LOW-CARBON ZONES
A PRACTITIONER’S HANDBOOK
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<th>Description</th>
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<tbody>
<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
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<tr>
<td>AHU</td>
<td>Air handling units</td>
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<tr>
<td>BAU</td>
<td>Business as usual</td>
</tr>
<tr>
<td>BCCSAP</td>
<td>Bangladesh Climate Change Strategy and Action Plan</td>
</tr>
<tr>
<td>BDT</td>
<td>Bangladeshi taka (currency of Bangladesh)</td>
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<tr>
<td>BEPZA</td>
<td>Bangladesh Export Processing Zones Authority</td>
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<td>BEZA</td>
<td>Bangladesh Economic Zones Authority</td>
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<tr>
<td>BOD</td>
<td>Bio-chemical oxygen demand</td>
</tr>
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<td>BPDB</td>
<td>Bangladesh Power Development Board</td>
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<tr>
<td>CAPEX</td>
<td>Capital expenditure</td>
</tr>
<tr>
<td>CETP</td>
<td>Central Effluent Treatment Plant (Bangladesh)</td>
</tr>
<tr>
<td>CH4</td>
<td>Methane</td>
</tr>
<tr>
<td>CO2</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical oxygen demand</td>
</tr>
<tr>
<td>DFID</td>
<td>Department for International Development (UK)</td>
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<tr>
<td>DG</td>
<td>Diesel generator</td>
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<tr>
<td>DOE</td>
<td>Department of Environment</td>
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<td>DSCR</td>
<td>Debt service coverage ratio</td>
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<td>EE</td>
<td>Energy efficiency</td>
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<td>EER</td>
<td>Energy efficiency ratio</td>
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<tr>
<td>EIP</td>
<td>Eco-industrial park</td>
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<td>EPZ</td>
<td>Export processing zone</td>
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<td>ESCO</td>
<td>Energy service company</td>
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<tr>
<td>EZ</td>
<td>Economic Zone</td>
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<tr>
<td>ETP</td>
<td>Effluent treatment plant</td>
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<td>FD</td>
<td>Forced draft</td>
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<td>FDI</td>
<td>Foreign direct investment</td>
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<td>FI</td>
<td>Financial institution</td>
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<td>FP</td>
<td>Free port</td>
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<tr>
<td>FTL</td>
<td>Fluorescent tube light</td>
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<td>FTZ</td>
<td>Free trade zone</td>
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<tr>
<td>FZ</td>
<td>Free zone</td>
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<tr>
<td>GHG</td>
<td>Greenhouse gases</td>
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<tr>
<td>GoB</td>
<td>Government of Bangladesh</td>
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<tr>
<td>HFO</td>
<td>Heavy fuel oil</td>
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<tr>
<td>HRSG</td>
<td>Heat recovery steam generator</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>HVAC</td>
<td>Heating, ventilation and air conditioning</td>
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<td>IA</td>
<td>Industrial area</td>
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<tr>
<td>IE</td>
<td>Industrial estate</td>
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<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
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<td>IH</td>
<td>Innovation hub</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<td>IRR</td>
<td>Internal rate of return</td>
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<tr>
<td>ISO</td>
<td>International Standards Organization</td>
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<tr>
<td>KPI</td>
<td>Key performance indicator</td>
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<tr>
<td>kW</td>
<td>Kilowatt</td>
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<td>LCZ</td>
<td>Low-Carbon zone</td>
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<tr>
<td>LCZG</td>
<td>Low-Carbon Zone Guidelines</td>
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<tr>
<td>LED</td>
<td>Light-emitting diode</td>
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<tr>
<td>LPG</td>
<td>Liquefied petroleum gas</td>
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<tr>
<td>MACC</td>
<td>Marginal abatement cost curve</td>
</tr>
<tr>
<td>MEID</td>
<td>Mediterranean Eco-Industrial Development</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
</tr>
<tr>
<td>NG</td>
<td>Natural gas</td>
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<tr>
<td>NGO</td>
<td>Nongovernmental organization</td>
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<tr>
<td>PCM</td>
<td>Phase change materials</td>
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<tr>
<td>PDB</td>
<td>Power Development Board (Bangladesh)</td>
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<tr>
<td>PMO</td>
<td>Prime Minister’s office</td>
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<tr>
<td>PV</td>
<td>Photovoltaic</td>
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<tr>
<td>RE</td>
<td>Renewable energy</td>
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<tr>
<td>RMG</td>
<td>Ready-made garment</td>
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<td>ROI</td>
<td>Return on investment</td>
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<td>SEZ</td>
<td>Special economic zone</td>
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<tr>
<td>SFC</td>
<td>Specific fuel consumption</td>
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<tr>
<td>SME</td>
<td>Small and medium enterprises</td>
</tr>
<tr>
<td>TCF</td>
<td>Trillion cubic feet</td>
</tr>
<tr>
<td>TOE</td>
<td>Ton of oil equivalent</td>
</tr>
<tr>
<td>TOR</td>
<td>Terms of reference</td>
</tr>
<tr>
<td>TPH</td>
<td>Tonnes per hour</td>
</tr>
<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
</tr>
<tr>
<td>UPGD</td>
<td>United Power Generation and Distribution Limited (Bangladesh)</td>
</tr>
<tr>
<td>USD</td>
<td>United States dollars</td>
</tr>
<tr>
<td>VSD</td>
<td>Variable speed drive</td>
</tr>
<tr>
<td>WBCSD</td>
<td>World Business Council for Sustainable Development</td>
</tr>
<tr>
<td>WRI</td>
<td>World Resources Institute</td>
</tr>
</tbody>
</table>
INTRODUCTION

I. Low-Carbon Zones ................................................................. 8
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II. About This Handbook ............................................................ 13
An Economic Zone (EZ) is a specific geographic area designated to produce goods, often primarily for export, and to generate employment on a substantial scale.\(^1\) Governments have long used these zones to promote and improve industrial activities and production. EZs are usually exempt from many of a country’s business laws regarding taxes, tariffs, foreign direct investment (FDI) limitations, quotas, labor laws, and others,\(^2\) which allows goods produced in the zones to be sold at globally competitive prices. Countries that are particularly focused on increasing exports, attracting FDI, increasing foreign exchange earnings, and creating local employment often create EZs that specialize in manufacturing exclusively for export; these are known as Export Processing Zones (EPZs).

EZs, in general, and EPZs in particular, have generated significant benefits for some of the countries in which they have been established. They have attracted substantial FDI and increased foreign exchange earnings. They have also been successful in generating substantial employment, particularly improving income opportunities for women, as well as contributing to the building of human capital, both at the worker level and also at the supervisory and managerial levels.\(^3\)

On the other hand, EZs have achieved mixed success. Anecdotal evidence turns up many examples of investments in zone infrastructure resulting in “white elephants,” or zones that largely have resulted in an industry taking advantage of tax breaks without producing substantial employment or export earnings. Moreover, many of the traditional EPZ programs have been successful in attracting investment and creating employment in the short term, but have failed to remain sustainable when labor costs have risen or when preferential trade access no longer offers a sufficient advantage.\(^4\) The negative environmental impacts of production activities within these zone have also raised concerns. EZs are often large users of energy of all kinds

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\(^{1}\) Depending on the circumstances, EZs are sometimes known as free zones (FZ), free trade zones (FTZ), industrial parks or industrial estates (IE), free ports (FP), free economic zones, or urban enterprise zones.


**Bangladesh** has been stopping new gas connection set-ups at industrial enterprises, because of dwindling domestic gas reserves. This has resulted in rising gas prices, which has adversely affected the profitability of several factories established within Bangladesh’s EPZs. In the past five years, industrial power rates were raised five times in the country’s Chittagong EPZ, which employs more than 150,000 people.

In the **Republic of Korea**, about 650 industrial parks account for 63% of the country’s industrial emissions, according to the Korea Industrial Complex Corporation.
within a relatively limited and well-defined geographical area, making them significant emitters of greenhouse gases (GHGs), which are a major contributor to climate change.

With climate change becoming one of the core development challenges of our time, these concerns have assumed growing importance, and require urgent consideration and response. EZs face a series of challenges and also opportunities in this evolving global economic, political, and social environment, including:

- **Growing energy insecurity**: As a whole, EZs are large consumers of electricity and other forms of energy, and energy costs are usually a significant component of the overall cost incurred by enterprises operating within an EZ. Energy prices are increasing across the board, and price fluctuations can be quite volatile. In addition, many EZs are located in less-developed or developing countries where a steady and reliable supply of energy, particularly electricity, can be a challenge. Uncertainty in energy supply is further complicated by governmental energy subsidies that lead to under-investment in the energy sector, which is often state-owned.

- **Evolving national climate change agendas**: With increasing awareness about the potential long-term detrimental effects of climate change, governments are actively seeking to address these issues. As the majority of GHG emissions result from electricity production and industrial processes, improving the efficiency of electricity generation and end-use and identifying opportunities to improve industrial practices and processes can help significantly reduce emissions. EZs, with their concentration of moderate-to-large energy-intensive industrial processes, are a good place to pioneer and pilot many GHG-emission-reduction efforts. The introduction of more energy-efficient technologies and industrial processes in an existing EZ could be an important first step toward developing a test case and scaling-up any successes.

---

Changing preferences of global buyers: Global buyers are increasingly focused on the sustainability of their supply chains, often driven by concerns raised by consumers. Increasingly, these buyers are imposing standards and criteria on their suppliers related to higher resource efficiency, lower GHG emissions, lower local pollution, and waste minimization and recycling. To ensure compliance with basic standards, many companies have launched supply chain performance standards and now pre-assess both direct and indirect suppliers on their adherence to these standards.

Table 1 provides some examples of standards and initiatives introduced by leading brands that typically procure in large volumes from EZs. Research and interviews with many of these leading global brands show that trends toward sustainable procurement will increase in the future, driven by stricter government regulations in many countries.
### Table 1: Sustainability criteria introduced by buyers

<table>
<thead>
<tr>
<th>Company</th>
<th>Sustainable Energy and Emissions</th>
<th>Sustainable Material, Water, and Waste Management</th>
<th>Sustainable Supply Chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nike</td>
<td>Footwear energy-efficiency program</td>
<td>5% organic cotton in all cotton-containing apparel</td>
<td>Phase out all hazardous chemicals from supply chain by 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Introduce sustainability index to evaluate all suppliers</td>
</tr>
<tr>
<td>Puma</td>
<td>25% reduction in energy use and carbon emissions by 2015</td>
<td>Cutting-edge sustainable packaging and distribution system</td>
<td>Raise awareness on more efficient resource management for suppliers based out of China and Vietnam</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25% reduction in waste and water by 2015</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% of international product collections to meet sustainability best practices standard by 2015</td>
<td></td>
</tr>
<tr>
<td>Levi's</td>
<td>Reduction in GHG emissions by 11% by 2011-12, with 2007 as baseline</td>
<td>NA</td>
<td>Established information system to track supply chain emissions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Plans to reduce logistics emissions by 50-60% by 2015</td>
</tr>
<tr>
<td>Unilever</td>
<td>Halve the GHG impact of products across their life cycles by 2020 as part of the “Sustainable Living Plan” initiative</td>
<td>Waste associated with the disposal of their products to be halved by 2020</td>
<td>Source 100% of agricultural raw materials sustainably by 2020</td>
</tr>
<tr>
<td></td>
<td>Increase renewable energy to 40% of total energy requirement by 2020</td>
<td></td>
<td>Source 75% of paper and board for packaging from certified sustainably managed forests or from recycled material by 2015</td>
</tr>
<tr>
<td>P&amp;G</td>
<td>Power all plants through 100% renewable energy in the long-term</td>
<td>Solid waste from production processes eliminated or reduced and waste used as raw materials</td>
<td>Replace 25% of petroleum-based raw materials with sustainably sourced renewable materials for products and packaging by 2020</td>
</tr>
<tr>
<td></td>
<td>Increase usage of renewable energy in plants to 30% by the year 2020</td>
<td>More material-efficient delivery systems</td>
<td>100% of paper packaging to contain either recycled or third-party-certified virgin content by 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zero manufacturing waste to landfill at 50 sites worldwide</td>
<td></td>
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</tbody>
</table>

Note: All information is sourced from the respective company websites.
I. Low-Carbon Zones

One way to address these challenges and opportunities is to create specialized Low-Carbon Zones (LCZs), or to transform existing EZs into LCZs. Such specialized zones will lower the carbon footprint of the industrial and related operations within the zone and provide a testing ground for pilot projects and policies for reducing the environmental footprint of industrial operations. With demand for green and low-carbon products on the rise, LCZs are expected to attract maximum investments and establish the new norm for production standards.

By promoting resource efficiency and sustainable operations, LCZs provide a number of important benefits both for the companies operating within them and for the national economy. These benefits include:

- **Boosting competitiveness through resource efficiency**: Increased energy efficiency enhances the profitability and long-term competitiveness of enterprises. While certain additional costs might be incurred in the beginning, these are usually offset within a relatively short time period. It is estimated that energy efficiency alone can lead to operating cost savings of 24 percent for industrial enterprises. Lower energy import needs and reduced production costs also enhance competitiveness.

- **Improved brand image**: LCZs result in improved reputation and positioning in the global marketplace for both the zone authorities and the individual enterprises, allowing them to offer a differentiated value proposition to would-be investors and customers. Most export-oriented developing economies supply products to global companies, many of which are placing increased emphasis on sustainable sourcing and green supply chains. Increased resource efficiency and environmentally-friendly processes and practices can give these suppliers a competitive advantage in this changing global market.

---

LCZ enterprises that make final products may also use the low-carbon dimension of their brand as part of their market strategies.

- **Developing new low-carbon-related industries**: As LCZs compel enterprises to adopt resource-efficient practices and projects, they create new demand for energy-efficient and low-carbon equipment, technologies and services, increasing opportunities for vendors to develop their manufacturing capability or start importing such equipment and technologies. For example, China manufactures LEDs on a large scale, and a significant portion of these products are supplied to its own EZs.

- **Attracting high quality “green” FDI**: LCZs can bring in more foreign investment in the form of “green” FDI, by offering investors access to infrastructure, finance, knowledge and institutional support for implementing low-carbon projects and earning a healthy commercial return. Green FDI can then attract higher-quality foreign investments, facilitating a shift from simple processing, assembly and low-level manufacturing toward research and development, high-end design, state-of-the-art manufacturing techniques, modern logistics, and other new areas. The spillover effect of green FDI creates new industry value chains, generates employment, and contributes to skill development of workers, engineers, and managers. A recent UNCTAD study indicates that, between 2003 and 2012, $500 billion in FDI was invested in clean energy generation, low-carbon processes, and green products and services, resulting in the creation of more than 200,000 jobs.\(^7\)
A. Framework for developing a Low-Carbon Zone

While the benefits of LCZs are clear, the transition is unlikely to be straightforward. A lack of awareness, knowledge, and institutional capacity to implement LCZs remains a key challenge to their adoption. In addition, many policymakers and business owners are concerned by the immediate costs of the renovation or retrofitting, despite the potential for lucrative new opportunities. At a technical level, innovative products and services often need time to be developed and refined prior to adoption and diffusion. Key technologies and practices gain maturity at different times, making it difficult for business owners to prioritize and commit to long-term investments. Even though there may be successful pilot projects, the scale effects of large-scale adoption of the new methods of production remain unknown.

Thus, to guide the successful development and implementation of an LCZ, it is important to operate within a robust framework that includes the following four important components:

1. **GHG mitigation target setting:** An LCZ should have the requisite methodologies and processes in place to support regular GHG emissions inventories, allowing the zone authorities to measure and analyze the zone’s performance related to lowering emissions.

2. **Sustainable infrastructure:** In order to promote the successful development and adoption of low-carbon infrastructure, LCZs should be able to demonstrate commercially viable and implementable solutions that will not only reduce GHG emissions but also result in cost savings and other co-benefits, such as skill development and job creation.

3. **Low-carbon policy and institutional framework:** Most LCZs fail to thrive on purely voluntary initiatives and need to be supported by a sound policy framework of both compliance requirements and incentives, as well as effective governmental and non-governmental institutions.
4. **Carbon financing:** Demonstrable reductions in GHG emissions can help attract additional financial resources from clean development mechanisms and voluntary carbon markets, helping to compensate for unattractive short-term returns. Developing the market for energy service companies (ESCOs) can also support companies that lack the financial resources to fund their mitigation projects.

B. Options for developing Low-Carbon Zones

There are two basic options for developing an LCZ, depending on specific circumstances and any comparative advantage that a particular location might have. The first approach is to *plan and design a new LCZ*.

