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Whitepaper on

State Energy Efficiency Action Plan for KARNATAKA

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 Karnataka, 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 7.13 million tonnes of oil equivalent (MTOE) in a moderate scenario and 11.02MTOE in an ambitious scenario for Karnataka.

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 sectors of the state, and knowledge partner CII GBC has developed a 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 Karnataka, 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 (Karnataka Renewable Energy Development Limited), 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 Karnataka referring to the fiscal year 2019-20 as a base year. Industries, Buildings, Transport, Agriculture &Fisheries are the identified focus 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 Karnataka has witnessed a significant growth in the industrial sector in the past few years. Rapid strides have been observed in various sectors such as Automobile, Chemical, Pharmaceuticals, Tyre Manufacturing, etc., in the region. Following are the major industries in Karnataka:

1. Food & Beverages Processing
2. Ceramics
3. Glass
4. Automobile
5. Tyre Manufacturing

Energy Efficiency Interventions in PAT Sectors in Karnataka

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, and 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 Karnataka's sustainable development and climate mitigation objectives.

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), KREDL and Department of Industry and Commerce

Actionable Items & Implementation Methodology - PAT Deepening Strategy

a. **Awareness & Capacity Building** - Build capacity for energy managers and auditors in PAT DCs and potential new sectors to ensure compliance with energy efficiency schemes and the adoption of new technologies. Focus on improving operational efficiency by strategically scheduling machinery operations, implementing well-designed machine control systems, and maintaining equipment to reduce energy wastage. Additionally, form energy management teams to monitor energy consumption and develop industrial energy productivity roadmaps, emphasizing future decarbonization and industry clustering.

b. **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).
c. **Financial Support**- Facilitate the implementation of energy efficiency projects by partnering with financial institutions and technology providers to support commercially scalable initiatives. Integrate energy-efficient equipment loans with existing CAPEX loans for MSMEs to reduce transaction costs and make it easier for businesses to invest in energy-efficient solutions.

Taking into account the application of the outlined strategies within the industrial sector, it is projected that around 2.27million 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 3.14 MTOE in energy savings.

Decarbonizing MSMEs through Cluster Approach

Karnataka, a progressive state committed to advancing urbanization and sustaining industrialization, faces a rising demand for resources and energy driven by these transitions. As the state hosts several vital MSME clusters, including the Bangalore Machine Tools cluster, Belgaum and Shimoga Foundry clusters, Malur Brick cluster, and Gokak Jaggery cluster, there is a significant opportunity to enhance energy efficiency within these industries.

A cluster-based strategy that benchmarks energy performance and sets competitive energy efficiency targets across these industry clusters holds substantial energy-saving potential. By promoting and mandating energy audits within these clusters, Karnataka can unlock considerable improvements in energy usage. For instance, interventions in the foundry cluster could involve replacing conventional furnaces with energy-efficient IGBT-based induction furnaces, while the brick and ceramic sectors could benefit from reducing radiation losses through energy-efficient coatings on kilns.

This approach not only aims to decarbonize the state's MSMEs but also positions Karnataka as a leader in sustainable industrial practices, driving both economic growth and environmental stewardship.

Implementing Agency: KREDL, Department of Industries and Commerce, District Industries Centre

Actionable Items & Implementation Methodology

a) **Sector-Specific Financial Assistance:** - Develop sector-specific policies to provide financial assistance for benchmarking MSMEs within clusters. This includes extending the current industry policy's interest subsidies on technology upgradation loans to energy efficiency projects. Additionally, reinstating subsidies for conducting energy audits would bolster energy efficiency activities among industries

b) **Subsidies for Energy Audits and Efficiency Projects**- Provide subsidies for energy audits and the implementation of energy efficiency projects. This could be facilitated by modifying the existing industry policy to support these initiatives, which would encourage more industries to adopt energy-efficient practices

c) **Promotion of Green Ratings**- Promote the green rating of companies, potentially integrating this initiative with the Zero Defect Zero Effect (ZED) scheme. This approach would incentivize companies to adopt sustainable practices and enhance their environmental performance.

d) **Capacity Building & Technological Linkages**- Build operational capacity by strategically scheduling machinery operations, implementing well-designed machine control systems, and ensuring efficient

maintenance of equipment to reduce energy wastage. Additionally, create linkages between agencies, Technology Demonstration Centres (TDCs), and R&D labs to provide technical inputs based on feedback from heavy industries, further supporting energy efficiency improvements

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 Karnataka, abundant in refineries, fertilizer, 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: KREDL, Department of Industries and Commerce

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 a push to Green H2, the state has a land policy approved in April 2023.

