zero emissions by 2070 and obtaining 50% of the country's energy from renewable resources by 2030.

The focus of this project was to develop strategies aimed at improving the energy efficiency of energy-intensive sectors within the state. This action plan aligns with the Nationally Determined Contributions (NDCs), also known as Panchamrit. For Maharashtra, the action plan identifies key sectors and evaluates the potential for energy conservation and efficiency improvements in the region.

The State Energy Efficiency Action Plan sets both short-term goals to be achieved by FY 2026 and long-term goals to be achieved by FY 2031, with the objective of achieving significant energy efficiency improvements by 2031. The implementation of the proposed action plan is expected to result in estimated energy savings of 13.15 million tonnes of oil equivalent (Mtoe) in a moderate scenario and 17.62 Mtoe in an ambitious scenario for Maharashtra.

Identification of the focus sectors

To facilitate the transition towards low-carbon development pathways, each state or union territory (UT) plays a crucial role. The Bureau of Energy Efficiency, under the guidance of the Ministry of Power in consultation with State Designated Agency, various stakeholders from different sector of the state and knowledge partner CII GBC has developed state-specific energy efficiency action plan to ensure that resource allocation aligns with the state's requirements and aids in achieving state-specific goals related to sustainable development.

Identifying the focus sectors or areas is important because certain sectors within a state tend to consume a significant portion of energy. To determine the focus sectors for Maharashtra, a comprehensive study was conducted, considering various parameters such as energy consumption patterns, emissions, Gross State Value Addition (GSVA), gap analysis in respective sectors, potential for energy efficiency and emission reduction, planned efforts by the state in prioritized sectors, State Designated Agency (Maharashtra Energy Development Agency), and inputs from stakeholders.

Based on the Total Final Energy Consumption (TFEC) in the state and its sectoral distribution, the following sectors have been identified as the focus sectors for devising energy efficiency strategies in Maharashtra referring the fiscal year 2019-20 as a base year. Industries, Buildings, Transport, Agriculture, Fisheries & Municipal are the identifiedfocus sector for the state.

By targeting these focus sectors and implementing energy efficiency measures, the state aims to optimize energy consumption, reduce emissions, and contribute to sustainable development goals.

Proposed Strategies with Implementation Methodology

The chapter discusses the proposed strategies outlined in the action plan for the identified focus sector along with their potential impact in terms of energy efficiency and emission reduction. These proposed strategies are stated below with their actionable items and implementation methodology.

1. Industry Sector

The state of Maharashtra has witnessed a significant growth in the industrial sector in the past few years. Rapid strides have been observed in various sectors such as Cement, Chlor-Alkali, Fertilizer, Iron and Steel, Pulp and Paper, Petrochemical and Textile, etc., in the region. Following are the major industries in Maharashtra:

1. Chemicals & Petrochemicals
2. Manufacturing
3. Agro Based Industries
4. Cement
5. Pharmaceuticals & Healthcare
6. Textiles

Energy Efficiency Interventions in PAT Sectors in Maharashtra

The proposition pertains to the Small and Medium Enterprises (SME) sector, encompassing MSMEs in key PAT sectors like Cement, Iron and steel, Pulp & paper, Textile, Chlor and Alkali, Fertilizers, among others. This strategy entails the adoption of energy-efficient technologies alongside novel decarbonization solutions within the market framework, with the primary aim of assisting SMEs in achieving their targeted energy conservation objectives.

PAT Deepening Scheme- The Perform, Achieve, and Trade (PAT) Deepening Scheme is designed to intensify the energy efficiency efforts of industries that have already achieved significant reductions in energy consumption. Through more stringent targets and advanced technology adoption, the scheme aims to further enhance energy performance and reduce greenhouse gas emissions. By incentivizing deeper energy-saving measures, the PAT Deepening Scheme contributes to Maharashtra's sustainable development and climate mitigation objectives.

Implementing Agency: Bureau of Energy Efficiency (BEE), Maharashtra Energy Development Agency (MEDA)

Actionable Items & Implementation Methodology - PAT Deepening Strategy

a. **Awareness & Capacity Building** - Enhancing the skills of Energy Managers and Energy Auditors in the PAT sector is coupled with the exploration of additional Designated Consumers (DCs) within the current sectors. This involves conducting a comprehensive study to assess the feasibility of reducing the existing sectoral threshold energy consumption.
b. **Energy mapping** - Conducting benchmarking studies and regular data collection exercises at intervals to ensure accurate and up-to-date information.
c. **Technology Intervention** - Promoting the uptake of energy-efficient technologies within industries via demonstration initiatives. A compilation of these energy-efficient technologies is accessible through the BEE's support hub on the ADEETIE portal (Assistance in Deploying Energy Efficient Technologies in Industries and Establishments).

PAT Widening Scheme- The Perform, Achieve, and Trade (PAT) Widening Scheme is an extension of the PAT initiative aimed at enhancing energy efficiency across various industrial sectors. Building upon the success of the original PAT scheme, the widening scheme encompasses a broader range of industries, encouraging them to improve energy performance through specific targets. This approach seeks to drive sustainable energy practices and reduce carbon emissions, contributing to the nation's overall energy efficiency and environmental goals.