Perhaps the quickest and most likely approach to establishing an LCZ, however, is to *transform an existing EZ into an LCZ*. In 2008, there were approximately 3,000 zones in 135 countries,⁸ and they represent a significant opportunity for not only pursuing the LCZ transformation agenda but also for demonstrating large-scale impact. Existing EZs provide an opportunity to make more effective use of an existing asset. The participating enterprises and their energy-, process- and performance-related characteristics are known, zone authorities have an ongoing relationship with the enterprises, and LCZ-related goals and objectives could be set through a highly participatory, consultative, and collaborative process.

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Box 1: Transformation of the Ulsan Industrial Park of Korea into an Eco-Industrial Park

In 2005, with a focus on improving resource efficiency and abating industrial pollution, the Korea National Cleaner Production Center (KNCPC) started a 15-year, three-phase project titled, “Eco-industrial Park (EIP): Construction for establishing infrastructure of cleaner production in Korea.” The Ulsan Industrial Park was selected as one of five demonstration sites for the project.

Currently, the Ulsan Industrial Park comprises 897 enterprises across a varied set of industries, including petrochemicals, automobiles, and heavy industry. With total production of USD 155 million and exports of USD 68 million, Ulsan industrial park is a significant economic vehicle for Korea’s industrial growth.

Through systematic application of industrial symbiosis techniques (such as exchange of steam between two enterprises), the Ulsan EIP initiative has already generated investments of USD 79 million and annual profits of USD 84 million. There are currently 22 industrial symbiosis projects in Ulsan industrial park, which have attracted R&D support funds to industrial symbiosis of USD 2.5 million and avoided 331kMt of annual CO$_2$ emissions.\(^9\)

II. About This Handbook

This handbook is designed to aid practitioners in understanding LCZs and the systematic process required to eventually develop and operate such zones. Interested readers may include both owners, managers, and engineers of the private enterprises located in the zone, as well as the relevant officials of the zone authority, developer, or co-developer of the zone.

- Chapter 2 presents a detailed explanation of the five key steps and activities involved in a low-carbon zone initiative, both for transforming an existing EZ and for establishing a new LCZ. While many of these activities are broadly applicable, they should nonetheless be tailored to each particular EZ. This chapter will be most useful to the zone developers, zone authorities, and zone enterprises that are involved in the implementation and operation of a zone.

- Chapter 3 explores the policy and institutional requirements for developing an LCZ and offers recommendations on how the LCZ-specific policies and institutions can be effectively integrated with national policies and institutions to accelerate further reforms to promote sustainable industrialization. While Chapter 2 deals with zone- or site-specific policy and institutional development, the low-carbon transformation of an EZ transcends local boundaries and stakeholders, and requires a national perspective. Developing and/or strengthening the low-carbon policy and institutional framework are national prerogatives, with ramifications beyond any single LCZ. National policy makers and regulators have a significant role to play in shaping these efforts, while the zone authorities or developers can catalyze policy implementation at the zone level. Sound enabling policies, regulations and institutions are vital to the successful promotion and scale-up of low-carbon initiatives, particularly in developing and under-developed countries, and, for this reason, a separate chapter is devoted to these issues.

- The handbook concludes with a set of practical tools for that can be used by the relevant practitioners to make key decisions and/or plans and develop projects and programs related to LCZ implementation. More tools are available at http://bit.ly/lczhandbook.
1. HOW TO DEVELOP A LOW-CARBON ZONE

Step 1: Identify your stakeholders and secure commitment ........................................19

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Voluntary actions alone have rarely led to successful low-carbon transformations at scale. For this reason, the zone authority or zone developer has a critical pioneering and catalytic role to play in the development of an LCZ, primarily in setting the vision, mission, and goals, creating an enabling policy/institutional environment, and monitoring progress of implementation activities.

Nevertheless, the ultimate responsibility for an LCZ initiative must lie with the zone’s private enterprises, which will eventually have to conceptualize, plan, and implement the low-carbon measures. While policies and regulatory mandates create an enabling environment, real implementation and scale-up happens only when enterprises appreciate the business case for low-carbon measures and have sufficient technical and financial capacity to implement them.

This chapter focuses on the steps necessary to transform an operating EZ into an LCZ, the most frequent path for low-carbon development in economic zones. At the end of the chapter, there is a brief discussion about the process of planning and designing an entirely new LCZ project and the ways in which this approach compares to the transformation process.

The transformation of an existing zone into an LCZ involves five main steps, each of which includes several distinct activities (see Figure 1). Because no two zones are exactly alike, each zone should work through the process in a way that suits its unique conditions and configuration, while ensuring that the process is collaborative and consultative. The zone authority or developer should take the lead in the planning, implementation, and monitoring of the transformation initiatives, in coordination with the national and/or regional governments and all other agencies and departments that have a role in the operations of the LCZ. They should also work closely with the private enterprises and financial institutions that play a primary role in the regular functioning of the zone.
### Figure 1: Steps toward transforming an existing economic zone into a Low-Carbon Zone

<table>
<thead>
<tr>
<th>Steps</th>
<th>Activities</th>
<th>To be carried out by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Secure Commitment</td>
<td>▶ Assess the political economy of low-carbon development&lt;br&gt;▶ Identify stakeholders and assess stakeholders’ needs&lt;br&gt;▶ Establish organization and leadership&lt;br&gt;▶ Create a vision statement</td>
<td>▶ Zone authorities/developers in association with national/regional governments</td>
</tr>
<tr>
<td>2 Technical Diagnostic</td>
<td>▶ Conduct GHG inventory and forecasting&lt;br&gt;▶ Conduct energy audit and energy survey&lt;br&gt;▶ Establish a zone-level baseline&lt;br&gt;▶ Identify potential GHG mitigation projects&lt;br&gt;▶ Assess business case and prioritize projects</td>
<td>▶ Enterprises in the zones (through appointment of consultants and sectoral experts)</td>
</tr>
<tr>
<td>3 Set Targets</td>
<td>▶ Establish different emission scenarios&lt;br&gt;▶ Set the target-GHG reduction based on the timeline&lt;br&gt;▶ Develop consensus around the possible target and its achievement</td>
<td>▶ Zone authorities/developers based on outcomes of Step 2</td>
</tr>
<tr>
<td>4 Planning &amp; Implementation</td>
<td>▶ Develop detailed plan for project implementation&lt;br&gt;▶ Project content&lt;br&gt;▶ Scheduling&lt;br&gt;▶ Technology and vendor selection&lt;br&gt;▶ Financing needs&lt;br&gt;▶ Training and manpower needs&lt;br&gt;▶ Identify financing mechanisms&lt;br&gt;▶ Identify institutional and organizational needs&lt;br&gt;▶ Strengthen institutions&lt;br&gt;▶ Roll out projects</td>
<td>▶ Enterprises in the zones (through appointment of consultants and sectoral experts)&lt;br&gt;▶ Zone authorities/developers in association with national/regional governments</td>
</tr>
<tr>
<td>5 Monitoring &amp; Reporting</td>
<td>▶ Develop GHG monitoring and tracking tool&lt;br&gt;▶ Collect information from enterprises and projects&lt;br&gt;▶ Develop stakeholder reporting structure&lt;br&gt;▶ Publish/circulate report</td>
<td>▶ Zone authorities/developers and enterprises in the zones</td>
</tr>
</tbody>
</table>
STEP 1: IDENTIFY YOUR STAKEHOLDERS AND SECURE COMMITMENT

This first step sets the stage for successful energy and emissions management by creating political and stakeholder buy-in to propel the rest of the process. The main players who will take actions to make things happen are the zone enterprises, and the key to success during this stage is effective communication with the private sector about the commercial viability and real business impacts of low-carbon investments. It is also important to establish the stakeholders’ commitment to the transformative process by involving them in developing the zone’s vision for the future and setting up a governance structure for implementation and monitoring of the plan.

- Assess the political economy of low-carbon development
- Identify all stakeholders and map stakeholder needs
- Establish organization and leadership
- Create a vision statement

Assess the political economy of low-carbon development

Low-carbon development of economic and economic zones needs political and bureaucratic support and, in some cases, assistance from international development partners. This is why it is important to assess the level of commitment and support for the LCZ at the political and ministerial level, by asking the following key questions:

- What are the existing national frameworks, strategies, policies, and institutions related to climate change and sustainable industrial development?
Are key stakeholders encouraged to pursue sustainable industrial development, especially within EZs, as part of the economic strategy of the country?

What are the key obstacles that might impede stakeholders from committing resources to low-carbon transformation of EZs?

Although an LCZ initiative ideally should benefit a majority of stakeholders, the zone authority and other implementation partners should recognize that there will be potential “winners” and “losers” in the process and develop appropriate safeguard measures. Thus, from the start, the transformation process should involve civil society organizations and local communities whose livelihoods depend directly or indirectly on the zone’s activities.

Identify all stakeholders and map stakeholder needs

Stakeholders can be broadly categorized into three groups:

1. **Public stakeholders** include government bodies and agencies that are responsible for driving the initiative by introducing relevant policies, regulations, fiscal incentives, and penalty mechanisms. Examples of government stakeholders include ministries of finance, industry, commerce, planning, energy, power, and the environment; energy or electricity regulatory commissions; zone authorities; political actors; and development partners.

2. **Private stakeholders** are typically enterprises within the zones and other industrial complexes, potential national and international investors in the zone, utility providers in the zone, equipment vendors, local banks and financial...
institutions, energy experts, local legal experts, and local and international policy experts. These stakeholders are the actual implementers of low-carbon initiatives and also the beneficiaries of the LCZ.

3. **Community stakeholders** typically include the local community and NGOs who would benefit from a cleaner environment and the spillover benefits of new knowledge and skills. They play an important role in ensuring that the local community also benefits from the LCZ.

All relevant stakeholders should be identified at the outset of the transformation process. Through direct interaction with stakeholders and consultation with knowledgeable experts, planners should map which group each stakeholder belongs to or can reasonably be associated with, their positions on the transition issue, the level of influence (power) they hold to be able to promote those positions, and the level of interest they have in any specific reform measures or initiatives. (See Table 2 for an example of stakeholder mapping categories for a typical low-carbon transformation.) Together, these attributes will determine the capability that a stakeholder has to either block or promote any low-carbon transformation activities.
### Table 2: Example of stakeholder mapping for transformation of an existing economic zone

<table>
<thead>
<tr>
<th>Stakeholder category</th>
<th>Relevant stakeholder</th>
<th>Roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government policy makers (external)</td>
<td>Ministry of Finance</td>
<td>Framing of policies and oversight of their implementation</td>
</tr>
<tr>
<td></td>
<td>Ministry of Industry &amp; Commerce</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ministry of Planning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ministry of Power/Energy/Non-conventional Energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ministry of Environment &amp; Forests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy/Electricity Regulatory Commission</td>
<td>Advocate policy suggestions to government</td>
</tr>
<tr>
<td></td>
<td>Investment and Export Promotion Agency</td>
<td>Assist government in framing new policies for private sector development</td>
</tr>
<tr>
<td></td>
<td>Ministry of Water/Natural Resources</td>
<td>Assist the national taskforce on investment climate facilitation</td>
</tr>
<tr>
<td>Implementing agency/staff (internal)</td>
<td>Zone authority, developer or operator</td>
<td>Attract investment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promote LCZs as a differentiator for attracting FDI in industrial clusters</td>
</tr>
<tr>
<td>Various entities operating and associated with zone activities (internal)</td>
<td>Zone enterprises</td>
<td>Conduct business and industrial activities in zone</td>
</tr>
<tr>
<td></td>
<td>Foreign and local investors (both equity and debt capital investors)</td>
<td>Invest capital in business operations within zones</td>
</tr>
<tr>
<td></td>
<td>Technology suppliers</td>
<td>Technology suppliers</td>
</tr>
<tr>
<td>Development partners (external)</td>
<td>ADB, World Bank, IFC, DFID</td>
<td>International financiers/multilateral agencies</td>
</tr>
<tr>
<td>Local community (external)</td>
<td>NGOs, etc.</td>
<td>Provide views of local community</td>
</tr>
<tr>
<td>Influence</td>
<td>Interest</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Provide incentives for investment in low-carbon initiatives</td>
<td>Attracting investment in low-carbon energy sector</td>
<td></td>
</tr>
<tr>
<td>Frame broad guidelines and directions for sustainable industrial development and promotion of local industries</td>
<td>Increasing income generation and employment creation through opening of untapped domestic market opportunities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Broadening the base of industry with a view to creating increased industrial activities in the regions</td>
<td></td>
</tr>
<tr>
<td>Develop the plan for low-carbon economic zones</td>
<td>Lowering dependence on dwindling non-renewable energy sources</td>
<td></td>
</tr>
<tr>
<td>Introduce policy-level reforms in energy efficiency and renewable energy</td>
<td>Achieving vision of government at national level for green growth</td>
<td></td>
</tr>
<tr>
<td>Introduce new environmental policies</td>
<td>Liaising with domestic and international organizations on matters relating to treaties and agreements with other countries and world bodies on subjects overseen by this ministry</td>
<td></td>
</tr>
<tr>
<td>Frame new regulations to promote energy efficiency practices such as cogeneration and incentives for export of low-carbon/resource products and services</td>
<td>Promoting and facilitating investment</td>
<td></td>
</tr>
<tr>
<td>Influence government on national policy and planning issues related to low-carbon transformation of industries</td>
<td>Attracting investment in the zones from foreign investors and financing institutions</td>
<td></td>
</tr>
<tr>
<td>Adopt new technology</td>
<td>Promoting resource efficiency industries and driving down operating costs</td>
<td></td>
</tr>
<tr>
<td>Identify sustainable investment opportunities</td>
<td>Achieving attractive returns on investment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meeting the sustainability issues related to investment</td>
<td></td>
</tr>
<tr>
<td>Provide technology</td>
<td>Generating new business opportunities</td>
<td></td>
</tr>
<tr>
<td>Form national and local partnerships to invest in and promote low-carbon development</td>
<td>Promoting sustainable socio-economic development of the country</td>
<td></td>
</tr>
<tr>
<td>Communicate to government about impacts on local population</td>
<td>Promoting sustainable livelihoods and development opportunities for local people</td>
<td></td>
</tr>
</tbody>
</table>
Stakeholder mapping provides a working understanding of the political, economic, and social impact of the specific initiative on interested groups, the hierarchy of authority and power among different groups, and the varying perceptions of the initiative among different groups. Figure 2 provides an example of a typical matrix used for stakeholder mapping.

**Figure 2: Stakeholder mapping matrix**

![Stakeholder mapping matrix diagram](image-url)
Establish organization and leadership

Successful transformation into an LCZ will depend on a zone’s institutional structure, governance, policies, and leadership. With strong leadership and good governance in place, the zone authority can garner wide support. Forward-looking leadership that is responsive to new ideas can make an enormous difference in the way a zone is operated or a new zone is designed, helping to ensure that projects and initiatives are implemented on time, resources are deployed optimally, and benefits are shared and distributed in a fair and equitable fashion.

As the first step, all relevant policies and regulations should be studied and analyzed in depth, to understand the gaps and deficiencies in the existing framework. Special emphasis should be placed on national-level and zone-specific (if any) policies, rules, and regulations on energy, environment, water, and waste, in addition to the general rules and laws of business.

A preliminary diagnostic review can be conducted to understand the roles and responsibilities of relevant institutions and their capacity to contribute to the LCZ initiative. Interactions with top officials of the zone authority and other concerned government ministries and departments can reveal any capacity gaps and identify the need to strengthen institutions or develop new organizational mechanisms.

It is also important to establish and promote low-carbon “champions” (either individuals or a group of individuals or enterprises) for any zone, to promote the initiative among the enterprises. In most developing countries, the awareness level and knowledge base of industries and government institutions on low-carbon issues is quite low. Champions help in capturing, showcasing and disseminating knowledge and driving real change.
Create a vision statement

To support the transformation of an EZ to an LCZ, zone authorities should create a vision statement that provides a picture of the future state the zone aspires to achieve. The vision statement should clearly set out the objective for low-carbon transformation, to guide the entire process and make sure that all enterprises, people, departments, organizations and utilities within the zone support the plan and are working toward the same goal. The vision statement (which may be part of a broader objective) should relate to the zone’s character and configuration and link energy and emissions goals to the zone’s overall economic objective.

It is important to ensure that this vision is then translated into targets and approaches that are followed throughout the process, so that the low-carbon objective is achieved. Stakeholder consultation should be carried out periodically to confirm that the vision remains relevant and to adjust the vision as and when needed.
STEP 2: CONDUCT TECHNICAL DIAGNOSTICS AND IDENTIFY GHG MITIGATION OPPORTUNITIES

The next step involves completing a series of technical diagnostic activities in order to determine which projects to implement for the low-carbon transformation. Conducting the GHG emissions inventory and cataloging past and ongoing energy efficiency and energy planning initiatives will help the zone authority to identify major trends and opportunities, so that it can assess the potential for energy and emissions reduction projects to meet its sustainability goals.