Considering the implementation of the strategies detailed for the overall industrial sector, it is anticipated that the moderate scenario could result in conserving about 3.29 million tonnes of oil equivalent (MTOE) in energy savings, whereas the ambitious scenario might generate approximately 4.68 MTOE in energy savings. Moreover, the moderate scenario holds the potential for reducing greenhouse gas (GHG) emissions by 10.31 million metric tons of CO2 (MTCO2), and the ambitious scenario could lead to a reduction of around 14.68 MTCO2.

2. Building Sector

The energy landscape of Karnataka 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 accounted for 10.05% of the total energy consumption, consuming 2.73 MTOE, while the commercial sector constituted 2.8% with a consumption of 0.76 MTOE. These sectors hold immense potential for energy efficiency improvements, not only to optimize energy usage but also to reduce greenhouse gas emissions. Karnataka'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 Karnataka'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 Karnataka'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 Karnataka'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: Bureau of Energy Efficiency (BEE), KREDL, Public Works Department, Department of Housing & Urban Development Department, Karnataka State Police Housing & Infrastructure Development Corporation Limited

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: Bureau of Energy Efficiency (BEE); KREDL, Energy Department, Urban Development Department, Housing Department and all other Govt. /undertaking Departments, Department of Housing & Urban Development)

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.

c) Technology Intervention- To enhance energy efficiency in upcoming building projects, a comprehensive approach should be adopted that includes the installation of sensor-based or automated switches to ensure lights and appliances are only active when necessary. Existing power-consuming lighting systems should be upgraded or replaced with energy-efficient alternatives like LEDs. Additionally, implementing auto switch-over mechanisms that activate low-wattage lighting in areas where full illumination is not required can further optimize energy use. This can be managed through different MCB controls. Finally, the installation of timer or auto-off mechanisms will help ensure that lights and other electrical systems are turned off automatically when not in use, significantly reducing energy waste.

Implementation of ECBC-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, KREDL, Public Works Department, Rural Development and Panchayat Raj, Architect Department, Urban Development Department including BBMP, DMA, TCP, and BDA.

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.

Standard and Labelling in the 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, KREDL, Public Works Department, Rural Development and Panchayat Raj, Architect Department, Urban Development Department including BBMP, DMA, TCP, and BDA, Housing Department, Karnataka State Police Housing & Infrastructure Development Corporation Limited and Karnataka Health System Development & Reform Project (KHSDRP)

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.

BEE Star Rating of Buildings, Green buildings in the Residential and commercial sector

The Building Energy Efficiency (BEE) Star Rating system serves as a pivotal tool in advancing energy efficiency within the construction landscape. Applied to both residential and commercial structures, this system categorizes buildings based on their energy performance, offering an easily comprehensible metric for consumers and investors to gauge their energy efficiency. Particularly in the context of green buildings, which encompass both residential and commercial spaces, the BEE Star Rating holds immense significance. Green buildings integrate sustainable practices into their design, construction, and operation, aiming to significantly minimize resource consumption and environmental impact. The synergy between BEE Star Ratings and green buildings aligns seamlessly with the broader goal of optimizing energy efficiency across the residential and commercial sectors, fostering a sustainable and eco-friendly built environment.

Implementing Agency: Bureau of Energy Efficiency, KREDL, Public Works Department, Rural Development and Panchayat Raj, Architect Department, Urban Development Department including BBMP, DMA, TCP, and BDA, Housing Department, Karnataka State Police Housing & Infrastructure Development Corporation Limited and Karnataka Health System Development & Reform Project (KHSDRP)

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) **Subsidy-** The comprehensive approach to promoting energy-efficient construction involves a multifaceted strategy. This includes offering incentives such as property tax rebates, additional floor area ratio (FAR), reduced stamp duties, and expedited environmental clearances for upcoming projects adhering to green building standards. Simultaneously, the transformation of government structures into net-zero energy buildings showcases a commitment to sustainable practices. Furthermore, the implementation of supportive incentive policies serves to drive the transition towards net-zero energy buildings, fostering a harmonious blend of economic benefits and environmentally conscious construction practices.

Promotion of energy-efficient data centers

Karnataka aims to establish over 200 MW capacity data centers by 2025, a goal that necessitates a focus on sustainable and energy-efficient practices. To achieve this target, the state must adopt several key recommendations. Guidelines should emphasize the development of efficient distributed Content Delivery Networks (CDNs) and offer incentives for energy-efficient data centers. This includes fast-tracking environmental clearances, reducing building taxes, and providing financial assistance at concessional rates.