Implementing Agency: Bureau of Energy Efficiency (BEE), Maharashtra Energy Development Agency (MEDA)

Actionable Items & Implementation Methodology- PAT Widening Strategy

a. **Awareness & Capacity Building** - Strengthening the capabilities of Energy Managers and Energy Auditors in Non-PAT sectors is paralleled by an examination of potential sectors (such as Dairy, Bricks, Ceramic, Foundry, etc.) for potential inclusion in the PAT scheme. This entails conducting a feasibility study. Additionally, a benchmarking study and comprehensive data collection at the cluster level are also part of this comprehensive approach.

b. **Technology Intervention** - Executing pilot initiatives, embracing digitization, automation, and adopting energy-efficient technologies form key components of the strategy. A roster of these energy-efficient technologies is accessible through the BEE's facilitation center on the ADEETIE portal.

Taking into account the application of the outlined strategies within the industrial sector, it is projected that around 3.70 million tonnes of oil equivalent (Mtoe) in energy savings could be conserved under the moderate scenario, while the ambitious scenario has the potential to yield approximately 4.59 Mtoe in energy savings.

Decarbonising MSMEs through cluster approach

Maharashtra, aiming to accelerate urbanization and sustain industrialization, faces a significant rise in resource and energy demands. The state can address these challenges by leveraging its numerous MSME clusters, such as Pune Forging, Kolhapur Foundry, and Bhiwandi Textile, through a cluster-based strategy. Mandating energy audits within these clusters can identify efficiency improvements and facilitate the implementation of energy-saving measures, significantly reducing energy consumption and emissions. This structured approach fosters resource sharing, adoption of best practices, and continuous improvement among clusters. It also encourages peer learning and competition, driving innovation and sustained progress. By focusing on these industrial hubs, Maharashtra can achieve its goals of sustainable industrialization and urbanization while mitigating the adverse environmental impacts associated with increased resource usage. The cluster-based strategy not only enhances energy efficiency but also contributes to the overall decarbonization efforts, ensuring a greener and more sustainable future for the state.

Implementing Agency: MEDA, Directorate of Industries, MSME Development & Facilitation Department

Actionable items & Implementation Methodology

a) **Policy Advocacy-** Sector-specific policy development for financial assistance on benchmarking the MSMEs within the clusters

b) **Subsidy**- Subsidies for conducting energy audits and implementation of energy efficiency projects.

c) **Green Rating**- Promotion of Green Rating for Companies.

d) **Electrification**- Incentives for electrification of MSME processes: Provide incentives for transitioning to energy-efficient electric induction furnaces, heat pumps, and microwave heating. Explore financing mechanisms like soft loans and tariff subsidies for electric processes. Promote local manufacturing through PLI schemes, capital subsidies, and awareness campaigns. Leverage the State's Energy Conservation Fund for MSME demonstration projects

Implementing a cluster-based strategy for decarbonizing MSMEs in Maharashtra can significantly impact energy savings and emissions reduction. In a moderate scenario for FY 2031, conventional energy offset potential is 1.12 MTOE, with a GHG emission reduction of 3.50 MtCO2. In an ambitious scenario, these figures increase to 1.29 MTOE and 4.05 MtCO2, respectively. These projections demonstrate the effectiveness of targeted interventions, including policy support, energy audits, and electrification incentives, in maximizing energy efficiency and contributing to the state's decarbonization goals.

Green Hydrogen for DCs

The Energy Efficiency Action Plan for green hydrogen underscores a comprehensive strategy aimed at enhancing the entire lifecycle of green hydrogen production and utilization. By strategically harnessing surplus renewable energy, such as solar and wind power, for electrolysis, the plan ensures optimal utilization of clean energy sources. It also underscores the imperative of advancing electrolysis technologies like proton exchange membrane (PEM) and solid oxide electrolysis cells (SOEC), which promise increased efficiency and reduced energy consumption.

Furthermore, the plan focuses on systemic optimization, advocating for dynamic control systems and machine learning algorithms that adapt electrolysis operations to real-time changes in renewable energy availability and demand. This adaptive approach minimizes energy losses and strengthens the overall efficiency of the process.

Hydrogen, a versatile energy source with extensive commercial and industrial applications, boasts extended storage capabilities. This energy's attributes present both opportunities and challenges. Green hydrogen, produced through water electrolysis with renewable energy-derived electricity, hinges on the carbon neutrality of its power source. Electrolyzer technology is vital for eco-friendly hydrogen production, encompassing alkaline and polymer electrolyte membrane (PEM) technologies, with advanced versions like solid oxide and anion exchange membrane emerging. Notably, regions like Maharashtra, abundant in power, cement, and steel industries, stand to benefit from hydrogen utilization for fuel and emissions reduction. Growing interest in environmentally friendly hydrogen arises from its expanding potential across power generation, steel and cement manufacturing, electric vehicles, heavy transportation, and green ammonia production for fertilizers.

Implementing Agency: SDA, Industry Department of Maharashtra,

Actionable Items & Implementation Methodology-

a) **Incentive**- The government has the capacity to propose precise regulations concerning the incorporation of hydrogen into existing consumption sectors like steel and heavy-duty transportation, as well as into potential future sectors such as refineries and ammonia production. This action will ensure a consistent demand for initial green hydrogen initiatives and foster the expansion of the market. Furthermore, the government can introduce incentives for pioneering applications, especially when the feasibility of deploying green hydrogen is in its early stages. For instance, it could implement a Production Linked Incentive (PLI) program targeting green steel production, with a focus on export markets.

b) **R&D support**- Hydrogen (H2) technology is in a state of ongoing development and has not yet achieved widespread scalability. Providing initial support for research and development (R&D) efforts can facilitate advancements, cost reduction, and the enhancement of technical capacities within industries.

c) **Green Hydrogen Policy**- Formation of State policy on Green H2, however, to give push to green H2, state has land policy approved in April 2023.