The activities involved in this step are highly technical and require specialized knowledge and experience if they are to be carried out effectively. Therefore, the zone developer or authority should work with expert consultants, who can not only advise on this process but also transfer knowledge and build capacity within the zone authority to make the initiative sustainable in the long-run.

- GHG inventory and forecast
- Energy audits and energy surveys
- Create a pipeline of “bankable” mitigation projects
- Establish the business case for the identified opportunities and prioritize the mitigation projects
GHG inventory and forecast

A GHG inventory is an accounting of all greenhouse gases emitted to or removed from the atmosphere in a certain area over a certain period of time. The inventory can be established based on both utility bill data (top-down approach) and preliminary surveys of energy consumption (bottom-up approach). A completed GHG inventory will identify the chief sources of emissions in the zone, to help guide the selection of effective mitigation interventions. Figure 3 shows an example of a GHG inventory for a zone.

Figure 3: GHG emissions inventory from Chittagong Export Processing Zone

<table>
<thead>
<tr>
<th>Source of Emissions</th>
<th>Emissions (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captive energy operations</td>
<td>45,252</td>
</tr>
<tr>
<td>Gas consumption by zone enterprises</td>
<td>115,815</td>
</tr>
<tr>
<td>Grid electricity purchase</td>
<td>26,731</td>
</tr>
<tr>
<td>Air conditioner</td>
<td>8,611</td>
</tr>
<tr>
<td>Total Emissions</td>
<td>348,826</td>
</tr>
</tbody>
</table>

Note: Emissions figures are in metric tons

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11 There are two primary approaches to data collection while performing GHG emissions accounting: (i) In a top-down approach, aggregated data, such as electricity generated within the zone or bought from the grid, is collected at the zone level. (ii) In a bottom-up approach, the relevant data is collected at the enterprise level by auditing the energy consumption of individual pieces of equipment; this data is then aggregated at the zone level to arrive at zone emissions.
The GHG inventory should be completed using internationally accepted guidelines and standards, such as “The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard,” published by the World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI), or the ISO 14064 standard, which specifies principles and requirements at the organizational level for quantification and reporting of GHG emissions and removals (see Figure 4). Based on these broad principles, IFC has designed an Excel-based tool called the Carbon Emission Estimator Tool, which can help with GHG accounting. For more details on this process, please see Tool 1: GHG Emissions Accounting, in the Toolbox at the end of this handbook.

12 The IFC CEET tool can be accessed here: http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/CB_Home/Policies+and+Tools/GHG_Accounting
Figure 4: Steps for estimating a GHG inventory

Establishing GHG inventory

*Using guidelines of ISO14064/WBCSD Corporate GHG Accounting protocol*

- Determine organizational & operational boundary
  - Determine the base year for GHG inventory calculation
  - Determine the organizational boundary – control approach/equity share approach
  - Establish the operational boundary
  - Inclusion of specific processes and equipment and logistics in the study

- Identify and categorize GHG sources and sinks
  - Categorization of GHG emissions into direct, energy indirect and other indirect emissions – Scope 1, 2 & 3 emissions

- Develop GHG inventory & carbon intensity in different zone enterprises
  - Mass and energy balance across process/system
  - Energy/fuel consumption in production process, inbound and outbound logistics
  - Compute GHG inventory and carbon intensity of each value chain segment

- Develop GHG inventory & carbon intensity in different zone enterprises
  - Establish process/system specific baseline GHG emissions based on extensive analysis of GHG inventory
  - Perform suitable test for completeness, conservativeness, transparency, relevance of baseline
Box 2: Technical diagnostics to estimate a GHG inventory for an industrial park, China

A recently published study by Bin Chen et al, “Greenhouse Gas Inventory of a Typical High-End Industrial Park in China,” uses a cradle-to-grave inventory methodology to perform GHG diagnostics in a southwest Beijing industrial park that is known for its good environmental quality and high-end industry concentration. The table below summarizes the methodology used by the researchers to estimate the GHG inventory of the industrial park.

**GHG inventory methodology**

<table>
<thead>
<tr>
<th>Methodology for GHG Inventorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takes a 3-phased life-cycle approach</td>
</tr>
<tr>
<td>1. Construction Phase</td>
</tr>
<tr>
<td>▶ Construction of buildings and affiliated municipal facilities</td>
</tr>
<tr>
<td>▶ Garden landscaping</td>
</tr>
<tr>
<td>2. Operation Phase</td>
</tr>
<tr>
<td>▶ Assumed to last 40 – 50 years</td>
</tr>
<tr>
<td>▶ Consumption of electricity, heat power, and water</td>
</tr>
<tr>
<td>▶ Daily discharge of wastewater and solid waste from buildings and public space</td>
</tr>
<tr>
<td>3. Demolition Phase</td>
</tr>
<tr>
<td>▶ Emissions estimated based on size and construction structure of the industrial park</td>
</tr>
<tr>
<td>Considers 5 major sources of emissions</td>
</tr>
<tr>
<td>1. Direct and indirect emissions from the consumption of energy – both primary and secondary</td>
</tr>
<tr>
<td>2. Direct emissions from industrial production processes</td>
</tr>
<tr>
<td>3. Emissions from the production and transportation processes of all the materials in the industrial park</td>
</tr>
<tr>
<td>4. Emissions from the production and transportation processes of all the equipment in the industrial park</td>
</tr>
<tr>
<td>5. Emissions from the sewage treatment and solid waste disposal processes</td>
</tr>
</tbody>
</table>
Using this methodology, the Beijing-based industrial park was estimated to emit ~1.9 million tons of CO2 during its entire life cycle, with the construction stage accounting for approximately 5 percent of total emissions, the demolition stage barely 0.1 percent, and the operations stage more than 95 percent. As operational activities have the most significant contribution to life-cycle GHG emissions, industrial park authorities and enterprises are focusing on them for the implementation of low-carbon measures. The chart below breaks down the operations-related emissions, illustrating the fact that attention needs to be devoted to electricity and heat consumption activities, along with sewage treatment.

**Breakdown of operations-related emissions**

**GHG Emissions from Operations Activities (in tons CO₂e)**

- ~25 Water Use
- ~45 Primary Energy Consumption
- ~175 Solid Waste Disposal
- ~250 Equipment Employment
- ~8500 Electricity Consumption
- ~12500 Heat Energy Consumption
- ~18000 Sewage Treatment

Note: There is a break in the x axis
Energy audits and energy surveys

An energy audit is used to review the energy consumption patterns and energy efficiency of equipment and to identify opportunities for improvement by bringing in new equipment, improving current equipment, and/or changing the way the existing equipment is used. Audits are a centerpiece of energy policy in many countries, including Japan, Korea, and India, where energy auditing is now mandatory for large companies with intensive energy consumption. Table 3 provides more details on the two main types of energy audits, walk-through and investment grade.

Before beginning an energy audit, it is important to decide whether the audit will be carried out for all firms in the zone or only for a selected set of firms. If only a set will be audited, that sample set can be selected through an energy survey, in which all firms complete pre-designed questionnaires detailing their basic utility (power/water/different fossil fuel consumption) and production data. Based on this data, those enterprises that cumulatively contribute to about 80 percent or more of the zone’s energy consumption can be selected for the full audit. This set should include a good spread of enterprises across the different sectors present in the zone. A sample questionnaire for an energy survey can be found in the additional tools available online at http://bit.ly/lczhandbook.

Certified auditors should be employed to carry out the energy audit. Primary data for each of the enterprises and cost centers identified can be collected either through existing monitoring equipment or with the help of portable meters. The energy audit will identify major energy cost centers and GHG-intensive processes in the zone, and provide a holistic map of energy consumption and loss patterns of the

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13 In Korea, as per the Energy Use Rationalization Act, energy audits are mandatory for companies consuming more than 2,000 Tons Oil Equivalent (ToE) per year. In India, under the Perform-Achieve-Trade Scheme of the Ministry of Power (part of the Energy Conservation Act of 2001), energy audits are mandatory for 478 Designated Consumers. The Energy Conservation Law of Japan provides for a regulatory framework for mandatory energy audits.

14 Certification of energy auditors requires an overarching national legal framework and is often the first policy tool toward improving energy efficiency across the industrial base of a country. For instance, in India, within the framework of the Energy Conservation Act, the Bureau of Energy Efficiency (BEE) is empowered to certify Energy Managers/Auditors. The BEE has retained the National Productivity Council (NPC) as the National Certifying Agency, which would conduct the National Level Certification Examination for Energy Managers & Energy Auditors.
various equipment and processes being utilized in the zone. After the audit is completed, the 80-20 rule should be followed, to focus on the 20 percent of processes/equipment that consume 80 percent of the total energy or emit 80 percent of the GHG emissions.\textsuperscript{15}

\textbf{Table 3: Types of energy audits}

<table>
<thead>
<tr>
<th>Walk-through energy audit</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is the simplest form of audit and involves:</td>
</tr>
<tr>
<td>▶ minimal interviews with site operating personnel;</td>
</tr>
<tr>
<td>▶ a brief review of the facility’s utility bills and other operating data;</td>
</tr>
<tr>
<td>▶ a walk-through of the facility to become familiar with the building operation and to identify any glaring areas of energy loss or inefficiency; and</td>
</tr>
<tr>
<td>▶ a brief description of corrective measures, including quick estimates of implementation costs, potential operating cost savings, and simple payback periods.</td>
</tr>
<tr>
<td>This type of audit usually takes about 4-5 hours\textsuperscript{16} per facility, and typically, only major problem areas are uncovered during the process.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investment-grade energy audit</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is a more complex form of audit conducted by enterprises aiming to upgrade their energy infrastructure, where:</td>
</tr>
<tr>
<td>▶ such investments compete for capital funding with non-energy investments; and</td>
</tr>
<tr>
<td>▶ both energy and non-energy investments are rated based on financial indicators, such as expected return on investment.</td>
</tr>
<tr>
<td>Such audits entail a complete, detailed engineering study to identify technical and economic issues that would justify an investment in upgrading energy infrastructure. Depending on the size of the facility, this can take up to 15-20 days.</td>
</tr>
</tbody>
</table>

Figure 5 provides more detail on the energy audit process, while Figures 6, 7, and 8 illustrate some typical outcomes of the energy audit process. For more information on how to conduct an energy survey and audit, and the equipment that is used during these processes, please see http://bit.ly/lczhandbook.

\textsuperscript{15} A general rule of thumb followed by industry and energy experts.  
\textsuperscript{16} http://home.cc.umanitoba.ca/~thompos4/energyaudit.pdf (accessed on 23 December 2013)
Figure 5: The energy audit process

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare factory information database</td>
<td>Preparation of a detailed list of the energy-consuming equipment</td>
</tr>
<tr>
<td>Prepare checklist of information</td>
<td>Preparation of a checklist of equipment, energy sources, forms of energy, and process flows for each of the identified firms</td>
</tr>
<tr>
<td>Survey the facility</td>
<td>Field visits conducted by the energy auditors in each of the identified firms</td>
</tr>
<tr>
<td>Draw process flow diagram and confirm operation</td>
<td>The process flow provides the auditors with the analysis of the efficiency of the process and also the energy loss areas.</td>
</tr>
<tr>
<td>Take rapid measurements and confirm reliability of devices</td>
<td>Measurement of major technical parameters</td>
</tr>
<tr>
<td>Establish baseline condition</td>
<td>Establishment of baseline condition for each of the identified firms</td>
</tr>
<tr>
<td>Allocate consumption &amp; draw process mass balance</td>
<td>Allocation of energy consumption across different processes</td>
</tr>
<tr>
<td>Validate data</td>
<td>Validation of the data collected through measurement and plant records</td>
</tr>
<tr>
<td>Determine energy cost centers</td>
<td>Determination of the cost centers of energy (i.e. areas of energy losses), based on the analysis</td>
</tr>
<tr>
<td>Recommend areas of improvement</td>
<td>Identification of areas of energy efficiency improvement and energy loss reduction</td>
</tr>
<tr>
<td>Complete final energy audit report</td>
<td>Preparation and submission of final energy audit report</td>
</tr>
</tbody>
</table>

The process flow provides the auditors with the analysis of the efficiency of the process and also the energy loss areas.
The energy bill of the CEPZ was USD 16.33 million for a revenue of USD 1.76 billion in 2011.

Power consumption increased from 171 million kWh to 174 million kWh between 2010 and 2011 ~ 2% increase.

Gas consumption increased from 69.8 cu.m to 71 cu.m in the same period~ 1.2% increase.

With another 6-7 units soon to be commissioned, the power and gas demand would increase significantly.

Power demand is expected to increase by another 50 MW by 2015.
Figure 7: Illustrative outcomes of an energy audit – Energy and water consumption

<table>
<thead>
<tr>
<th>Industry</th>
<th>Energy Consumption (ToE)</th>
<th>Water Consumption (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry 1</td>
<td>40,000</td>
<td>45,000</td>
</tr>
<tr>
<td>Industry 2</td>
<td>20,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Industry 3</td>
<td>15,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Industry 4</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Industry 5</td>
<td>8,000</td>
<td>12,000</td>
</tr>
</tbody>
</table>

**Energy consumption industry-wise**

**Water consumption industry-wise**

Figure 8: Illustrative outcomes of an energy audit – Power consumption

<table>
<thead>
<tr>
<th>Industry</th>
<th>Power Consumption (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry 1</td>
<td>70</td>
</tr>
<tr>
<td>Industry 2</td>
<td>20</td>
</tr>
<tr>
<td>Industry 3</td>
<td>15</td>
</tr>
<tr>
<td>Industry 4</td>
<td>10</td>
</tr>
<tr>
<td>Industry 5</td>
<td>8</td>
</tr>
</tbody>
</table>

**Power consumption industry-wise**

<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Power Consumption (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise 1</td>
<td>10</td>
</tr>
<tr>
<td>Enterprise 2</td>
<td>7</td>
</tr>
<tr>
<td>Enterprise 3</td>
<td>6</td>
</tr>
<tr>
<td>Enterprise 4</td>
<td>5</td>
</tr>
<tr>
<td>Enterprise 5</td>
<td>8</td>
</tr>
</tbody>
</table>

**Power consumption enterprise-wise**
A zone-level GHG inventory is a summation of all the GHG inventories of the different enterprises in the zone. This total will represent a baseline for the entire facility and can be used for target setting and as a basis for comparison in monitoring and reporting on progress in the low-carbon transformation. To ensure that the reported zone-level baseline is accurate, each individual enterprise’s reported GHG emissions data should meet the following conditions:

- **Relevance:** A GHG inventory should appropriately reflect the GHG emissions of the enterprise and serve the decision-making needs of users – both internal and external to the enterprise. An important aspect of relevance is the selection of an appropriate inventory boundary that reflects the reality of the enterprise’s business relationships.

- **Completeness:** It is important to ensure that all GHG emission sources and activities within the chosen inventory boundary are accounted for in the inventory. Any specific exclusion should be clearly stated and justified.

- **Consistency:** The consistent application of accounting approaches, inventory boundaries, and calculation methodologies is essential to producing comparable GHG emissions data over time. Any changes to the data, inventory boundary, methods, or any other relevant factors in the time series should be clearly documented.

- **Transparency:** All data and information used to develop the GHG inventory should be well-documented and based on a clear audit trail. Any relevant assumptions and appropriate references to the accounting and calculation methodologies and data sources used should be documented.

- **Accuracy:** Data should be sufficiently precise to enable intended users to make decisions with reasonable assurance that the reported information is credible and accurate. The quantification of GHG emissions should be neither over- nor under-estimated, and uncertainties should be reduced as far as practicable.
Create a pipeline of “bankable” mitigation projects

The identification of “bankable” GHG mitigation projects is the most important and crucial step in the entire low-carbon transformation process in a zone. It is vital to ensure that there is interest in investing in those energy efficiency and GHG mitigation projects that will tangibly improve the energy and emission performance of the zone enterprises. The low-carbon transformation process, therefore, requires an emphasis on comprehensive evaluation of investment opportunities, based on their potential financial return as well as their GHG abatement potential and other social and economic development impacts. This exercise will result in a repository of well-defined low-carbon projects that can be pursued with enterprises, financial institutions, potential partners, and the international donor community.

Before beginning to identify possible GHG mitigation projects, it is important to get a good idea of how prepared different enterprises inside the zone are for low-carbon development, by looking at their basic awareness, willingness to invest, investment capacity, etc., and then cataloging the energy efficiency and clean technology initiatives that they have already implemented.