As data centers are substantial consumers of electricity, rising operational costs due to increased energy prices necessitate a reduction in energy use to stay competitive. Therefore, adopting "Green IT" principles and integrating innovative designs for energy efficiency are essential for sustained growth. Existing data centers should implement best practices in design, operation, and maintenance to enhance energy performance. New data center designs must incorporate energy efficiency methods from the outset.

Key areas for reducing carbon emissions in data centers include:

Electrical Systems/Power: Implement power management strategies such as fine-tuning UPS and transformer loading, installing harmonic filters, and exploring emerging technologies like Rotary UPS systems and LED lighting.
Critical Cooling Systems: Adopt advanced cooling methods to manage the increased heat from higher processor densities. Technologies such as thermal storage systems, water cooling, and cooling system economizers can improve cooling efficiency.
IT Peripherals: Utilize high-density servers, virtualization, and optimize storage to maximize resource utilization and reduce energy and cooling demands.

The promotion of energy-efficient data centers will be supported by the Bureau of Energy Efficiency, KREDL,

and various state departments, under the KA Data Center Policy 2022-27. Data center managers are encouraged to seek intelligent solutions that enhance efficiency and manage resources effectively, leveraging virtualization to achieve better resource utilization and reduced energy consumption. Implementing the latest technologies in data centers can lead to significant energy savings and operational improvements.

Implementing Agency: Bureau of Energy Efficiency; KREDL; Department of Electronics Information Technology Biotechnology and Science & Technology, Urban Development Department

Actionable Items & Implementation Methodology:

c) **Environment:** Expedite the process for environmental clearances to facilitate timely project approvals and implementation.

d) **Subsidy-** Provide concessions in state GST for the procurement of energy-intensive equipment such as chillers, transformers, and UPS systems to promote energy-efficient technology adoption. Additionally, implement reductions in property tax and offer concessional power tariffs to further incentivize energy efficiency investments. For green-rated data centers, exempt them from restrictions on the usage of both on-site and off-site green power, allowing unrestricted procurement of green power within and outside the state

Envisioning the execution of the outlined strategies within the building sector, it is projected that the moderate scenario has the potential to conserve roughly 0.266 million tonnes of oil equivalent (MTOE) through energy savings, while the ambitious scenario could yield approximately 0.437 MTOE in energy savings. Furthermore, the moderate scenario presents an opportunity for curtailing greenhouse gas (GHG) emissions by about 0.83 million metric tons of CO2 (MtCO2), and the ambitious scenario could potentially drive a reduction of approximately 1.37 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 the local context, particularly in Karnataka, becomes paramount. Given that the state houses a considerable vehicular population, with approximately 2,84,23,515 vehicles as of September 2022, and a substantial majority of 84.42% of these vehicles being powered by petrol, 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 toward 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 toward 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 including BMTC, KSRTC, RTO and BESCOM, Urban Development Agencies

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. **Incentivize EV Purchases:** Implement subsidies and offer Tax/GST rebates to encourage the purchase of electric vehicles.
d. **Battery Disposal Guidelines:** Establish and enforce guidelines for the safe and judicious disposal of EV batteries and other components to prevent negligent or unsafe practices.

Adequate Public Transport

The integration of a robust and efficient public transport system forms a cornerstone of Karnataka 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, etc., 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 Karnataka's residents. In embracing this strategy, Karnataka 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 including BMTC, KSRTC and RTO, Urban Development Agencies

Actionable Items & Implementation Methodology:

a. **Capacity Building:** Mandate major urban agglomerates to develop Comprehensive Mobility Plans (CMP). Conduct integrated public transport studies for major urban areas to optimize connectivity and efficiency
b. **Infrastructure Improvement:** Develop and enhance public transport systems, such as metro networks, to create user-friendly options that encourage usage across all societal strata.
c. **Subsidies & Technology Intervention:** Provide incentives for regular travelers who use public transport. Facilitate last-mile public transport solutions through the deployment of electric three-wheelers.

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 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 3.58 million tonnes of oil equivalent (MTOE) in energy savings could be preserved, while the more ambitious approach holds the potential to unlock around 5.67 MTOE in energy conservation. Correspondingly, the moderate scenario is projected to yield a reduction of 11.20 million metric tonnes of CO2 emissions, with the ambitious scenario further elevating the potential reduction to 17.74 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

Karnataka is one of the leading agricultural states in India and plays a significant role in contributing to the country's overall agricultural output. The state has a diverse range of agro-climatic conditions, which allows for the cultivation of various crops. According to the information available, during the fiscal year 2018-18, there were approximately 23.2 lakh diesel and electric pumps in operation. The PM-KUSUM scheme has significantly advanced solar-powered irrigation in Karnataka. Under Component B, focused on individual solar irrigation pumps, Phase I achieved the installation of 319 systems by December 2019. As of February 14th, 2024, Phase II has seen the installation of 672 out of the planned 1,325 systems. Building on this momentum, MNRE sanctioned an additional 25,000 standalone solar pumps in December 2023, marking the initiation of Phase III.