Considering the implementation of the strategies detailed for the industrial sector, it is anticipated that the moderate scenario could result in conserving about 4.15 Mtoe in energy savings, whereas the ambitious scenario might generate approximately 5.48 Mtoe in energy savings. Moreover, the moderate scenario holds the potential for reducing greenhouse gas (GHG) emissions by 16.43 million metric tons of CO2 (MTCO2), and the ambitious scenario could lead to a reduction of around 22.88MTCO2.

2. Building Sector

The energy landscape of Maharashtra is marked by its vibrant residential and commercial sectors, each contributing significantly to the state's overall energy consumption. In the fiscal year 2020, the residential sector and commercial sector accounted for 19% of the total energy consumption in the state, with residential sector consuming 6.56 MTOE, while the commercial sector consumed of 1.55 MTOE. These sectors hold immense potential for energy efficiency improvements, not only to optimize energy usage but also to reduce greenhouse gas emissions. Maharashtra's commitment to sustainable energy practices is underscored by its recognition of the need for energy-efficient building solutions. Despite this, the Energy Conservation and Sustainable Building Code (ECSBC) for the commercial sector and the Eco-Niwas Samhita (ENS) for the residential sector have not yet been mandated. However, the state's push towards these standards comes at a crucial juncture, considering the significant energy demand of the building sector and the escalating concerns about carbon emissions. This section explores the imperative of implementing energy-efficient practices in Maharashtra's buildings, outlining the potential benefits and the broader impact on the state's energy consumption and environmental goals.

Energy efficiency strategies in the buildings sector

Implementation of ENS-Residential Sector

The implementation of the Eco-Niwas Samhita (ENS) in the residential sector stands as a pivotal component of Maharashtra's comprehensive energy efficiency action plan. ENS, a set of guidelines and standards aimed at promoting energy-efficient practices in residential buildings, presents a remarkable opportunity to address the growing energy consumption and environmental concerns within this sector. As Maharashtra's urban centers continue to expand and housing demands rise, the need for sustainable building practices becomes increasingly urgent. The integration of ENS into the residential sector not only aligns with global sustainability goals but also holds the potential to significantly reduce energy consumption, lower utility bills for residents, and contribute to a greener and more resilient energy future.

Implementing Agency: Maharashtra Energy Development Agency (MEDA)

Actionable Items & Implementation Methodology-

a) **Awareness & Capacity Building** - Efforts include market outreach for Energy Norms and Standards (ENS) compliant products through mediums like radio jingles and social media campaigns, alongside initiatives to provide training for individuals to become certified home energy auditors.

b) **Subsidy** - Establishing a framework for adherence and offering incentives in the form of rebates for energy savings within initial residential projects.

c) **Technology Intervention**- Efforts include both the creation and upkeep of an ENS compliance portal and the allocation of resources towards pilot projects that serve as tangible case studies for effective ENS implementation.

Deepening of Standard & Labelling Programme-Residential Sector

The Bureau of Energy Efficiency (BEE) in India has implemented an initiative that employs standard labeling to promote energy-efficient appliances. This program encourages the replacement of old and inefficient devices with those meeting minimum energy performance standards (MEPS) set by BEE. The labels empower consumers to make informed choices, reducing energy consumption and costs. In domestic buildings, this effort can significantly curtail energy use by advocating efficient appliances, lighting, and construction materials. This approach contributes to greenhouse gas emission reduction, lower consumer energy bills, and sustainable development. The introduction of BEE's labeling has shifted consumer demand towards energy-efficient appliances, but further adoption is essential to enhance building sector efficiency.

Implementing Agency: Maharashtra Energy Development Agency (MEDA)

Actionable Items & Implementation Methodology-

a) **Awareness & Capacity Building**- Conduct workshops focusing on energy-efficient technology to enhance the skills of technology suppliers and professionals. Establish a web portal aimed at distributing information regarding energy-saving methods to the general public. Provide training for home energy auditors.

b) **Subsidy**- Deploying Demand-Side Management (DSM) initiatives facilitated by DISCOMs can encompass the promotion of energy-efficient appliances like BLDC fans and air conditioning systems. These schemes aim to encourage the adoption of technologies that conserve energy and enhance overall efficiency.

Standard and Labelling in commercial sector

The implementation of standard and labeling practices within the commercial sector serves as a cornerstone for promoting energy efficiency. By setting clear standards for energy performance and affixing informative labels, this initiative empowers businesses and consumers to make informed choices that contribute to reduced energy consumption and environmental impact.