Often at this stage, a broader consultation process using group discussions, brainstorming sessions, or focus groups can be quite useful to understand historical activities, future plans of the enterprises and also the implementation challenges they have faced. This information can be gathered through face-to-face interviews or structured questionnaires (see Table 4).

Once the existing initiatives have been documented, new GHG mitigation opportunities may be identified. GHG-reduction opportunities primarily arise from energy-efficiency levers, which can be categorized as demand-side or supply-side measures.
Table 4: Typical questions for stakeholders regarding already implemented initiatives

- Which enterprise first implemented the project? Was it done voluntarily or in response to a government mandate?
- How much time was spent implementing the project?
- How much money was spent on the project? What were its financial returns?
- How was the project funded: self-financing, donor funding, or bank loans, etc.?
- What data on the impact of the project were collected?
- Which stakeholders benefited the most, and who lost out from the project?
- What were the challenges to implementation?
- How are the impacts of the project being monitored and recorded?
**Demand-side measures**

Many enterprises in economic zones are small and medium enterprises (SMEs), such as light manufacturing, chemical processing, garment, and textile industries, which typically employ simple processes. As such, improvements in energy efficiency represent a significant proportion of their GHG mitigation potential. An energy audit would identify major energy cost centers and GHG-intensive processes for each enterprise, and subsequently, the 80-20 rule can be applied to focus on the 20 percent of processes or equipment that consume 80 percent of total energy or emit 80 percent of GHG emissions.

Increases in the efficiency of high-energy-consuming equipment, such as boilers, compressors, and other machines/motors can be achieved either through retrofit measures or by complete replacement, resulting in reduced use of energy either in the form of electricity or other fuels.

There are two major categories of demand-side GHG mitigation measures: (i) energy efficiency retrofit/process improvement, including equipment modernization and (ii) industrial symbiosis. Enterprises can achieve a quick payback through these measures, which do not usually require complex technological applications, are quite common in industry and have established vendors who can help with implementation.

1. **Energy efficiency retrofit, renovations, and modification, including equipment modernization:** These measures range from incorporation of small changes within processes to complete replacement of existing equipment with modern technology. Energy efficiency retrofit opportunities are “quick-fix” solutions for zone enterprises, as they are less capital intensive, easier to implement, and do not involve any major process change. By contrast, energy efficiency renovation and modification measures involve relatively higher capital costs and medium-to-long payback periods. Unlike retrofit measures, renovation or modification may require a plant shutdown for several days.
Table 5 illustrates the demand-side measures that were identified in the Chittagong EPZ study. Most of these measures have a fairly rapid payback (less than five years) and low capital investment requirements, offering quick-win solutions for companies to significantly improve their bottom-line (through savings generated by reduced energy consumption) without affecting the quality of their products.

**Table 5: Demand-side measures for Chittagong Export Processing Zone**

<table>
<thead>
<tr>
<th>No.</th>
<th>Levers</th>
<th>Technology</th>
<th>Capex</th>
<th>Energy savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air optimization in boiler</td>
<td>Optimize combustion air to the boiler</td>
<td>~2,500 USD for an 8 TPH boiler</td>
<td>19 k Nm³ for an 8 TPH unit</td>
</tr>
<tr>
<td>2</td>
<td>Boiler FD fan RPM optimization</td>
<td>Optimize the RPM of the FD fan as per boiler loading</td>
<td>~ 1,300 USD for a 4.5 kW FD fan motor</td>
<td>1571 MWh (considering 40-50 boilers of capacity 2-to-10 TPH)</td>
</tr>
<tr>
<td>3</td>
<td>Compressed air recycling system</td>
<td>Recycle the compressed air</td>
<td>~13,000 USD for a 250 kW Compressor</td>
<td>351,859 kWh for a single compressor</td>
</tr>
<tr>
<td>4</td>
<td>Steam condensate recovery from bleaching/dryer units</td>
<td>Recover and reuse steam condensate from dryer and bleaching m/c</td>
<td>~ 25,500 USD for average 8 TPH boiler</td>
<td>0.15 million Nm³ of NG for 8 TPH</td>
</tr>
<tr>
<td>5</td>
<td>Heat insulation paint for can-dryer</td>
<td>Heat insulation with ceramic paint</td>
<td>~ 4,000 USD for painting</td>
<td>~ 0.12 million Nm³ of NG for a unit</td>
</tr>
<tr>
<td>6</td>
<td>Energy savings from steam-trap management</td>
<td>New bucket-type steam traps</td>
<td>~ 54,000 USD for a steam network of 18 TPH</td>
<td>~ 0.3 million Nm³ for 18 TPH</td>
</tr>
<tr>
<td>7</td>
<td>Waste-heat-recovery type pre-heater</td>
<td>A heat exchanger for preheating combustion air</td>
<td>~ 2,500 USD for 8 TPH</td>
<td>~ 34 k Nm³ for 8 TPH</td>
</tr>
<tr>
<td>8</td>
<td>High-efficiency inverter boiler</td>
<td>Replacing the existing fire tube boiler</td>
<td>~ 190,000 USD for a 30 TPH boiler</td>
<td>~ 0.6 million Nm³ for 30 TPH</td>
</tr>
<tr>
<td>9</td>
<td>Introduction of low-liquor ratio dyeing system</td>
<td>Reducing liquor ratio reduces energy requirement</td>
<td>~ 17,000 USD for each dyeing unit</td>
<td>~ 0.12 million Nm³ for 9 dyeing units</td>
</tr>
<tr>
<td>Payback</td>
<td>Implementation plan</td>
<td>Priority</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 3.60 years</td>
<td>The air optimization unit comes ready to install</td>
<td>□ Low savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Moderate payback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ No implementation challenge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 0.60 years</td>
<td>Boiler to be isolated from process for 4-6 hours</td>
<td>□ Moderate savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Low payback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ No implementation challenge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 0.60 years</td>
<td>Execution plan has to be aligned with plant annual shutdown</td>
<td>□ Moderate savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Low payback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ No implementation challenge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 2.20 years</td>
<td>Condenser recovery line can be laid without process stoppage</td>
<td>□ High savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Moderate payback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Condensate may be contaminated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 1.30 years</td>
<td>It can be implemented in a phased manner</td>
<td>□ Moderate savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Low payback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ No implementation challenge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 2.30 years</td>
<td>Implementation has to be planned during plant shutdown</td>
<td>□ Moderate savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Moderate payback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Plant shutdown required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 3.60 years</td>
<td>The preheated air comes prefabricated</td>
<td>□ Low savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Moderate payback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Plant shutdown required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 5.50 years</td>
<td>Planned in phased manner to minimize effect on production</td>
<td>□ Very high payback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Plant shutdown required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 10.20 years</td>
<td>It is to be done during plant annual shutdown</td>
<td>□ Very high payback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Plant shutdown required</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. **Industrial symbiosis**: Industrial symbiosis is a novel concept that provides simple but cost-effective solutions to resource efficiency and waste minimization within an EZ through an exchange of energy, waste and material resources between firms, so that the waste or excess material of one enterprise becomes the input to another’s production activities. This allows significant optimization and savings of energy and resources and vastly cuts down on the resource losses and environmental impact of the zone as a whole. Also, the waste material can be converted into valuable products that could find their own markets. Examples of industrial symbiosis opportunities include (i) creating a company-to-company industrial symbiosis network through a waste-heat-recovery steam generator, (ii) development of a solid waste collection, segregation, and recycling network, and (iii) a waste-water reclamation and reuse network involving the installation of microfiltration and purification equipment. Successful applications of industrial symbiosis have taken place in the Kalundborg eco-industrial park in Denmark (see Box 3) and the Ulsan eco-industrial park in South Korea.

**Box 3: Industrial symbiosis at Kalundborg Eco-Industrial Park**

Kalundborg Eco-Industrial Park, in Denmark, is perhaps the best example of the application of industrial symbiosis in an EZ. In addition to several companies that participate as recipients of materials or energy, the industrial symbiosis ecosystem comprises six main partners:

1. Asnaes – a power station;
2. Statoil – an oil refinery;
3. Novo Nordisk – a biotechnology company;
4. Gyproc – a Swedish company producing plasterboard for the building industry;
5. Bioteknisk Jordrens – a soil remediation company; and
6. The town of Kalundborg, which receives excess heat from Asnaes for its residential district heating system.

The primary resource exchanges include:

- **Water**: Statoil’s refinery supplies its purified wastewater, as well as its used cooling water, to Asnaes power station, thereby allowing this water to be used twice and saving an additional 1 million m$^3$ of water per year.

- **Steam**: Asnaes power station supplies steam to both Statoil and Novo Nordisk for heating of their processes. By functioning in a co-generation mode, the power station is able to increase its efficiency.

- **Gas**: Excess gas from the operations at the Statoil refinery is treated to remove sulfur, which is sold as a raw material for the manufacture of sulfuric acid, and the clean gas is then supplied to Asnaes power station and to Gyproc as an energy source.

- **Raw material (gypsum)**: Asnaes power station installed a desulfurization unit to remove sulfur from its flue gases, which allows it to produce calcium sulfate (gypsum). This is the main raw material in the manufacture of plasterboard at Gyproc. By purchasing synthetic “waste” gypsum from Asnaes power station, Gyproc has been able to replace the natural gypsum that it used to buy from Spain.

- **Fertilizer**: Novo Nordisk creates a large quantity of used biomass from its synthetic processes, and the company has realized that this can be used as a fertilizer, since it contains nitrogen, phosphorus, and potassium.

- **Heat**: Residual heat is provided by Asnaes power station to the district heating system of the town.
**Supply-side measures**

Supply-side projects can be implemented at the zone level, or first at the enterprise level and then scaled up to the zone level. Although these projects typically require higher capital investments and involve relatively complex technological applications, they also result in considerable GHG emissions reductions. Success of these large projects is dependent on skillful planning and project management. Policy reforms, such as higher electricity tariffs and fiscal incentives, can improve the commercial viability of these projects and accelerate implementation. Table 6 provides details on some possible supply-side measures that were identified for the Chittagong EPZ.

<table>
<thead>
<tr>
<th>No.</th>
<th>Levers</th>
<th>Technology</th>
<th>Capex</th>
<th>Energy savings/ energy generation potential</th>
</tr>
</thead>
</table>
| 1   | Cogeneration of steam from the exhaust gases of power generation company | Installation of HRSG at the outlet of the gas engines to generate steam | ~ 4.6 million USD for an 80 TPH cogen system with steam network | ▶ Generation of ~ 60 TPH of steam from waste energy  
▶ Savings potential of 44 million Nm³ of natural gas |
| 2   | Development of rooftop solar project | Installation of solar PV panels on the rooftops of the units within zone | ~ 1.9 million USD per MW of solar | ▶ Generating capacity of 10 MW  
▶ Generation of 17,099 MWh |
| 3   | Power generation through anaerobic digestion of wastewater | Wastewater treatment from the CETP in anaerobic digester to generate bio gas and subsequently power | ~9.21 million USD for 45,000 Nm³/day of wastewater treatment facility | ▶ Generating capacity of 2.7 MW |
| 4   | Replacement of current FTL lighting with LED | Replacement of 36W FTL with 22W LED, thereby reducing the lighting load | ~ 15 USD per LED | ▶ 27,831 MWh estimated electrical energy savings |
## Table 6: Supply-side energy efficiency measures for Chittagong Export Processing Zone

<table>
<thead>
<tr>
<th>No.</th>
<th>Levers</th>
<th>Technology</th>
<th>Capex</th>
<th>Energy savings/energy generation potential</th>
<th>Return on investment</th>
<th>Implementation plan</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Cogeneration of steam from the exhaust gases of power generation company</td>
<td>Installation of HRSG at the outlet of the gas engines to generate steam</td>
<td>~ 4.6 million USD for an 80 TPH cogen system with steam network</td>
<td>Generation of ~ 60 TPH of steam from waste energy</td>
<td>Savings potential of 44 million Nm³ of natural gas</td>
<td>IRR has been estimated to be 19.40%</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Development of rooftop solar project</td>
<td>Installation of solar PV panels on the rooftops of the units within zone</td>
<td>~ 1.9 million USD per MW of solar generating capacity</td>
<td>Generating capacity of 10 MW</td>
<td>Generation of 17,099 MWh</td>
<td>IRR has been estimated to be 4.13%</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Power generation through anaerobic digestion of wastewater</td>
<td>Wastewater treatment from the CETP in anaerobic digester to generate bio gas and subsequently power</td>
<td>~9.21 million USD for 45,000 Nm³/day of wastewater treatment facility</td>
<td>Generating capacity of 2.7 MW</td>
<td>Utilization of the wastewater from CETP to generate bio-gas</td>
<td>IRR has been estimated to be 13.27%</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Replacement of current FTL lighting with LED</td>
<td>Replacement of 36W FTL with 22W LED, thereby reducing the lighting load</td>
<td>~ 15 USD per LED</td>
<td>Estimated electrical energy savings of 27,831 MWh</td>
<td>Lumen for the lighting has been considered to be the same</td>
<td>Payback estimated at 3.18 years</td>
</tr>
</tbody>
</table>
Cogeneration of electricity and steam can significantly improve efficiency and reduce GHG emissions from an energy supply system. The independent power producer at Dhaka EPZ recently received approval from the Bangladesh Export Processing Zone Authority to generate and supply steam to its subsidiary firms within the zone. The steam will be produced by recovering waste gas from the electricity generation process and transferring it to the subsidiary firms. This will allow those firms to eliminate their respective steam generation systems and thus avoid burning fuel and producing GHG emissions.
Establish the business case for the identified opportunities and prioritize the mitigation projects

Once a set of potential low-carbon projects has been identified, each project should be assessed using the following parameters, to evaluate its viability and potential impact and allow planners to identify priorities for investments of time, money, and equipment. All of these analyses should be performed based on the current energy profile of the zone and current energy prices, including for electricity and other fossil fuels:

▶ **Rationale of the measure in the context of the zone:** How the project will address the technical gaps and inefficiencies identified during the energy audit.

▶ **Technical modifications:** The exact technical details and specifications for the project, including the required installations, process of operation, and related control systems and mechanisms.

▶ **Uniqueness of the project:** The potential replicability and scalability of the project, including any technical peculiarities or boundary conditions that may be necessary for implementation.

▶ **Energy and GHG savings potential:** The direct GHG emissions reduction, based on avoided energy consumption due to improved efficiency or the use of clean energy inputs. One or more technical assumptions may be required, for example the number of hours of operation, number of instances of project implementation, etc. This data can be based on existing systems or standard engineering assumptions.

▶ **Target industry:** The identified sectors where this project can be successfully implemented.

▶ **Equipment supplier:** Potential suppliers for the equipment required for the measure.

▶ **Implementation barriers and plans:** Expected barriers to implementation of the measure and a tentative implementation plan. Large capex investments will typically require a shutdown of operations.
In addition, a thorough financial analysis of each proposed project will be necessary to demonstrate its financial feasibility, explore avenues for sourcing investment funds and, ultimately, determine whether it should be a priority for low-carbon development moving forward. This analysis should look at required capital investment expenditure, as well as operational expenses, such as fuel cost, repair and maintenance costs, or human resources expenses, for the proposed project. In addition, it should evaluate expected revenue from the project, including both avoided costs resulting from reduced energy consumption and any revenue that might be earned from selling a direct output of the project, such as power from a renewable energy (RE) project. Finally, the evaluation should examine financial incentives that might accrue to the project as incremental revenue; these may take the form of a fiscal measure like a feed-in-tariff for RE power or a capital/tax subsidy on energy efficient investments.
STEP 3: SET TARGETS FOR GHG MITIGATION FOR THE ECONOMIC ZONE

Setting a credible GHG emissions reduction target provides an incentive for the enterprises in an EZ to take action to reduce their emissions, in turn allowing zone authorities and operators to promote their country’s EZs as low-carbon zones. A credible and accepted target will also make it easier for the zone authority or developer to measure progress toward achieving the GHG emissions reduction goals.

- Establish different emissions scenarios
- Set the target GHG reduction based on the timeline
- Develop consensus around the possible target and its achievement

Establish different emissions scenarios

Target setting should consider how the energy consumption, and hence GHG emissions, of the zone might evolve under different scenarios. GHG emissions should be estimated for the zone for the latest year and then projected for another 10 years into the future, for both a business-as-usual (BAU) scenario and a low-carbon scenario. In order to verify the results, computation of the BAU scenario should be completed using both a top-down approach (GHG emissions are estimated based on total fossil fuel and electricity consumed in the zone) and a bottom-up approach (fossil fuel and electricity consumption of each enterprise is collected and added up to arrive at GHG emissions).