Component C, which addresses feeder-level solarization for irrigation, emphasizes large-scale implementation. In Phase I, 1,302.31 MW of solar capacity was sanctioned across three DISCOMs: CESC (10,000 pumps), HESCOM (65,000 pumps), and BESCOM (262,331 pumps). Bids have been received for 766.18 MW, with work orders pending. Furthermore, Phase II saw MNRE's sanctioning of solarization for 250,000 pumps through KREDL in January 2024, with tender invitations in progress.

The following are the strategies proposed for the agriculture sector: -

Adoption of Solar powered 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, MNRE, KREDL, BESCOM

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. Combine other agricultural loads with solar pumps to enhance solar power use and prevent over-pumping.

e. Encourage the use of Bharat Stage VI tractors, precision farming tools, and efficient irrigation systems like drip and sprinklers.

f. Promote rainwater harvesting and establish model farms for demonstrating efficient practices.

g. Provide low-interest loans, grants, and subsidies for new technology adoption, including solar-powered agricultural equipment.

h. Promote group farming to share the costs of solar appliances.

i. 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

Considering the implementation of the mentioned strategies in the agriculture sector, it is estimated that approximately 0.015 MTOE energy savings can be saved under the moderate scenario and 0.031 MTOE under the ambitious scenario for 2031.

5. Fisheries Sector

Integrating energy efficiency measures within the fisheries sector as a component of Karnataka'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

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 for 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.

The Karnataka State Energy Efficiency Action Plan identifies the fisheries sector as having significant energy-saving potential by 2031. Under a moderate scenario, the sector could achieve savings of 0.12 MTOE, leading to a reduction in GHG emissions by 0.38 MtCO2, primarily through optimized engine usage, improved refrigeration, and better insulation in storage facilities. In a more ambitious scenario, with the adoption of advanced technologies and energy-efficient practices, energy savings could reach 0.16 MTOE, further reducing GHG emissions by 0.51 MtCO2, highlighting the sector's crucial role in supporting the state's energy efficiency and climate goals.

6. Municipal Sector

India's municipal sector, which consumes approximately 4% of the total electricity used in the country, presents a significant opportunity for energy conservation. This sector accounts for 23% of energy use inefficiencies nationwide. In Karnataka, the municipal sector similarly consumes around 4% of the state's overall energy. To address these inefficiencies, Municipal Demand Side Energy Management (MuDSM) interventions are crucial. These initiatives aim to reduce the burden on utilities during peak hours and help mitigate financial losses stemming from high electricity consumption in the municipal sector.

Recognizing the substantial energy savings potential within municipalities, the Bureau of Energy Efficiency (BEE) has launched a nationwide MuDSM program. This program targets energy inefficiencies in key areas such as drinking water and sewage water pumping systems, street lighting, and public buildings across urban local bodies (ULBs) and municipalities. Through these efforts, Karnataka aims to significantly enhance energy efficiency within its municipal sector, contributing to broader state and national energy conservation goals.

EE in street lighting and water pumping systems

Implementing Agency: Bureau of Energy Efficiency (BEE), KREDL, Directorate of Municipal Administration (DMA), Local bodies, and Municipal authorities

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 streetlights 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 0.02 MTOE under the moderate scenario and 0.025 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 0.063 $MtCO_2$ in the moderate scenario and 0.078 $MtCO_2$ 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 Karnataka Renewable Energy Development Limited (KREDL), CII GBC in consultation with the Bureau of Energy Efficiency and in association with Karnataka Renewable Energy Development Limited (KREDL) has developed a comprehensive State Energy Efficiency Action Plan for the state of Karnataka. 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 Karnataka's TFEC will reach 120 MTOE by FY 2031.

Considering this projection, the action plan identifies Industry, Buildings, Transport, Municipal, Agriculture, and Fisheries 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 7.31MTOE in total energy consumptionby FY 2031. In the ambitious scenario, the reduction is projected to be 11.02 MTOE. Additionally, this plan aims to generate awareness at a mass level and create a market potential of approximately Rs. 20,280 Crore in the energy efficiency sector. Furthermore, it is anticipated to contribute to an emission reduction of 22.82 MtCO2 in the moderate scenario and 34.46 MtCO2 in the ambitious scenario in terms of CO_2 emissions by FY 2031.