Implementing Agency: Bureau of Energy Efficiency; Maharashtra Energy Development Agency (MEDA)

Actionable Items & Implementation Methodology:

a. **Awareness & Capacity Building** - Promoting awareness regarding energy-efficient appliances and equipment, fostering green education initiatives, conducting Energy Auditor Training specifically for commercial auditing, and establishing an energy-saving web portal dedicated to appliance end-users are integral components of the comprehensive approach aimed at enhancing energy efficiency. These strategies collectively contribute to informed consumer choices, a sustainability-oriented education system, skilled professionals capable of assessing energy consumption in commercial settings, and easily accessible information for optimizing appliance usage for energy conservation.

b. **Subsidy** – Providing rebates for upgrading to energy-efficient appliances is a compelling incentive. These financial incentives encourage consumers to replace old, energy-consuming appliances with modern, efficient models, leading to reduced energy usage, lower bills, and a smaller carbon footprint. This strategy, supported by governments and utility companies, accelerates the adoption of sustainability practices in households and businesses.

c. **Procurement (Scheme)**- Enabling end-users to access energy-efficient equipment and appliances is facilitated by strategies such as bulk procurement or innovative financing mechanisms. This approach ensures the widespread availability of technologically advanced and energy-saving products, promoting sustainability and cost-effectiveness across various sectors.

Implementation of ECSBC-Commercial Sector

The recent 2022 amendment to the Energy Conservation (EC) Act has introduced a comprehensive framework known as the "Energy Conservation and Sustainable Building Code" (ECSBC), which now encompasses both commercial and residential structures. During the transition period until ECSBC is implemented at the State/UT level, the current Energy Conservation Building Code (ECBC) and Eco-Niwas Samhita (ENS) will be treated as ECSBC. To realize energy efficiency advancements within the construction sector, the focus lies in the effective execution of the ECSBC, aimed at increasing the count of buildings compliant with ECBC and ENS guidelines within the state.

Implementing Agency: Bureau of Energy Efficiency; SDA MEDA; Town and country planning department, Urban Development Department (UDD)

Actionable Items & Implementation Methodology:

a. **Awareness & Capacity Building** - Promote ECSBC compliant products through a comprehensive market outreach campaign that includes strategies like radio jingles and social media awareness. Additionally, foster green education initiatives to enhance public awareness. Provide training for energy auditors specializing in commercial spaces to ensure effective energy audits.

b. **Subsidy/Incentives** - The proposed initiatives encompass a compliance framework with energy-saving incentives for initial residential projects, policy strategies aimed at promoting green and net-zero energy buildings, the facilitation of eco-friendly certified product adoption within the Public Works Department through Sustainable Procurement Policies, and support for upcoming green-rated building projects through extra floor area ratio (FAR), reduced stamp duty, and expedited environmental clearance processes.

c. **Technology Intervention** - The establishment and ongoing management of the ECSBC compliance portal, coupled with targeted investments in pilot projects serving as illustrative case studies for ECSBC implementation, constitute integral components of the initiative.

Promotion of energy efficient data centres

Maharashtra, with the highest concentration of data centers in India, is poised for significant growth in this sector. Over 50% of India's data center investments are in the state, primarily concentrated in Mumbai due to its dense wet cable ecosystem and nine internet cable landings. Projections indicate that data centers in Maharashtra are expected to double by 2025, with around 75% of new installations in Maharashtra and Tamil Nadu.

To support this growth while promoting sustainability, the state government is preparing a data center policy with guidelines focused on energy efficiency. Strategies include incentivizing energy-efficient data centers, fast-tracking environmental clearances, reducing building taxes, and providing financial assistance at concessional rates. Key areas for improvement include power management, critical cooling systems, and IT peripherals. Adopting "Green IT" principles and novel designs can significantly reduce energy consumption and operational costs.

Energy saving potential is considerable, with a reduction in Power Usage Effectiveness (PUE) from 2.0 to 1.5 in a moderate scenario and 1.2 in an ambitious scenario. This translates to potential energy savings of 0.21 MTOE and 0.33 MTOE respectively. Emphasizing renewable energy sources and cleaner fuels, like liquefied natural gas, will further enhance sustainability as new data centers are established.

Implementing Agency: Bureau of Energy Efficiency (BEE); Maharashtra Energy Development Agency (MEDA); Department of Housing & Urban Development; Department of Electronics Information Technology Biotechnology and Science & Technology

Actionable Items & Implementation Methodology:

a) **Awareness & Capacity Building**- Promoting green education integrates environmental awareness across all educational levels, instilling knowledge about renewable energy, conservation, waste reduction, and ecosystem interdependence. Encouraging sustainable practices within institutions further reinforces these principles, ensuring a more eco-conscious society.
b) **Environmental Measures**- Fast-track environmental clearance for data center projects
c) **Subsidy-** Implement a comprehensive subsidy program including concessions in state GST for energy-intensive equipment like chillers, transformers, and UPS systems; reductions in property tax and concessional power tariffs; exemptions for green-rated data centers on the use of on-site and off-site green power; and promotion of LNG (liquefied natural gas) usage for cleaner energy alternatives.

Envisioning the execution of the outlined strategies within the building sector, it is projected that the moderate scenario has the potential to conserve roughly 2.18 million tonnes of oil equivalent through energy savings, while the ambitious scenario could yield approximately 2.89 Mtoe in energy savings. Furthermore, the moderate scenario presents an opportunity for curtailing greenhouse gas emissions by about 6.84 MTCO2, and the ambitious scenario could potentially drive a reduction of approximately 9.03 MTCO2.

3. Transport Sector

Enhancing energy efficiency in the transport sector focuses on optimizing energy consumption and reducing waste across various modes of transportation. This includes improving vehicle fuel efficiency, promoting the use of cleaner fuels, advancing public transportation systems, and implementing intelligent transportation technologies. These efforts not only reduce energy consumption and greenhouse gas emissions but also lead to cost savings and environmental benefits.