For the low-carbon scenario, mitigation of emissions using different identified opportunities is estimated, to draw a predicted emissions trajectory for the future. A more aggressive low-carbon scenario may also be drawn up, assuming higher levels
Many economic zones have set targets for GHG emissions reduction, either based on business-as-usual (BAU) projections of GHG emissions or GHG emissions of a specified base year. The Incheon Free Trade Zone in South Korea has a target to reduce GHG emissions by 30 percent of the BAU projection for 2020, while Jilin EZ in China has a GHG emissions reduction target of 37 percent compared to the BAU projection for 2030. EZs in Belgium have a target to reduce 20 percent of GHG emissions (below the 1990 level) by 2020, while Falta EZ in India has a target to reduce GHG emission intensity by 20 percent in 2020 from 2005 levels.
of adoption of GHG abatement opportunities within the zone. In building each of these scenarios, the zone authority or developer has to remain conscious of the national targets on GHG mitigation and how they can have a bearing on the future performance of the companies within the EZs.

**Set the target GHG reduction based on the timeline**

A zone-wide GHG mitigation target should be based on a realistic set of low-carbon opportunities, as identified in the previous steps (see Box 5). The target can be considered voluntary for the first few years, before it becomes mandatory for the zone enterprises. Providing this initial voluntary target period will allow the zone enterprises to gradually build up their strategy and action plans for low-carbon measures and, once they start realizing the benefits, it will be easier to introduce mandatory targets. This gradual transition will also ensure that investors do not feel discouraged at the prospect of higher costs to meet the low-carbon targets.

It is important to set realistic and viable zone-wide targets that are also meaningful to stakeholders. Although the level of detail contained in an established target will vary, all successful plans rely on measurable targets. For the first draft of an energy and emissions plan, targets should be overarching (applicable to broader sectors rather than specific projects) until more is understood about the potential opportunities and constraints in each sector.

Figure 9 shows an example of different GHG emissions scenarios for a zone. The BAU scenario shows the emissions trajectory under the business-as-usual case, including the addition of new enterprises in the zone. Low-carbon scenario-1 gives the emissions trajectory once certain low-carbon technologies are adopted by the enterprises and the zone authorities have introduced low-carbon zone policies. There could be several such low-carbon scenarios. The aggressive low-carbon scenario in this example would include extensive adoption of low-carbon technologies and several policy/regulatory enablers, as well as financing schemes, such as fiscal incentives or grant schemes, being implemented by the zone/national authorities.
Figure 9: Potential GHG emissions scenarios for a zone

Notes:
(1) The “trigger point” is the year when implementation of GHG mitigation initiatives begins. Based on the awareness level within the zone and ongoing activities, a minimum of six months to one year could be required to plan mitigation initiatives in any zone.
(2) The gestation period, which may vary from one-to-three years, begins at the trigger point. At the end of the gestation period, the GHG mitigation technologies come into effect.

The zone authority or developer should clearly assess the costs and benefits of any GHG mitigation targets. While enterprises will be more concerned with the direct financial costs and returns, the zone authority or developer should take a broader view. The latter should consider the long-term economic and environmental benefits in light of the capital invested in providing infrastructure and institutional support to the enterprises and deploying appropriately trained manpower to monitor the progress. A complete picture of the economic benefits of an LCZ will include co-benefits, such as increased productivity, skill development, additional job creation, ambient air quality improvement, etc.
Develop consensus around the possible target and its achievement

Without stakeholder support, low-carbon transformation initiatives will be very difficult to implement. Internal and external stakeholders, including national authorities, government departments, enterprises, and other stakeholders (such as investors in the zone) should be consulted in the finalization of the GHG emissions reduction target, and the low-carbon zone policy direction communicated in a consistent manner. It is very important for all relevant government or zone departments and agencies to buy into the low-carbon zone initiative, and they should be made aware of related guidelines and invited to participate in capacity-building workshops. All private sector stakeholders, including investors, suppliers, and NGOs, should also be consistently made aware of the LCZ messages. A strong and consistent communications program will also help enhance the zone’s image of responsible citizenship to global investors and mobilize responsible investment into the zone.

Communications and awareness-raising can be facilitated by including LCZ guidelines as an annex to all new environment-related zone permits/clearances and in other media, such as zone websites or brochures. Zones can compete for international zone rankings, such as in FDI Magazine or The Financial Times, and individual enterprises can be encouraged to participate in voluntary GHG emissions disclosure programs. The progress of LCZ initiatives might also be presented at international conferences (e.g., UNFCCC conference, world EZ conference, UNIDO EE conference, etc.).
Box 6: Low-carbon development in Jilin Industrial City

The low-carbon development process of industrial establishments in Jilin, China, is a good example of the development of scenarios for GHG abatement potential – a key step toward setting a GHG reduction target over a specific time period. In a detailed assessment undertaken by Energy Research Institute (ERI), in collaboration with Jilin University, three scenarios were drawn up, showing energy consumption and related CO₂ emissions through 2030. These scenarios show how, with the help of state-of-the-art technologies, Jilin City can reorient itself away from a business-as-usual (BAU) trajectory toward a low-carbon pathway. The scenarios also demonstrate the technical feasibility and investment affordability of a shift to a low-carbon economy in Jilin City. Scenario analysis can be a valuable tool for analyzing the effect of a combination of policies on energy and emissions.

Within the scenario analysis, more than 400 existing and potential future technologies were considered, on both the demand and supply sides. By adjusting assumptions about the development and deployment of these technologies, three scenarios were developed, as depicted in table and graph below.

The findings clearly suggest that low-carbon and energy-saving policies could dramatically improve Jilin City’s emissions situation – to such a degree that emissions for Jilin City could peak in about 2020 and decline to 60 percent of the business-as-usual scenario by 2030.
### Scenarios for GHG abatement in Jilin City

<table>
<thead>
<tr>
<th>BAU Scenario</th>
<th>Based on the current economic development pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Includes current policy commitments on energy intensity and other key areas</td>
</tr>
<tr>
<td></td>
<td>Assumes that no further policies are introduced</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Policy Scenario</th>
<th>Captures the effect of additional energy-saving measures, renewable energy promotion and pollution reduction (driven by policy, investment, and energy expenditure)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drivers are:</td>
</tr>
<tr>
<td></td>
<td>▶ Adjustment of economic structure</td>
</tr>
<tr>
<td></td>
<td>▶ Deployment of energy-saving technology.</td>
</tr>
<tr>
<td></td>
<td>▶ Excellence in heavy industry through achievement of advanced country performance benchmarks of cleaner and more efficient production by 2020</td>
</tr>
<tr>
<td></td>
<td>▶ New buildings reach the energy-saving standard</td>
</tr>
<tr>
<td></td>
<td>▶ Rapid deployment of renewable energy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low-Carbon Scenario</th>
<th>All of the above policy scenario measures are included</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Further efforts are made to decarbonize the energy system, including:</td>
</tr>
<tr>
<td></td>
<td>▶ Faster penetration of renewables and nuclear power</td>
</tr>
<tr>
<td></td>
<td>▶ Rapid introduction and scale-up of carbon capture and storage (CCS)</td>
</tr>
</tbody>
</table>

### Emissions scenarios for Jilin City (carbon emissions from energy), 2006–2030

![Graph showing emissions scenarios for Jilin City]
STEP 4: PLANNING AND IMPLEMENTATION

All stakeholders have important roles to play in the low-carbon transformation of an EZ. The zone authority or government can encourage low-carbon projects, while the actual planning and implementation of the low-carbon zone initiatives engages many different types of stakeholders, with the zone’s companies as the primary actors.

This section focuses on the steps that zone enterprises must take to implement low-carbon projects, including systematic development of a detailed plan, identification of financing measures, and, finally, roll out of low-carbon projects. The roles of the zone authority or developer and the government, including institutional reform and policy development, will be discussed in more detail in the next chapter. The steps discussed in this chapter are, by and large, operational activities that a particular EZ, its authority and enterprises included, needs to employ to transition toward an LCZ. However, low-carbon policies and institutions can rarely be dealt with in such isolation. They have to necessarily function and be implemented at a more national level, so that they will influence all LCZ initiatives within the country. These broader policy and institutional factors will be discussed in more detail in the next chapter.

SUBSTEPS

- Develop a detailed plan for project implementation
- Identify financing mechanisms
- Roll out projects
Box 7: Low-carbon projects at Chittagong Export Processing Zone

During the low-carbon transition of the Chittagong EPZ, several enterprises adopted low-carbon initiatives, for example:

- A footwear manufacturing enterprise installed 4-watt LED bulbs at the needle point of 30,000 sewing machines, instead of the less energy efficient and more GHG emitting T-5 lamps. As a result, the enterprise is realizing an annual energy savings of 2.3 GWh and avoiding 1,724 tCO2 of GHG emissions.

- A terry towel manufacturing enterprise installed a condensate recovery pump to increase the energy efficiency of three of its boilers. Condensate recovery allows the enterprise to heat the feed water to the boilers and thereby reduce gas consumption by the boiler itself. The enterprise is realizing an annual energy savings of 7.9 GWh and avoiding 1,603 tCO2 of emissions.

- The independent power producer at the zone is considering the installation of waste heat recovery systems to cogenerate steam along with electricity. It is expected that the enterprise will be able generate 25TPH of steam while reducing annual energy consumption by 87 GWh and avoiding 17,670 tCO2 of annual emissions.
Develop a detailed plan for project implementation

For each of the priority projects identified earlier in the process, the interested EZ companies should develop a detailed plan for project implementation, carefully considering the following factors:

- **Alignment with the LCZ strategy**: From the outset, each project should be aligned to the zone’s GHG emissions mitigation strategy, to help contribute to the overall target.

- **Project content**: A conceptual design and feasibility study should be undertaken to cover major technical characteristics of the project, including detailed cost-benefit assessment of capital costs, operations and maintenance costs, savings or revenue estimation, and the financial and economic return from the project. The study should also specify the resource requirements.

- **Scheduling**: The feasibility study should assess any need for plant shutdown (complete or partial) to implement the new GHG mitigation project. If a shutdown is required for several days, it can be scheduled during annual plant maintenance.

- **Technology and vendor selection**: It is important to select the right technology and vendor for each project, based on cost and experiences in similar regions and industries. Especially when an enterprise is doing this exercise for the first time, it is advisable to appoint an experienced consultant who can develop an implementation plan and make connections with the appropriate vendors.

- **Financing needs**: Once the total project costs are estimated, the enterprises should determine whether the financing needs can be met through their own equity, or if external funds will also be required.

- **Training and manpower needs**: The most cost-effective available training (including workshops for key staff, training programs for energy services, and donor-funded capacity-building activities) should be identified. Key staff may also need one-on-one training from experts who have implemented
similar projects. Staff may attend relevant conferences or go on trips to learn about similar projects in the region. In-house training also provides an opportunity for zone authority staff from different offices to network, serving as a platform for future collaboration. In addition, the minimum number of staff required to implement and operate the new projects should be determined. Keeping staffing costs low is critical to minimizing project overhead. Provision for hiring of new staff with special energy programming or sector experience is another way to build capacity.

### Identify financing mechanisms

There is growing interest among financial institutions (FIs) and the international donor community in supporting sustainable and energy-efficient infrastructure, processes, and practices within economic zones and industrial clusters. However, there are challenges in successfully mobilizing financial resources for such activities, including:

- defining an achievable goal;
- identifying a well-vetted set of bankable projects that can be readily communicated to potential investors;
- ensuring adequate capacity of the zone authority and the enterprises to execute and oversee implementation; and
- designing metrics to measure performance.

Financial institutions often tend to shy away from extending debt-capital to low-carbon investors, because they are unfamiliar with the related concepts and technologies. It is, therefore, important that project developers help officials from banks and FIs to clearly understand both the value and expected return of low-carbon investments.

In many developing countries, international donors are working with the countries’ central banks or other FIs to develop criteria and guidelines for lending on green projects. Once such criteria are integrated into the investment appraisal and decision-making framework of banks and FIs, mobilization of funds for low-carbon
projects is much easier. In some countries donors have also established a dedicated credit line and mobilized concessionary funds through a local bank, thereby reducing the initial burden on the lending institutions.

Along with capacity building of FIs and rationalization of energy prices, introduction of appropriate financing mechanisms is also vital for mobilizing financial resources toward implementation of many of the identified GHG mitigation projects. A detailed review of existing and new sources of financing should be completed. Potential financing mechanisms for promoting energy-efficiency projects can be broadly classified into two categories: fiscal-incentive-driven financing and market-based financing (see Table 7). These financial mechanisms can be further classified according to their ability to finance specific types of GHG mitigation projects (see Table 8).

### Table 7: Typical financing mechanisms for low-carbon development

<table>
<thead>
<tr>
<th>Category of Financing</th>
<th>Specific Financial Instruments</th>
</tr>
</thead>
</table>
| **Fiscal-incentive-driven financing** | Preferential tariff for renewable energy technologies  
Capital subsidy on equipment/goods related to energy efficiency and renewable energy  
Creation of government funds to promote climate change mitigation and energy conservation investments |
| **Market-based financing** | Debt financing by banks for energy efficiency and renewable energy projects categorized as priority sectors. Further debt schemes such as refinancing or soft loans can be catalysts to such financing opportunities.  
Equity financing in energy efficiency and renewable energy projects, pooling the funds from private equity investors, some SPVs, etc.  
Performance-based incentives that grant access to finance based on the energy performance achieved  
Creation of a consortium of investors to invest specifically in energy-efficient technologies or renewable energy technologies. The members of the consortium may be banks, government bodies, vendors, other financial institutions, ESCOs, etc.  
Clean Development Mechanism (CDM) financing, through the Kyoto Protocol of the UN Framework Convention on Climate Change, can potentially improve the viability of some of the less financially attractive GHG mitigation projects. |
### Table 8: Financing mechanisms for different GHG mitigation options

<table>
<thead>
<tr>
<th>GHG mitigation options</th>
<th>Financial viability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficiency retrofit</td>
<td>Average payback period of zero-to-five years</td>
</tr>
</tbody>
</table>
| ▶ Air optimization in boiler  
▶ Boiler FD fan RPM optimization  
▶ Compressed air recycling system  
▶ Steam condensate recovery from bleaching/dryer units  
▶ Heat insulation paint for can-dryer  
▶ Energy savings from steam trap management  
▶ Waste heat recovery type pre-heater | |
| Energy efficiency retrofit and modification | Average payback period of five-to-10 years |
| ▶ High-efficiency inverter boiler  
▶ Introduction of low-liquor ratio dyeing system | |
| Cogeneration/heat recovery steam generation and distribution | Typical IRR of 18-20 percent |
| Solar PV/solar street lighting | Typical IRR of four-to-five percent |
| LED lighting | Average payback period of three-to-four years |
| Sludge-based power generation in ETP | Average IRR of 13-to-14 percent |
### Key instruments

- Can mostly be funded through internal accruals of the enterprise
- Banks can furnish loans for energy efficiency projects as:
  - i) part of their normal corporate lending;
  - ii) part of green financing or sustainable financing schemes;
  - iii) an SPV or consortium to furnish loans or guarantees for financing, formed by public/private banks;
  - iv) funding and non-financial assistance from Development Banks;
  - v) refinancing schemes of banks; and
  - vi) energy efficiency vendor financing for energy efficiency industrial products such as motors, pumps, compressors etc.
- Debt-equity funding by banks
- Soft loans by Development Banks
- Cogeneration tariff to be set at an optimal level so that it gives a reasonable ROI to the investors
- CDM financing
- IRR can be increased with introduction of preferential tariff or feed-in tariff for solar power
- Funding for solar street lighting can come entirely from zone authorities (can engage vendor on BOT basis)
- This being a high capex project, zone authorities or developers can implement one demonstration project, leveraging a government subsidy (capital subsidy)/donor grant/bilateral line of credit, CDM financing, etc.
- Zone authorities can secure funding from the central bank’s sustainable fund for such projects
- Capital subsidy given by government so that cost of LED bulbs are lower than prevailing market prices
- Vendor finance
- Zone authorities can bring down cost by facilitating centralized procurement
- Preferential tariff may be given to improve the IRR
- Capital subsidy given by government for procurement of anaerobic digester system
Zone authorities, in turn, can act as potential matchmakers, by helping the EZ enterprises develop low-carbon project proposals to leverage appropriate financial mechanisms and connect to prospective FIs. It is also recommended that in collaboration with the zone authority.¹⁷

A substantial amount of financial resources are required in the initial phases of LCZ development. These resources should be deployed first to carry out a pilot exercise that will involve appointing consultants or expert organizations to conduct a zone-wide study and identify potential improvement areas. Significant funds should be dedicated to awareness-raising and capacity-building initiatives for the zone authority, as well as for the zone enterprises.

Roll out projects

This final part of the planning and implementation step involves rolling out projects once they have been identified and developed. This is the last stage in the implementation phase and may require months or years to accomplish, particularly for a major project. Both manpower resources and time are necessary to undertake new projects.

¹⁷ Bank officials may refer to manuals and guidelines published by multilateral agencies such as the EBRD.
Box 8: Energy service company financing for energy efficiency projects

Energy service companies (ESCOs) develop, implement, and provide or arrange upfront financing for energy efficiency investments by their clients. The fundamental concept of the ESCO business model is that the client does not have to come up with any upfront capital investment and is only responsible for repaying the investment made or arranged by the ESCO.

Among the two dominant structures of ESCO financing, the most relevant and frequently used in developing countries is the shared-savings model. In a shared-savings model, the ESCO finances the total upfront capital cost of the project and is responsible for repaying the lender. The client pays the ESCO a percentage (or it can be a fixed amount) of its achieved savings from the project, large enough for the ESCO to repay the project investment to its lenders, and to cover monitoring and verification costs and any other associated costs. The energy end-user assumes no direct contractual obligation to repay the lender; only the ESCO has this obligation.

Vietnam has had some initial success with ESCO financing mechanisms. Viet ESCO, established in 2012, has been negotiating energy efficiency solutions for many businesses from different sectors, including hotels, public lighting systems, and factories. These solutions help businesses reduce their energy costs by 15-30 percent, while the related investment capital can be recovered within two-to-three years. Viet ESCO has succeeded with financial assistance from the International Finance Corporation (IFC), Vietnam Joint Stock Commercial Bank for Industry and Trade (Vietinbank), and the Dragon Capital Group, as well as cooperation from many businesses.

STEP 5: MONITORING AND REPORTING

Regular monitoring of the progress of enterprises to reduce their GHG emissions is critical to the success of the transformation process. Different levels of management at the enterprises should work together to collect various levels of data and understand what the data are revealing about the projects’ successes and challenges. Using this data and feedback from industry stakeholders, a zone can evaluate the progress of its program and decide on a communications strategy to report to its various stakeholders and interested parties.

- Develop a GHG monitoring and tracking tool
- Collect information from enterprises and projects
- Develop a stakeholder reporting structure and publish/circulate report

Develop a GHG monitoring and tracking tool

Each zone should develop its own specific key performance indicators (KPIs) and monitoring framework to evaluate the success of its transition to an LCZ. Table 9 gives some examples of potential indicators and how they can be interpreted.

A number of factors may contribute to inherent uncertainties in the GHG footprint estimation, including:

- completeness of the inventory and any source exclusions that may make a significant impact on the overall reported data;
- a change in energy mix in the national grid;
- accuracy of the methodology used to quantify emissions;
uncertainties in the underlying data, such as instrument accuracy based on calibrations and performance checks; and

potential weaknesses in the data management systems in place to control the quality of the data throughout the collection, reporting, and management processes.

Table 9: Examples of key performance indicators

<table>
<thead>
<tr>
<th>Issue</th>
<th>Available indicators</th>
<th>Interpretation of the KPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG emissions</td>
<td>CO₂ emission intensity (measured as ratio of CO₂eq emissions and export value or volume from the zone)</td>
<td>A decrease in the value of GHG emission intensity would indicate less energy consumed for the same amount of goods or products manufactured and processed.</td>
</tr>
<tr>
<td>Air quality</td>
<td>SO₂ and NOₓ emissions intensity</td>
<td>An overall improvement in the air quality would be associated with a decrease in GHG emission intensity.</td>
</tr>
<tr>
<td>Waste recycling</td>
<td>Ratio of waste recycled to total waste generated</td>
<td>More waste recycling would indicate a lower amount of waste disposed of in landfills.</td>
</tr>
<tr>
<td>Solid waste generation</td>
<td>Increase in waste generation rate</td>
<td>A decreasing level of waste generation indicates higher industrial symbiosis and recycling.</td>
</tr>
<tr>
<td>Water recycling&lt;sup&gt;19&lt;/sup&gt;</td>
<td>Ratio of water recycled to water consumed</td>
<td>A higher recycling ratio indicates less consumption of fresh water, and thus increased conservation of freshwater resources.</td>
</tr>
</tbody>
</table>

<sup>19</sup> This indicator is more appropriate for water-scarce regions.
In general, an effective quality management system can help to address these factors and improve the reliability and accuracy of the reported data. Figure 10 illustrates a potential structure for internal GHG verification that can help ensure the reliability of GHG reporting.

**Figure 10: GHG monitoring and reporting structure**

- **Overall Infrastructure**
  - There should be clear roles and responsibilities for the accounting and reporting of GHG emissions at the operation and corporate levels of the enterprises.
  - Compliance with the method adopted in GHG footprint of the base year, and its consistent implementation across the enterprise, should be assessed periodically by internal audits and technical reviews.

- **Unit-Level Controls**
  - Each enterprise within the zone should maintain the copy of the data inputs in the format as used in the base year (for example, fuel & electricity consumption, production, etc.)
  - Confirm that the meters for monitoring the key data sources, such as energy consumption or fuel flow rate, are calibrated on a regular basis.

- **Corporate-Level Controls**
  - Check that assumptions and criteria for selection of methods, activity data, emission factors, and other parameters are documented.
  - Detailed review of the monitoring and archiving procedure.
  - Review GHG performance of the current reporting period against past performance and forecasts.
Collect information from enterprises and projects

In order to furnish quality data and information for the GHG monitoring and tracking tool, each enterprise should have a governance structure in place that includes several levels of personnel in the company (see Table 10).

**Table 10: Organizational responsibilities for GHG monitoring and verification**

<table>
<thead>
<tr>
<th>Monitoring and verification steps</th>
<th>Key activities</th>
<th>Responsible entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting and reporting guidelines</td>
<td>Identification of key principles and standards of reporting followed; and reporting frequency and period</td>
<td>Corporate level</td>
</tr>
<tr>
<td>Organizational boundary considerations</td>
<td>Identification of sites/entities reportable for GHG footprint; and whether GHG emissions should be aggregated at the facility, business unit or corporate level</td>
<td>Corporate level in consultation with middle management</td>
</tr>
<tr>
<td>Operational boundary considerations</td>
<td>Identification of processes relevant to GHG reporting within each site/entity</td>
<td>Middle management in consultation with unit-level head</td>
</tr>
<tr>
<td>Emissions estimation methodologies</td>
<td>Process-wise determination of mass and energy balance and structuring of GHG footprint methodology</td>
<td>Middle management in consultation with unit-level head</td>
</tr>
<tr>
<td>Review of the GHG footprint</td>
<td>Review of present level of GHG footprint vs. base-year level; Identification of uncertainties in GHG reporting</td>
<td>Corporate level in consultation with middle management</td>
</tr>
</tbody>
</table>
Develop a stakeholder reporting structure and publish/circulate report

A stakeholder reporting framework is a useful tool, involving both internal and external stakeholders.

To reach external stakeholders, the zone authorities can:

- regularly update the website on various low-carbon initiatives taken and publish the improvements in the KPIs;
- include a default message in all email signatures stating that the zone is a pioneer in low-carbon initiatives; and
- send periodic newsletters to potential investors and consumers.

To inform internal stakeholders, the zone authorities can:

- design screensavers communicating climate awareness and low-carbon initiatives being taken within the zone;
- send e-mails advising enterprises to reduce their carbon footprint and improve their climate awareness;
- hold regular green quiz or creative competitions involving climate change;
- promote tree-planting group activities; and
- host competitions, get-togethers, discussions, etc. on climate-related topics on special days such as World Water Day (March 22), Earth Day (April 22), World Environment Day (June 5), etc.
Box 9: Planning and Designing a New LCZ and/or Sustainable Innovation Hub

While the majority of LCZs will likely be developed by transforming an existing economic zone, there will be some cases when new zones are developed as LCZs. The steps for developing a new LCZ would be very similar to those for transforming an existing zone to an LCZ. However, a new zone has the advantage that low-carbon practices and resource-efficiency features can be incorporated into land-use planning and design considerations from the start, rather than retroactively. Table 11 compares the process for developing a new LCZ to that of transforming an existing EZ.

Several additional considerations should be kept in mind during the land-use planning for a new LCZ, and integrated into the overall EZ policy framework, including:

- No LCZs should be planned in sensitive areas, such as forests, mangroves, coral reefs, archeologically important sites, sensitive ecosystems, etc.
- While planning the new LCZs, care should be taken to ensure that the enterprises falling in the hazardous category are sited at least a minimum stipulated distance from the nearest boundary of any ecologically sensitive areas.
- Layout and use should maximize potential for industrial symbiosis opportunities among the zone’s enterprises.
- New LCZs should provide a common area to collect and store recyclable waste.
- Green areas should be considered in open areas that are not reserved for development of units or infrastructure.
- LCZs with industrial installations with effluent and hazardous waste potential should include a common effluent treatment plant (CEPT) and a hazardous waste treatment, storage and disposal facility (TSDF) as an integral part of the zone proposal.
Table 11: Comparing steps for LCZ development

<table>
<thead>
<tr>
<th>Steps</th>
<th>Transforming an existing EZ to an LCZ</th>
<th>Developing a new LCZ</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Secure commitment</strong></td>
<td>Aims to bring all relevant stakeholders on board to drive consensus and craft a unified vision for low-carbon development of already operating enterprises in the existing zone</td>
<td>Aims to bring on board the political leadership of the country, along with the relevant ministries, to formulate a unified vision for low-carbon industrial development and translate this vision into a national policy for EZ design and development</td>
</tr>
</tbody>
</table>
| **Technical diagnostics** | Typically employs mechanisms such as GHG accounting and energy audits and surveys of existing industrial establishments within the zone, to establish baselines, identify gaps and recommend low-carbon investment opportunities | ▶ Assess low-carbon resource availability, for example the potential for generating and/or sourcing renewable power in the new EZ  
▶ Incorporate low-carbon considerations into industry and technology selection for the enterprises and utilities within the EZs – perform global benchmark studies for the same  
▶ Establish infrastructure and logistics to maximize the potential for industrial symbiosis opportunities  
▶ Incorporate GHG, energy, water, and waste management reporting within the overall framework for performance reporting  
▶ Select skilled employees with experience in operating sustainable industrial processes |
| **Set targets**         | A critical exercise that establishes a clear, time-bound goal for the LCZ initiative                  | GHG target setting is built into the design of the new EZ                              |
| **Planning & implementation** | Provides guidance to zone authorities and enterprises on implementing the identified low-carbon projects | Guiding principles should be articulated for both zone authorities and enterprises. In addition, planning of new industrial processes should be based on global best practices.          |
| **Monitoring & reporting** | Provides a framework for tracking progress of the zone against the stipulated objectives of low-carbon development | A new LCZ design should incorporate a robust monitoring and reporting framework from its inception |
2. CREATING AN ENABLING POLICY AND INSTITUTIONAL FRAMEWORK

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Step 4: Mainstream LCZ strategies in the national economic zone policy framework......101
Successful development of LCZs will require a broad policy and institutional framework at the national level that can accommodate various types of zones at different locations across a country, so that low-carbon industrialization becomes part of the wider economic and political strategy. There is a fundamental debate in public policy about whether economic zones promote country-wide economic policy reforms by serving as “demonstration areas” and catalysts of new development, or whether they instead act as “pressure valves” for unemployment, reducing the incentive to reform and diverting the direction of reform. A 1992 World Bank study raised serious concerns that EPZs could be used by developing countries to “muddle along without reforms,” and emphasized the need to use zones as a supplement to country-wide reform, rather than just creating isolated free market enclaves (World Bank 1992).

Because the overall national benefits of EPZs are low when zones are isolated from the domestic economy, it is important to ensure that the zones and their strategies are integrated with the local business community and supported by national policies and institutions. The same is true for LCZs. Sound policy on LCZs should both guide independent actions inside the zone and also help incubate policies and accelerate reforms in the national economy. LCZs can act as demonstration sites for best practices and catalysts for reform by introducing low-carbon development strategies into the economic, industrial, and trade policies of a country, while sustainable practices, knowledge, and technology can be transferred between zone-based enterprises and domestic firms outside the zone. In this way, countries can leverage low-carbon industrial growth as a major enabler to transform their domestic industries and clusters.

The national government has an important role to play in ensuring that low-carbon development strategies become part of the broader EZ policy framework. The government can introduce a mix of policy instruments, including fiscal incentives and mandates, that provide the signals for change. At the same time, the government should develop good practice guidelines for zone enterprises and establish institutions to promote and facilitate the implementation of projects and monitor results. The goal for government policy making should be to develop a comprehensive
policy framework that is conducive to low-carbon investment. This overall policy framework should include regulations that facilitate the entry, treatment, and protection of foreign investment in low-carbon areas, as well as sector-specific low-carbon related regulations that benefit industries both inside and outside the zones. For example, a policy designed to attract FDI in renewable energy creates opportunities to develop a dedicated zone for manufacturing renewable energy equipment and also provides avenues for investors to install and operate renewable energy power plants to run factories inside a zone.

Successful development of LCZs also requires strong market drivers for low-carbon products, services and technologies in the industrial sector. Policy instruments such as feed-in tariffs, renewable portfolio standards, blending mandates, mandatory energy performance standards (MEPS), and green public procurement guidelines can be used to build new business opportunities and create markets for low-carbon products and technologies.

A sound policy framework designed to achieve low-carbon objectives, coupled with an effective promotional effort, can enhance the value and attractiveness of the zones to investors, increase the competitiveness in the global marketplace of zone industries and attract leading global brands looking to increase the sustainability of their supply chains. The national or local Investment Promotion Agency (IPA) can use a green marketing strategy to attract foreign investors and create new low-carbon opportunities. Government policy should also encourage the sharing of technology and best practices between the foreign investment entity and the domestic firms to maximize the value of FDI in low-carbon development.

LCZs can also serve as testing grounds for new policy interventions to promote low-carbon development or improve the investment climate. Based on the success of such measures at the EZ level, policy makers can then choose whether to scale them up at the national level for the greater benefit of industries. In China, for example, the government experimented with market-oriented FDI, land, and tax policies in SEZs before extending them to all enterprises. SEZs in a number of Middle Eastern countries are being used to pilot dramatic liberalizations in foreign investment ownership policies. The same can be done with low-carbon policies.
STEP 1: REVIEW NATIONAL AND INTERNATIONAL POLICY FRAMEWORK FOR LOW-CARBON GROWTH

The LCZ development process requires an integrated policy development approach, both at the national and the zone level. Typically, most overarching environmental, energy, and climate change policies and regulations would already be in place at the national level, as part of the national sustainable development goals of a country. LCZs can develop zone-level policies, which should align with these national policies and regulations. Zone authorities and developers should work closely with national policy makers to coordinate activities, develop a mutual understanding of responsibilities and expectations and, where possible, align national and zone-specific goals. This will contribute to the advancement of zone-wide low-carbon development goals, and help the government to later mainstream the LCZ concept into the national EZ policies and also into the broader trade and industrial policy framework of the country.

Thus, in the preliminary stages of LCZ development, the zone authority or developer should engage in a systematic, in-depth review of existing national policies and frameworks, first to identify the current gaps and then to develop feasible zone-specific solutions that are acceptable to all stakeholders. In specific cases, the zone authority or developer can advocate with national policy makers for broader policy reforms that benefit the zones and also industries residing outside the zone.