Tailoring the state energy efficiency action plan to local context, particularly in Maharashtra, becomes paramount. Given that the state houses a considerable vehicular population, with approximately 318 Lacs vehicles as of September 2022, and a substantial majority of these vehicles being powered by petrol and diesel, the transport sector emerges as a focal point for energy efficiency initiatives.

In this pursuit, it becomes crucial to focus on multifaceted strategies. These encompass elevating vehicle fuel efficiency by leveraging technological innovations, fostering the adoption of environmentally friendlier fuels, bolstering the efficiency of public transit systems, and harnessing smart transportation technologies. These actions not only hold the potential to curtail energy consumption and emissions but also stand to yield tangible economic and ecological benefits, thereby aligning seamlessly with the overarching goals of the state's energy efficiency action plan.

Encouragement to use EVs & infrastructure development for EV charging stations

Embracing electric vehicles (EVs) and fostering the development of a comprehensive charging infrastructure is a pivotal stride towards a sustainable and eco-conscious transportation paradigm. EVs offer an array of compelling advantages, including zero tailpipe emissions, diminished reliance on finite fossil fuels, and long-term cost savings. Government incentives and rebates sweeten the deal, while continuous technological advancements in battery efficiency and range propel EVs towards mainstream viability. The resulting reduction in air pollution brings about tangible health benefits and paves the way for urban planning enhancements. By investing in the EV industry, nations can assume a leadership role in global sustainability efforts, foster job creation, and position themselves at the forefront of innovative transportation solutions. Collaborative efforts between public and private sectors, coupled with strategic charging station placement, standardization, and rapid charging networks, will ensure the seamless integration of EVs into our daily lives, leading us towards a cleaner, more efficient, and environmentally conscious future.

This strategy outlines a transformative approach aimed at transitioning newly registered vehicles within the state to electric vehicles by the fiscal year 2031. The conversion objectives are rooted in two distinct trajectory scenarios: a moderate course and an ambitious trajectory.

- **Implementing Agency:** State Transport Department, Maharashtra State Electricity Distribution Company Limited

  Actionable Items & Implementation Methodology:

  a. **Awareness & Capacity Building**- Raise public consciousness regarding the Standard & Labelling Program for Tyres and the Energy Efficiency Program dedicated to High Energy Lithium-Ion Traction Battery Packs and Systems. Simultaneously, institute a regulatory framework aimed at the advancement of electric vehicle charging infrastructure. Pilot projects on battery swapping

stations.

b. **Technological Intervention** - The strategy encompasses a multifaceted approach to fortify the electric vehicle (EV) landscape, incorporating diverse initiatives. By embracing the Combined Charging Systems (CCS Standard), seamless compatibility is ensured among charging stations, fostering a streamlined charging experience. Open access charging stations further enhance accessibility, making EV charging convenient for all users. To explore alternative clean energy avenues, pilot projects focused on Hydrogen Fuel Cell Vehicles are initiated, contributing to a more diversified and sustainable transportation ecosystem. Additionally, the implementation of Battery Swapping stations through pilot projects across all ten model cities seeks to revolutionize EV energy replenishment methods, exemplifying the commitment to innovative and efficient charging solutions.

c. **Retrofit Programs**- Boost retrofitting of electric vehicles (EVs) to promote sustainability, offering economic and environmental benefits. Consider relaxing scrapping policies for retrofitted EVs passing fitness tests and streamline re-registration through Vahan integration.

Electrifying road transport in Maharashtra presents substantial energy and emissions benefits. In the moderate scenario for 2030, the energy saving potential is 2.00 MTOE, with a GHG emission reduction of 6.27 MtCO2. In a more ambitious scenario, these figures rise to 2.97 MTOE and 9.30 MtCO2, respectively. These projections highlight the significant impact of adopting electrification strategies, including widespread EV adoption, development of charging infrastructure, and promotion of advanced battery technologies, on reducing energy consumption and greenhouse gas emissions.

Adequate Public Transport

The integration of a robust and efficient public transport system forms a cornerstone of Maharashtra State's comprehensive Energy Efficiency Action Plan. This visionary strategy aims to optimize energy consumption, reduce emissions, and enhance overall sustainability within the state's transportation sector. By bolstering public transportation options such as buses, trains, and trams, the plan endeavors to provide citizens with viable alternatives to personal vehicles, consequently decreasing individual energy consumption and vehicular emissions. Through thoughtful route planning, streamlined operations, and investments in modern, eco-friendly vehicles, the public transport system will not only promote energy efficiency but also alleviate traffic congestion and enhance the overall quality of life for Maharashtra's residents. In embracing this strategy, Maharashtra State takes a decisive step towards fostering a greener, more energy-conscious future while catering to the diverse mobility needs of its population.

- **Implementing Agency:** State Transport Department, Urban development agencies

Actionable Items & Implementation Methodology:

a. **Capacity Building:** Mandate major urban agglomerates to develop Comprehensive Mobility Plans (CMPs) and conduct integrated public transport studies for these areas. Additionally, incentivize regular travelers to use public transport.

b. **Subsidies & Technology Intervention:** Facilitate last-mile connectivity through e-rikshaws and electric 3-wheelers. Improve fuel efficiency of existing oil-based public transport fleets by establishing guidelines, providing driver training, and focusing on regular hardware checks.