Table 12 lists examples of the national policies and laws that a zone authority or developer would need to review before developing a specific LCZ guideline and policy framework or setting a GHG mitigation target for the zone. A thorough review of these policies will allow zone authorities and developers to develop a baseline policy scenario for EZ enterprise performance and a comprehensive understanding of the relevant policy issues that can influence low-carbon projects within the EZ.
Table 12: Review of national policies relevant to low-carbon development

<table>
<thead>
<tr>
<th>#</th>
<th>Policy Framework</th>
<th>Focus Area</th>
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<tbody>
<tr>
<td></td>
<td><strong>Policy framework governing energy performance</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Electricity and other energy regulation</td>
<td>▶ Overarching legal framework establishing definition and pricing of energy, and(guiding the behaviors of relevant authorities governing and participating in energy transactions)</td>
</tr>
<tr>
<td>2</td>
<td>Energy efficiency law and associated polices</td>
<td>▶ Framework for implementing energy performance standards across the country, including business enterprises within EZs ▶ Establishes the governing authority and sets standards for different categories of energy consumers</td>
</tr>
<tr>
<td>3</td>
<td>Minimum energy performance standards (MEPS)</td>
<td>▶ Generally implemented in conjunction with energy labeling program ▶ Guides or mandates energy consumers to move toward a more energy efficient future</td>
</tr>
<tr>
<td>4</td>
<td>Energy audit</td>
<td>▶ Represents the basic first step toward energy management ▶ Sets forth energy audit processes ▶ Certifies energy auditors ▶ May mandate periodic energy audits at select or all business enterprises</td>
</tr>
<tr>
<td>5</td>
<td>Standards &amp; labeling</td>
<td>▶ Extension of the overarching energy efficiency law ▶ Stipulates best-practices for improving energy and environmental performance of both appliances (e.g. lighting, fans, and air conditioning) and industrial equipment (e.g. boilers)</td>
</tr>
<tr>
<td></td>
<td><strong>Policy framework governing environmental performance</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>National pledges for GHG emission reduction</td>
<td>▶ Can be voluntary or mandatory ▶ Represents the minimum emission reduction standards for all business enterprises within the country</td>
</tr>
<tr>
<td>2</td>
<td>National environmental law and associated policies</td>
<td>▶ Sets the standards for management and discharge of waste, water, and other effluent from business enterprises</td>
</tr>
<tr>
<td></td>
<td><strong>Policy framework governing energy pricing</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Energy and resource tariff regulations</td>
<td>▶ Sets the tariff computation mechanism for energy and other resource transactions ▶ Allocates subsidies to select resources ▶ Introduces incentive mechanisms like feed-in-tariffs for renewable energy</td>
</tr>
<tr>
<td>2</td>
<td>Incentives and budgetary support</td>
<td>▶ Allocates capital subsidies or grants toward “promoted” industries or initiatives to improve competitiveness and overcome market failures</td>
</tr>
</tbody>
</table>
If any key policy gaps are identified, the zone authority may want to make additional policy recommendations and proposals at the national level. Because amendments in national policy or regulations take time, a first attempt should always be made to introduce LCZ policies within the legal framework laid out by the existing national EZ policy. However, if the existing frameworks fail to accommodate low-carbon development goals, broader reforms should be initiated. In either case, active consensus-building activities should be organized to bring on board relevant national stakeholders associated with the LCZ initiative. This will help to reduce resistance and smooth the approval process for the reforms.
Box 10: How the low-carbon transformation of Chittagong EPZ triggered national policy reform

During the Chittagong EPZ study, cogeneration of steam and electricity was identified as one of the most promising options for GHG mitigation in the zone. The initiative involved generation of steam from the waste gas of the power generation unit and then supplying it to other enterprises. However, neither the EPZ rules and regulations nor Bangladesh’s current energy regulations had legal provisions for commercial transactions involving the buying and selling of steam between two companies. After detailed consultation with the zone enterprises, BEPZA (the zone authority) approached the Bangladesh Energy Regulatory Commission and the Ministry of Power to develop a regulatory framework that provides incentives to scale up industrial cogeneration at the national level.
STEP 2: DEVELOP POLICY AND IMPLEMENTATION MECHANISMS

A zone-level policy that promotes industrial best practices for low-carbon development can address inefficiencies and loopholes identified in the existing national energy and environment policies and help to promote energy and environment regulations that are better aligned with global good practices.

Low-carbon policies should be evidence-based and have clear objectives. Concrete policy goals can be established using the results of the energy audit, GHG inventory, and baseline activities. Once the policies are identified, a governance framework should be established to track progress against these measures, using zone-level KPIs, and measure the impact of policies on low-carbon performance within the zone. (See Chapter 2, Step 5 for more on monitoring and reporting.)

Table 13 provides a set of guidelines for EZ policy makers on the components that make up an effective LCZ policy framework.
<table>
<thead>
<tr>
<th>Policy Items</th>
<th>Rationale</th>
</tr>
</thead>
</table>
| 1 Energy audit                                  | ‣ Allows enterprises to comprehensively map the energy consumption patterns across equipment and processes  
<p>|                                                 | ‣ Reveals inefficiencies and leakages                                                                               |
| 2 Enterprise-level GHG accounting               | ‣ Enables EZ enterprises to continually monitor performance against the emission reduction targets                   |
| 3 Minimum energy performance standards for equipment | ‣ Establishes an energy performance benchmark for each type of equipment deployed in operations within the EZs |
| 4 Minimum energy performance standards for enterprises | ‣ Helps to establish a clear target for specific energy consumption at an enterprise level                         |
| 5 Energy performance standards for steam systems such as boilers, pipelines, etc. | ‣ Comprises a significant source of energy consumption and GHG emissions, and hence efficiency improvements can potentially have sizeable impacts |</p>
<table>
<thead>
<tr>
<th><strong>Objective</strong></th>
<th><strong>Precondition</strong></th>
</tr>
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<tbody>
<tr>
<td>▶ An enterprise energy consumption limit needs to be stipulated (in electricity or steam load terms), beyond which all enterprises should be mandated to perform periodic energy audits and submit reports to relevant authorities (primarily, zone authorities).</td>
<td>Adequate national institutions should facilitate the promulgation of audit guidelines and certification of energy auditors. The certification process should effectively address the processes of accreditation and education to develop qualified energy auditors. ▶ In India, the Bureau of Energy Efficiency (BEE) certifies Energy Managers/Auditors. ▶ BEE has also has propagated the standardized guidelines for energy audits in India.</td>
</tr>
<tr>
<td>▶ EZ enterprises should quantify direct and indirect GHG emissions, at least scope 1 and scope 2 (please see the Toolbox for more details on GHG Emissions Accounting), on a periodic basis and strive to reduce them over time, in alignment with the zone-level emission reduction targets.</td>
<td>Zone authorities should circulate the standard GHG emissions accounting methodology, drawing on the principles established by WBCSD and WRI.</td>
</tr>
<tr>
<td>▶ EZ enterprises to be mandated to use only equipment that is above a minimum energy efficiency rating ▶ Equipment could include air conditioners, lighting fixtures, refrigerators, chillers, boilers, transformers, heaters, etc.</td>
<td>A comprehensive energy labeling program - In India, BEE runs the energy labeling program that qualifies energy consumption by equipment on a scale of 1 to 5 (1 being most energy-intensive and 5 being least).</td>
</tr>
<tr>
<td>▶ Set clear time-bound targets on specific energy consumptions ▶ Targets to be reasonable based on the expected trends of technological advancements and commercial feasibility</td>
<td>Comprehensive background energy audit and study is necessary to set enterprise-specific targets on energy consumption.</td>
</tr>
<tr>
<td>Beyond the MEPS for boilers, EZ enterprises should be mandated to; ▶ maintain periodic logs to monitor boiler operating performance, such as steam generation, fuel consumption, inlet air flow, exhaust gas temperature, etc.; ▶ carry out periodic boiler efficiency measurement (direct or indirect method) by relevant testing agency; and ▶ Minimize thermal losses and leakages from steam generation and distribution systems through application of insulation techniques.</td>
<td>A national institution, like a boiler inspectorate, needs to be designated to carry out standardized tests on boiler performance.</td>
</tr>
</tbody>
</table>
Table 13: Typical low-carbon policy items for an LCZ [continued]

<table>
<thead>
<tr>
<th>Policy Items</th>
<th>Rationale</th>
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</thead>
<tbody>
<tr>
<td>6 Minimization of energy loss through waste heat recovery</td>
<td>▶ Recovery and reapplication of its heat content before release of waste heat/gas can significantly reduce energy consumption in industries such as power generation.</td>
</tr>
<tr>
<td>7 Promotion of renewable energy</td>
<td>▶ Can entail a transformational reduction in GHG emissions</td>
</tr>
<tr>
<td>8 Reuse of CETP waste</td>
<td>▶ CETP waste can be effectively reused to promote improved waste management.</td>
</tr>
<tr>
<td>9 Waste management</td>
<td>▶ Promotes reuse, recycling, and reduction</td>
</tr>
<tr>
<td>10 Water management</td>
<td>▶ Reduces water withdrawal from groundwater and open sources</td>
</tr>
<tr>
<td><strong>Policy Items</strong></td>
<td><strong>Rationale</strong></td>
</tr>
<tr>
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<td></td>
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<tr>
<td>Promotion of renewable energy</td>
<td>Can entail a transformational reduction in GHG emissions</td>
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<td>Waste management</td>
<td>Promotes reuse, recycling, and reduction</td>
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</tr>
<tr>
<td>Water management</td>
<td>Reduces water withdrawal from groundwater and open sources</td>
</tr>
<tr>
<td></td>
<td>EZ enterprises should be mandated to:</td>
</tr>
<tr>
<td></td>
<td>▶ install water flow meters;</td>
</tr>
<tr>
<td></td>
<td>▶ perform periodic water footprint exercises to map operational water consumption across business processes;</td>
</tr>
<tr>
<td></td>
<td>▶ treat wastewater to standards that would allow it to be recycled for landscaping purposes;</td>
</tr>
<tr>
<td></td>
<td>▶ explore opportunities for rain water harvesting to reduce water withdrawal from external sources; and</td>
</tr>
<tr>
<td></td>
<td>▶ reduce specific water consumption by a stipulated amount over a certain time period.</td>
</tr>
</tbody>
</table>
Table 13: Typical low-carbon policy items for an LCZ  [continued]

<table>
<thead>
<tr>
<th></th>
<th>Policy Items</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Integration of industrial symbiosis considerations in EZ design standards</td>
<td>▶ Holds tremendous potential for resource efficiency in an EZ, as has been demonstrated in Kalundborg Eco-Industrial Park in Denmark (see Chapter 2)</td>
</tr>
<tr>
<td>12</td>
<td>100% compliance with national environmental laws and associated policies</td>
<td>▶ Often, compliance levels are low due to lack of capacity of pollution control bodies or other leakages in the system.</td>
</tr>
<tr>
<td>13</td>
<td>Rationalization of EZ management processes</td>
<td>▶ Extending adequate authority and autonomy to EZ authorities to effectively regulate enterprise performance within EZs</td>
</tr>
<tr>
<td>Objective</td>
<td>Precondition</td>
<td></td>
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</tr>
</tbody>
</table>
| Typical policy considerations should address:  
  ▶ detailed feasibility analysis of industrial symbiosis before development of an EZ;  
  ▶ contractual framework for commercial transaction of resources and energy between EZ enterprises;  
  ▶ transfer pricing guidelines on resource exchanges under industrial symbiosis;  
  ▶ demand-supply mapping between transaction parties, including standards and specification of resource and energy being transacted; and  
  ▶ dispute resolution for contractual non-performance. | Given that few countries would have an overarching legal framework for industrial symbiosis, most of the industrial symbiosis options need to be dealt with on a case-to-case basis. |
| All EZ enterprises should have to mandatorily comply with the national and sub-national pollution control standards. | A national framework on environmental management practices by business enterprises should be present. |
| EZ authorities will establish simplified processes for management of environment and energy performance of firms within EZs. | The national legal framework for EZs should vest sufficient capacity in zone authorities to build, implement, and monitor performance within EZs. |
Figure 11: Institutional framework to support LCZ development
STEP 3: CREATE AN INSTITUTIONAL FRAMEWORK TO SUPPORT AND IMPLEMENT LCZ POLICY

In most national programs, zone authorities have not yet effectively pursued low-carbon planning or management practices, and evidence shows that in the economic zones of developing countries, even basic environmental compliance is often not met. The planning, implementation, operation, management, and monitoring of low-carbon activities in an LCZ entail cross-sectoral and cross-functional activities and active communication and coordination among a diverse set of agencies and institutions, both at the national level and at the zone level (see Figure 11). This presents a governance and enforcement challenge that needs to be addressed through comprehensive institutional strengthening, development, and reform.

Successful development of LCZs will depend on the presence of a strong institutional ecosystem that not only includes the enterprises, zone developer, government departments, and ministerial bodies, but also the business service providers, engineers, consultants, operations and maintenance professionals, equipment suppliers, financiers, academic institutes, and vocational training centers. Since LCZ is a relatively new concept, the recruitment of skilled engineering professionals and consultants is vital for enhancing awareness among industries about low-carbon industrial practices and technologies and supporting them in actual implementation. Experienced consultants can share best practices, perform technical audits, develop project feasibility studies, and subsequently connect the interested enterprise with vendors, technology providers, and financiers. The concept of low-carbon industrialization is also increasingly a part of engineering curricula at universities and vocational training courses, meaning that new engineers and technicians will be familiar with the relevant ideas, tools and techniques.
Zone authorities, along with the relevant government ministry or ministries, are key to this process. They can help:

- create the necessary partnerships and linkages to advocate the right policies;
- enhance the investment climate;
- improve the zone’s overall image;
- target low-carbon investors; and
- provide services to develop a low-carbon business community.

To fully play this role, the zone authority will generally have to strengthen its governance framework either by improving its existing organizational structure or building new institutions.

**The Green Cell**

One way that the zone authority can designate dedicated resources for overseeing low-carbon development is by setting up a specialized body or “green cell” within the zone to champion low-carbon initiatives. The green cell, made up of technological experts, engineers and consultants, is charged with establishing the zone’s strategy for low-carbon transformation, including major actions and initiatives. A green cell formalized in legislation may strengthen its mandate to affect changes in the zone and lend credence to the coordination, governance and communication structures necessary to promote LCZs.

The green cell provides a platform for collaboration among zone enterprises and donors, equipment suppliers, NGOs, and civil society. It can evolve to become a one-stop service center that will coordinate with external and internal agencies to drive implementation of low-carbon activities in the zone and help to ensure continuous national dialogue and coordination on low-carbon growth.
The green cell can perform various functions to improve performance in the LCZ, including:

- driving the transition of the EZs to LCZs by adopting GHG emissions mitigation targets and implementing the zone-wide LCZ strategy and related LCZ policies;
- establishing low-carbon performance KPIs and continually monitoring the progress of zone enterprises against those KPIs and related time-bound targets as set under LCZ policy;
- performing inspections and oversight activities to identify champions and laggards with respect to low-carbon performance;
- periodically revisiting and upgrading the goals, guidelines, and standards set in the LCZ strategy related to sustainable energy, waste, water, and other resource management within the EZs;
- supporting EZ enterprises in the implementation of low-carbon projects;
- acting as the first point of contact and the single point of contact for all low-carbon-development-related queries and activities within EZs; and
- facilitating and assisting the zone authority and operator in inter-departmental and inter-ministerial coordination and communications, to ensure that respective government agencies are informed and their policies are taken into consideration, and to encourage these agencies to provide necessary inputs and feedback.
Box 11: The Green Cell at Bangladesh Export Processing Zones Authority

In its current form, the BEPZA is primarily responsible for facilitating investment in economic zones in Bangladesh by providing tailored infrastructure and business services to the enterprises. However, promotion of sustainable practices in the EPZs is beyond BEPZA’s purview. With World Bank support, BEPZA has recently taken a first step toward bridging this institutional gap by developing an Environmental Management System (EMS) to improve the environmental performance of the enterprises in its eight EPZs. The scope of this program is restricted to basic environmental monitoring and inspection activities and should ideally be extended to include the broader dimensions of energy efficiency, GHG mitigation, and waste and water management.

In this context, the creation of a Green Cell (GC) has been proposed, to serve as an executive body within BEPZA in order to bridge the institutional and capacity gaps and drive conceptualization, planning, implementation, and evaluation of green activities in the EPZs. The GC will oversee the EMS counselors, whose roles fit well with the GC’s agenda. Functionally, the GC will drive active coordination with the EPZ enterprises and other private and government stakeholders and identify and support green investments beyond those already made by the enterprises in the zone.
The chief objectives of the GC are to:

- drive the transition of current and upcoming EPZs to LCZs, by conducting regular and focused capacity-building programs on the environmental and energy performance of enterprises;

- support EPZ enterprises in implementing energy efficiency projects and other low-carbon projects by acting as the first point of contact (FPOC) and the single point of contact (SPOC) for all low-carbon development-related queries and activities within EPZ;

- formulate and implement EPZ-level rules, guidelines, and governance mechanisms on GHG emission mitigation, energy efficiency, and waste and water management. These policies will be aligned with national acts, laws, regulations and other development priorities; and

- facilitate and assist BEPZA in inter-departmental and inter-ministerial coordination and communications, to ensure that respective government agencies are informed and their policies are taken into consideration, and to encourage these agencies to provide necessary inputs and feedback.