Ethanol Blending Program

Under this strategy, it is proposed to ensure the mixing of ethanol in motor spirit (petrol) in a fixed ratio to offset a part of the energy consumed by petrol and bring about reduction in emissions. In the proposed strategy and in line with the country's target of 20% blending of ethanol blending in petrol by 2031, a 10% blending target is suggested in the moderate scenario and a 20% blending target is suggested in the ambitious scenario.

Implementing Agency: State Transport Department

Actionable Items & Implementation Methodology:

a. **Technological Intervention** - Establishing the necessary infrastructure to facilitate the availability of ethanol for blending, the state can streamline storage, transportation, and regulatory requirements pertaining to industrial fuel-grade ethanol. Financial Assistance on Biofuel production plants.

b. **Subsidy**- To stimulate the establishment of new distilleries for ethanol production and the adoption of CPCB-approved methodologies, a comprehensive set of incentives is proposed. This includes capital subsidies covering technical civil works and plant machinery. Moreover, a state government-driven interest subsidy, applicable over a 5-year term, complements the central government's assistance, fostering the growth of ethanol manufacturing within the state.

By implementing the strategies detailed within the Transport sector, a notable impact is anticipated. Under the moderate scenario, an estimated 3.93 million tonnes of oil equivalent (Mtoe) in energy savings could be preserved, while the more ambitious approach holds the potential to unlock around 6.12 Mtoe in energy conservation. Correspondingly, the moderate scenario is projected to yield a reduction of 12.31 million metric tonnes of CO2 emissions, with the ambitious scenario further elevating the potential reduction to 19.17 million metric tonnes of CO2 emissions. These projections underscore the significant strides that can be achieved by embracing these strategies in the pursuit of sustainable energy and environmental goals.

4. Agriculture Sector

Maharashtra, a leading agricultural state in India, has the largest share of electric pump-sets in the country, accounting for approximately 20% of the national total, with 43.6 lakh agricultural consumers as of 2019. In the fiscal year 2022-23, Maharashtra State Electricity Distribution Company Limited (MSEDCL) achieved a record by providing electricity connections to 1,70,263 agricultural pumps, the highest in the past decade. As of March 2023, the total number of energized pump sets in the state reached 47,56,094. MSEDCL's efforts have not only resulted in the highest number of new connections in ten years but also reduced the number of pending connections to an all-time low. Over the past three fiscal years, electricity connections were provided to 96,327 pumps in FY 2019-20, 1,17,304 in FY 2020-21, and 1,45,867 in FY 2021-22. According to the All India Agriculture Input Survey 2016-17, there were 3,93,300 diesel pumps, and by June 30, 2022, 17,137 stand-alone solar pumps were installed.

Solarization of pumps & replacement of inefficient pumps:

By FY 2031, the agriculture sector intends to implement a strategy that involves shifting from traditional diesel pumps to solar-powered pumps. This approach aligns with the nation's objective of replacing diesel with renewable energy sources within the agricultural domain, ultimately aiming to eliminate diesel usage entirely by FY 2050. This transition is imperative to decrease the sector's reliance on fossil fuels and embrace a more sustainable and ecologically conscious energy alternative.

Implementing Agency: Department of Agriculture, MEDA, EESL

Actionable Items:

a. Study on agricultural pump systems and EESL replacement initiatives.

b. Upgrading standard pumps to energy-efficient models through retrofitting.

c. Promotion of energy efficiency in agriculture via mandatory BEE 4-star pumps and sprinkler system adoption.

d. Enhanced engagement with stakeholders for PM KUSUM Yojana and capacity building of local officials.

Implementation Methodology:

a. Access feasibility
b. Awareness and training programs
c. Financial incentives and support
d. Vendor selection and procurement
e. Installation and commissioning
f. Monitoring and mechanism
g. Evaluation and impact assessment

Micro Irrigation Project Promotion Subsidy

This strategy aims to Promote subsidies for micro-irrigation projects & to encourage the adoption of efficient irrigation methods among farmers by providing financial incentives or discounts to reduce the overall cost of installation. These subsidies are typically offered by government agencies or agricultural departments to improve water use efficiency and reduce water wastage in agriculture.

By 2031, Maharashtra's agriculture sector is set to achieve substantial energy savings and CO2 reductions through various strategies. The total energy saving potential is estimated at 0.26 MTOE under a moderate scenario and 0.35 MTOE under an ambitious scenario. Specifically, converting diesel pumps to electric pumps could save 0.11 MTOE to 0.12 MTOE and reduce CO2 emissions by 0.33 to 0.37 million tons. Transitioning electric pumps to solar power could yield 0.13 MTOE to 0.20 MTOE in energy savings and cut CO2 emissions by 0.41 to 0.62 million tons. Upgrading electric pumps to BEE star rated models might save 0.02 MTOE to 0.04 MTOE and reduce CO2 emissions by 0.07 to 0.11 million tons. In total, these measures are projected to save between 0.26 MTOE and 0.35 MTOE of energy and reduce CO2 emissions by 0.82 million tons to 1.11 million tons.

5. Fisheries Sector

Integrating energy efficiency measures within the fisheries sector as a component of Maharashtra's State Energy Efficiency Program holds significant promise. By optimizing energy consumption and practices in fishing, processing, and related activities, the sector can achieve notable benefits. These encompass reduced energy expenses, enhanced economic viability, and minimized environmental impact. Implementing energy-efficient technologies, such as energy-efficient fishing vessels, cold storage units, and processing equipment, can contribute to energy savings. Additionally, adopting best practices like proper maintenance of equipment, optimizing fuel consumption, and utilizing renewable energy sources where feasible can further amplify energy efficiency. Collaborative efforts between the government, industry stakeholders, and research institutions will be pivotal in formulating tailored strategies and incentivizing the adoption of energy-efficient practices within the fisheries sector.

Implementing Agency: Dept. of Fisheries, MEDA

Actionable Items & Implementation Methodology: -

a) **Awareness & Capacity Building**- Offering assistance for skill development while raising awareness about resource efficiency and the use of cleaner refrigerants.

b) **Technological Interventions**-

1. **First and last mile transportation**- Integrating Phase Changing Materials (PCM) technology into coolers and freezers, along with the implementation of energy-efficient aerators and the adoption of electric vehicles (EVs), are key initiatives to enhance energy efficiency.
2. **Cold Storage & processing**- The integration of energy-efficient solutions within the fisheries sector includes the implementation of a solar PV system for fishery and cold storage operations. This involves adopting an efficient ammonia or CO2 brine system within the cold storage facilities. Additionally, utilizing an evaporative condenser for cooling purposes and incorporating a low-charge ammonia refrigeration system are essential components of these energy-efficient measures.

3. **Reefer Transport**- Utilizing mobile chilling for reefer trucks and considering the substitution of phase change material (PCM) substances are both essential strategies in enhancing energy efficiency.
4. **Multiple areas**- Integrating innovative technologies into refrigeration systems includes solutions such as Variable Frequency Drives (VFDs) for controlling system variables, Electronic Level Controls to manage refrigeration levels, and the application of Internet of Things (IoT) technology for enhanced monitoring and management of refrigeration systems.

Note: Implement energy-efficient fishing vessels by adopting energy-efficient engines and reducing vessel weight to decrease fuel consumption by up to 40%. Promote efficient fish processing by utilizing energy-efficient equipment, optimizing cooling systems, and using renewable energy sources, potentially reducing energy consumption by up to 30%. Enhance energy-efficient cold storage by implementing energy-efficient cooling systems, insulation, and efficient lighting, leading to a reduction in energy consumption by up to 25%. Encourage the use of renewable energy sources such as solar-powered boats and solar-powered cold storage facilities. Retrofit boats with on-board active refrigeration systems using absorption/adsorption-based systems driven by engine exhaust heat or solar thermal energy and upgrade inefficient or old refrigeration plants in seafood processing with low Global Warming Potential (GWP) refrigerants.

The energy efficiency strategies across the fisheries sector aim to achieve significant energy savings and emission reductions. Under the moderate scenario, the targeted energy saving is 0.14 MTOE, with an emission reduction potential of 0.44 MtCO2. In the ambitious scenario, the energy saving target increases to 0.19 MTOE, with an emission reduction potential of 0.59 MtCO2. These savings will be achieved through various measures, including adopting energy-efficient fishing vessels, optimizing fish processing and cold storage, and integrating renewable energy sources.

6. Municipal Sector

The street lighting and water pumping systems are major energy consumers in Maharashtra's municipal sector. To address this, the state has initiated a scheme for installing energy-saving devices in Municipal Councils, Municipal Corporations, and Maharashtra Jeevan Pradhikaran. This scheme provides financial assistance up to Rs. 20 lakhs for energy-efficient equipment and monitoring systems in street lights, and Rs. 5 lakhs for monitoring systems. By March 2023, 40 Municipal Councils and Corporations were covered, achieving an energy savings of approximately 206 TOE per year.

Maharashtra has 409 Urban Local Bodies (ULBs) across 35 districts, with Nagpur having the highest number (22) and Mumbai the lowest (1). Notable energy efficiency initiatives include the replacement of 35,922 streetlights with LED lamps in Amravati, reducing power consumption from 3,900 KW to 1,673 KW and saving 9.75 MU annually. This project decreased the annual energy bill from INR 123.34 crore to INR 42.65 crore, resulting in cumulative savings of INR 28.85 crore over seven years.

According to the Central Electricity Authority (CEA) forecast, energy consumption in Maharashtra is expected to rise significantly by 2031. The Agriculture Demand Side Management (AgDSM) and Municipal Demand Side Management (MuDSM) schemes aim to reduce energy intensity in the agricultural and municipal pumping sectors by upgrading to energy-efficient pump sets, with potential energy savings of 30%-40%.

EE in street lighting and water pumping systems

Implementing Agency: ULB; MEDA; DISCOMs,EESL

Actionable Items & Implementation Methodology : -

Data Collection: To enhance the effectiveness of energy efficiency measures in the municipal sector, comprehensive data collection is essential. This involves developing detailed electrical distribution single-line diagrams and documenting lighting specifics, including the types of lamps and pole distances. Additionally, outlining transformer specifications such as sizes, capacities, and connected loads will provide a clear understanding of the existing infrastructure. This foundational work will facilitate informed decision-making for subsequent efficiency improvements.

Technology Intervention: For advancing energy efficiency, technology interventions play a crucial role. Implementing automated On/Off controls, such as timers, sensors, or smart systems, will help prevent unnecessary operation of street lights. Furthermore, installing radio frequency-based street lights with centralized control and monitoring systems in major cities, along with Supervisory Control and Data Acquisition (SCADA) systems, will enhance operational efficiency and enable real-time management of street lighting. These advancements will significantly contribute to reducing energy consumption and improving system performance.

Localized Planning: Transition from a schematic approach to a strategic program-based approach for energy efficiency. Create localized plans prioritizing energy efficiency.

The energy-saving potential of the municipal sector is projected to be 0.12 MTOE under the moderate

scenario and 0.15 MTOE under the ambitious scenario for FY 2031. This includes the impact of replacing conventional streetlights with energy-efficient LED lighting and improving the efficiency of water pumps. Additionally, these measures are expected to yield a CO_2 reduction potential of 0.36 $MtCO_2$ in the moderate scenario and 0.48 $MtCO_2$ in the ambitious scenario, highlighting significant environmental benefits alongside energy savings.

Financing Mechanism

Energy efficiency has emerged as a pivotal approach in addressing the escalating demand for energy, mitigating greenhouse gas emissions, and fostering socio-economic advancements. Realizing the full potential of energy efficiency hinges on strategic investments that stimulate technological advancements in the market and encourage the integration of energy-efficient practices by consumers. This transformative process has been successfully catalyzed by innovative financing models, particularly in developed nations. India, too, is embracing such models, exemplified by the Energy Service Companies (ESCOs) model, to tap into the reservoir of energy efficiency financing potential. This study delves into several prominent financing models that can revolutionize energy efficiency across commercial, residential, and industrial sectors. While established approaches like financial institutions, microfinance institutions, dealer finance, and financial incentives are prevalent in India, the exploration of globally recognized models like On-Bill Financing, ESCOs, Leasing, and Bulk Procurement holds promise for a sustainable energy-efficient future.

Energy Efficiency Financing Models:

1. **On-Bill Financing Model**: The On-Bill Financing Model is a creative approach that integrates energy efficiency investments directly into consumers' utility bills. This method streamlines the repayment process by allowing consumers to pay back the cost of energy efficiency improvements over time, coinciding with the reduction in their energy bills. This approach minimizes the initial financial burden on consumers while providing immediate financial incentives for adopting energy-efficient technologies.
2. **Energy Service Companies (ESCOs):** ESCOs have gained traction globally and are now being explored in India as well. Under this model, specialized companies (ESCOs) provide energy-efficient solutions to consumers, covering the upfront costs of equipment and installation. Consumers then repay the ESCOs from the cost savings they achieve due to reduced energy consumption. This model eliminates the initial financial barrier and creates a win-win scenario where consumers benefit from lower energy bills while ESCOs profit from the generated energy savings.
3. **Leasing Model:** The leasing model enables consumers to access energy-efficient equipment without the need for large upfront capital investment. Consumers lease the equipment from leasing companies and make regular payments over the leasing period. This approach is particularly attractive for businesses and industries looking to upgrade their energy systems without compromising their cash flow.
4. **Bulk Procurement:** Bulk procurement involves aggregating the demand for energy-efficient products or services from multiple consumers, thus achieving economies of scale. This enables the negotiation of better prices and terms with suppliers, making energy-efficient solutions more accessible and affordable for individual consumers or organizations.
5. **Green Finance:** Green finance in energy efficiency encompasses a range of financial instruments, including green bonds, energy efficiency funds, and sustainable loans, which channel capital towards environmentally beneficial projects like building retrofits and renewable energy initiatives. This approach,

bolstered by mechanisms like carbon pricing, incentives, and performance contracts, fosters a transition to a low-carbon economy by incentivizing investments in energy-saving technologies and practices, ultimately contributing to global climate mitigation efforts and a more sustainable energy landscape.

In the context of the state's energy efficiency program, the recommendation is the introduction of a financing initiative inspired by the Bureau of Energy Efficiency's efforts under the National Mission for Enhanced Energy Efficiency. The proposed initiative aims to establish a platform for productive interaction between the state government, Financial Institutions, and project developers. The primary objective is to facilitate the smooth implementation of energy efficiency projects that are in line with the state's overarching goals and vision.

Summary

Through extensive research and collaboration with various stakeholders and the Maharashtra Energy Development Agency (MEDA), CII GBC in consultation with Bureau of Energy Efficiency and in association with Maharashtra Energy Development Agency (MEDA) has developed a comprehensive State Energy Efficiency Action Plan for the state of Maharashtra. This plan recognizes the necessity, potential, and opportunities for energy efficiency within the state. The action plan outlines a detailed roadmap for implementing these strategies, while also emphasizing the importance of monitoring their implementation through involvement from multiple stakeholders. By projecting the state's total final energy consumption (TFEC) based on energy consumption and economic growth, it is estimated that Maharashtra's TFEC will reach 114.98 MTOE by FY 2031.

In light of this projection, the action plan identifies Energy, Industry, Buildings, Transport, Agriculture, Fisheries and Municipal as the key focus sectors. It further analyses sector-specific strategies to achieve energy savings. In the moderate scenario, the implementation of this plan is expected to result in a reduction of 13.15 Mtoe in total energy consumptionby FY 2031. In the ambitious scenario, the reduction is projected to be 17.62 Mtoe. Additionally, this plan aimsto generate awareness at a mass level and create a market potential of approximately Rs. 31,789 Crore in the energy efficiency sector. Furthermore, it is anticipated to contribute to an emission reduction of 41.16 $MtCO_2$ in the moderate scenario and 55.15 $MtCO_2$ in the ambitious scenario in terms of CO_2 emissions by FY 2031.