Presently, the GC is being instituted in a pilot capacity to support the low-carbon transition of Chittagong EPZ, and once it has been mainstreamed, the GC will be scaled up to support all the other zones under BEPZA.
Technical assistance and capacity development

The green cell, under the leadership of the zone authority or operator, can lead periodic, focused capacity-building workshops for the EZ enterprises. Workshop topics could initially be based on the low-carbon levers identified during the technical diagnostics phase (described in Chapter 2), along the following lines:

1. Introduction to the low-carbon project: brief description of the systematic steps followed to identify the lever

2. Technical details of the low-carbon project: detailed discussion on design and implementation modalities

3. International case studies: preferably presented by external experts specializing in the field of engineering for similar low-carbon projects

4. Vendor presentation: brief presentations by a group of vendors of technology and services necessary to implement the low-carbon project

5. Knowledge sharing by local champion: If any EZ company has already implemented a similar low-carbon project, representatives of that company can be invited to share their case studies

6. Demonstrating a business case for the low-carbon intervention: Presentation on how to develop a business case for low-carbon projects. This is the most important topic; private sector enterprises can be enticed to invest in projects that have a high return on investment and that have been successfully implemented elsewhere.
STEP 4: MAINSTREAM LCZ STRATEGIES IN THE NATIONAL ECONOMIC ZONE POLICY FRAMEWORK

Ideally, low-carbon standards should be mainstreamed within the overarching framework of the national EZ policy. However, most economic zones in developing countries lack a cohesive nationwide policy and regulatory framework to drive, implement, and monitor low-carbon development, and even where regulations do exist, the degree of regulatory enforcement and government oversight varies from country to country. This section describes the key policy issues that need to be addressed to fully and effectively support LCZ initiatives.

Integration of low-carbon considerations into national EZ policy can be both horizontal and vertical. Horizontal policy integration involves cross-sectoral measures and procedures undertaken to mainstream or bring about comprehensive integration of low-carbon goals into EZ policy. Typical examples would include broad climate change strategies and the integration of climate policies into the preparation and adoption of new regulations and the annual budget. Vertical policy integration within the zone levels involves the integration of climate policies into a specific sector.

Table 14 presents best practice guidelines for how low-carbon development can be integrated into the five key components of a national EZ policy framework:20 (i) core policy, (ii) incentives, (iii) regulations, (iv) institutional structures, and (v) physical development and management.

Although the scope and role of the zone authority in national energy- and environment-related policies and regulation is limited, zone authorities can influence enterprise-level behavior through voluntary programs and targeted incentives. These programs can then influence development of national policies and low-carbon initiatives at other enterprises around the country.

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Table 14: Best practice guidelines for a national economic zone policy

(i) Core Policy Framework
Stipulate energy and environmental performance standards within EZ design and operation requirements, covering broad themes such as:
- targets for GHG emission reductions;
- energy audits;
- minimum energy efficiency standards;
- renewable energy promotion;
- waste management;
- water management; and
- industrial symbiosis through connected utilization of energy and other resources.

(ii) Incentive Framework
- Price signals and fiscal incentives to promote resource efficiency
- Acknowledging low-carbon champions through financial or non-financial incentives

(iii) Regulatory Framework
- Streamlining and fast-tracking processes for implementation of low-carbon projects
- National environmental and energy regulations to guide most of the low-carbon activities in the zone

(iv) Institutional Framework
- Legislate the zone authority to act on low-carbon policy implementation issues
- Institutional capacity strengthening is a key enabler for rapid scaling up of low-carbon projects within EUs

(v) Physical Development and Management Framework
- Implement proper land-use planning for developing infrastructure for industrial symbiosis
- Develop and implement an M&E framework for tracking progress against set targets and goals for LCZ development

An effective way to communicate the zone’s low-carbon strategy to existing facilities and developers is to develop a Low-Carbon Zone Roadmap and Low-Carbon Zone Guidelines and disseminate them widely among the existing and future zone investors and government and private sector stakeholders. Such documents constitute the collective vision for building or transforming an economic zone into a low-carbon zone and delineate strategies that can be implemented both at the zone level and at the national level (see Box 12 for information on Chittagong’s Low-Carbon Zone Roadmap and Guidelines).
Box 12: Low-Carbon Zone Roadmap and Guidelines

The IFC-led technical assistance program at Chittagong EPZ produced two key documents, the Low-Carbon Zone Roadmap (LCZR) and Low-Carbon Zone Guidelines (LCZG), to help enable the low-carbon transition of all EPZs in the country. Following the official adoption of these documents, BEPZA is now overseeing the LCZ transformation process.

The LCZR provides BEPZA with strategic and systematic guidance on facilitating the transition of the EPZs into competitive, low-carbon, and resource-efficient economic zones. It covers topics such as potential GHG emissions mitigation, developing implementation plans, and establishing a policy framework to promote low-carbon development in zones and other industrial areas such as industrial estates, high-tech parks, industrial complexes, and clusters. Using existing tools available to businesses and policy makers, the LCZR covers five key steps that are instrumental in transformation of EPZs to LCZs:

1. GHG emissions accounting
2. Energy audit and energy survey
3. Identification of mitigation opportunities
4. Financial assessment and prioritization of opportunities
5. Target-setting for GHG emission reduction

The LCZR concludes by outlining the enabling policy environment to support the above steps.
The LCZG is the tactical policy document to be implemented by BEPZA on a day-to-day basis. In its current form, the LCZG provides a step-by-step guide to enterprises and governing agencies on low-carbon and resource-efficient practices. The purpose of the LCZG is to promote the development of low-carbon zones or the transformation of the current EPZs under BEPZA and to streamline the role of BEPZA to facilitate implementation of the guidelines. The guidelines can also be adopted by other economic zone authorities and are applicable for other categories of economic zones, such as EZs, High Tech Parks, Industrial Estates, and Industrial Complexes. Please see Tool 6 in the Toolbox at the end of this handbook for the full text of the LCZG.
CONCLUSION

LCZs must continue to evolve in response to global climate change, the energy scarcity challenges and changing dynamics of international trade, and the rise of regional free trade areas. While zones cannot and should not compete on the basis of fiscal incentives alone, they can differentiate themselves in terms of facilities, services, and best practices and, most importantly, by providing successful demonstration cases of modern and sustainable production and distribution concepts and approaches. This demonstration effect can be magnified by creating an enabling policy and regulatory environment and building institutional capacity. In many countries, LCZs will also play a critical role in incubating and accelerating policy reforms. Several pilot LCZ initiatives should be tested in various parts of the world to make the concept more acceptable and familiar to the wider industrial and business community. Eventually, these pilot zones can facilitate the mainstreaming of low-carbon development into the trade and investment policies of the countries, so that future economic zones will be designed, developed, and operated with LCZ considerations from the start.

Already, developing countries are showing strong interest in adopting the LCZ concept as a transformative way to address their energy and resource scarcity challenges. Through LCZs, both developed and developing countries can deliver on their voluntary low-carbon goals. The future of EZs will, therefore, intersect with LCZs. As the market for low-carbon technology matures, the cost-effectiveness of LCZs is only expected to improve, which will further catalyze the mainstreaming of the LCZ concept within the overall framework of EZs.
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Tool 5: Draft TOR for a study to identify low-carbon interventions in an economic zone ..131
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TOOL 1: GHG EMISSIONS ACCOUNTING

“The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard,” published by the World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI), is commonly referred to as the WBCSD GHG Protocol Corporate Standard. It provides standards and guidance for companies, organizations, business leaders, and policy makers to understand, quantify, and manage GHG emissions.

ISO 14064-1:2006 specifies principles and requirements at the organization level for quantification and reporting of GHG emissions and removals. It includes requirements for the design, development, management, reporting, and verification of an organization’s GHG inventory.

Based on the above methodologies, a three-step approach, detailed below, can be adopted by any practitioner to calculate GHG emissions from industrial operations:

- Determine organizational & operational boundary
- Identify and categorize GHG sources and sinks
- Develop GHG inventory & carbon intensity of processes in different enterprises of the zone
Determine organizational & operational boundary

- **Selection and validation of base year:** An enterprise may need to track emissions over time as a requirement of a variety of business goals, such as public reporting, establishing GHG targets, managing risks and opportunities, or addressing the needs of investors and other stakeholders. The preliminary use of the GHG inventory is to develop future abatement, mitigation, and management strategies. A meaningful and consistent comparison of emissions over time requires setting up a performance datum with which to compare current emissions; this datum is the base year. For consistent tracking of emissions over time, the base year emissions may need to be recalculated, as there may have been significant structural changes, such as acquisitions, divestments, and mergers. The base year may be a single year or a multi-year average. The selection of a base year may depend on the availability of verifiable GHG emissions data for that year.

- **Determination of the organizational boundary:** In setting organizational boundaries, an enterprise selects an approach for consolidating GHG emissions and then consistently applies the selected approach to define those businesses and operations that constitute the company for the purpose of accounting and reporting GHG emissions. The WBCSD Protocol defines two approaches for establishing the organizational boundary:

  - **Equity Share Approach:** In this approach, an enterprise accounts for GHG emissions from operations according to its share of equity in the operation. The equity share reflects economic interest, which is the extent of rights an enterprise has to the risks and rewards flowing from an operation.

  - **Control Approach:** In this approach, an enterprise accounts for 100 percent of the GHG emissions from operations over which it has control. It does not account for GHG emissions from operations in which it owns an interest but has no control. Control can be defined in either financial or operational terms:
- **Financial control:** An enterprise has financial control over an operation if the former has the ability to direct the financial and operating policies of the latter, with a view to gaining economic benefits from its activities.

- **Operational control:** An enterprise has operational control over an operation if the former or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation.

- **Determination of the operational boundary:** Assessment of the operational boundary involves identifying the emissions associated with the operations, categorizing them as direct or indirect emissions, and then choosing the scope of the emissions (see Figure 12).

**Figure 12: Organizational and operational boundaries of a zone**
Identify and categorize GHG sources and sinks

To help identify direct and indirect emissions sources, improve transparency, and provide utility for different types of organizations and different types of climate policies and business goals, three “scopes” are defined for GHG accounting and reporting purposes (see Table 15 below). Scopes 1 and 2 are defined to ensure that two or more companies will not account for emissions in the same scope, thus eliminating the chances of double counting of GHG emissions.

Table 15: Categories of GHG emissions

<table>
<thead>
<tr>
<th>Scope 1 (Direct Emissions)</th>
<th>Scope 2 (Indirect Emissions)</th>
<th>Scope 3 (Additional Indirect Emissions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All fossil fuels (petroleum, diesel, coal, LPG, natural gas, petcoke, fuel oil, etc.) consumed within the physical boundary of zone</td>
<td>All purchased electricity in the zone</td>
<td>Air travel</td>
</tr>
<tr>
<td>Methane emissions from ETP</td>
<td></td>
<td>Business travel in rental cars/taxis or employee-owned cars</td>
</tr>
</tbody>
</table>

- **Collection of data:** Templates can be developed to collect the necessary GHG data for different sectors; sample templates for some sectors can be found in this Toolbox.

- **Estimation of various emission factors:** This data can be collected from international or national databases and/or locally available sources, such as the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and other sources, including DEFRA, US-EPA, EIA, etc. However, for the computation of the electricity emission factor, the following should be considered:

  - If the electricity is purchased from the national grid, the grid emission factor should be used.
If the electricity is generated by a utility company, the power may be supplied only within the zone or partly within the zone and partly exported outside the zone.

**Power supplied only within the zone:** The consumption of the fuels (coal, gas, diesel, etc.) used to generate the power is already accounted for under Scope 1 emissions of the utility company. However, for other enterprises within the zone, the consumption of this power falls under Scope 2 emissions, and the emission factor is calculated using the following equation:

\[
\text{Emission factor} = \frac{\sum(Q_i \times NCV_i \times EF_i) \times 1000}{EG}
\]

Where,
- Emission factor is in tCO₂/kWh
- \(Q_i\) = Quantity of fuel i consumed (in tons)
- \(NCV_i\) = Net Calorific Value of fuel i (in kCal/kg)
- \(EF_i\) = GHG emission factor of fuel i (in tCO₂/kCal)
- \(EG\) = Total electricity generated (in kWh)
Develop GHG inventory & carbon intensity of processes in different enterprises of the zone

Using the collected data and emission factors, the GHG inventory for each enterprise can be computed.

- Scope 1 emissions = \( \sum (Q_i \times NCV_i \times EF_i) \times 1000 \)
- Scope 2 emissions = Emission factor of purchased electricity \( \times \) total purchased electricity
- Scope 3 emissions\(^{21}\) = Business travel by cars + air travel
- Emissions due to business travel by cars = \( \sum (Q_i \times NCV_i \times EF_i) \times 1000 \)
- Emissions due to air travel = Distance travelled (in km) \( \times \) emission factor (in tCO\(_2\)/km) as given by WRI

Where,
Scope 1, 2, and 3 emissions are estimated in tCO\(_2\)
\( Q_i \) = Quantity of fuel \( i \) consumed (in tons)
\( NCV_i \) = Net Calorific Value of fuel \( i \) (in kCal/kg)
\( EF_i \) = GHG emission factor of fuel \( i \) (in tCO\(_2\)/kCal)
Emission factor of purchased electricity is in tCO\(_2\)/kWh
Total purchased electricity is in kWh

---

\(^{21}\) For all practical purposes, Scope 3 emissions can be overlooked, as they are rarely under the direct operational influence of the organization concerned.
TOOL 2: ECONOMIC EVALUATION OF INVESTMENTS

A thorough economic evaluation can assess the financial attractiveness of a low-carbon project and also compare it with other competing investment options. Economic evaluation shows the benefits of projects relative to their capital costs. It is difficult to find any single parameter for economic evaluation. Instead, there are different measures, each of which highlights different aspects of a project and has its own strengths and weaknesses. Two possible approaches are:

**Simple investment method:** This approach is used for preliminary financial assessment of energy efficiency projects. Assessment of investment efficiency is based on non-discounted cash flows, and a rise in prices is not considered a cash flow. The parameters of the project’s effectiveness are estimated without financing (from the point of view of all the project investors), and the results show if it is reasonable to proceed with technical and economic calculations for the project.

The most frequently used simple investment methods are calculation of rate of return and calculation of payback period. However, the disadvantage of these approaches is the inaccuracy of the calculations, as activity after the payback period is not taken into consideration. Simple investment methods cannot be used for comparing variants with different project durations.

**Discounting method:** The essence of this method is in preliminary discounting of the estimated cash flow based on the feasible discount rate. Most commonly, the real discount rate (cleared from the inflation rate) is used when the energy projects are evaluated. Inflation expectations are not taken into consideration when the project cash flow is structured. When the rate of energy cost increase is defined, the total inflation index is not taken into consideration.

There are several different types of discounting methods, each of which has its own advantages and disadvantages. The net present value (NPV) method considers the value of money but not the risks, and the fact that money is the absolute measure does not allow for comparison of projects with different levels of financing. The
internal rate of return (IRR) method addresses these disadvantages but does not take into account the cost of capital and does not have any economic definition (for example as NPV); this indicator is a bit more complicated. Finally, there is the payback period method, which does not take into consideration the time value of funds. A project payback period without absolute and relative project income does not provide a full picture of the effectiveness of the investments.
TOOL 3: MARGINAL ABATEMENT COST CURVE

The marginal abatement cost curve (MACC), developed by McKinsey, is a useful prioritization tool for low-carbon investment programs. The focus of MACC is to compare multiple low-carbon investment options against the dual criteria of cost of one unit of GHG abatement and volume of GHG abatement. MACC has become an essential planning tool as governments look to reduce greenhouse gas emissions and improve energy security. Even in low-carbon transformation of EZs, the MACC tool is used as an analytical framework to answer the following key questions:

- Among available mitigation options, which will be the most efficient and cost-effective?
- What are the potential results associated with each option?
- What does it cost to implement each option?

MACC analysis can help an EZ authority or planning agency to compare the costs and benefits of alternative emissions reduction options. The cost-benefit assessments are based on cash flow projections over the lifetime of the projects and include the applicable fiscal incentives, if any. The options that have positive costs per unit of GHG abatement are the ones that require further support in the form of incentives to make them financially viable. It also enables the planning authority to assess the total investment needed to shift toward low-carbon growth. Once the requisite incentives are worked out, an EZ authority could take policy initiatives to introduce some of them at the zone level (if they have the adequate mandate to do so) and/or advocate policy reform at the national level by approaching the relevant national government agencies.

The World Bank’s Energy Sector Management Assistance Program (ESMAP) is developing software that provides an easy way to build marginal abatement cost curves, and to calculate break-even carbon prices. The user-friendly interface will guide users through a simple data entry process that is otherwise a typically laborious process. However, at this point in time, the software version of the MACC tool is yet
to be fully developed and is only available in a beta version. The following section elaborates on the technicalities of operationalizing and using MACC.

The MACC has two major inputs: the marginal cost of the low-carbon option and the total abatement potential of the low-carbon option at the sector level and at national level. The abatement cost is calculated as an incremental cost by comparing the NPVs of the investment, operations costs, and revenue for the technologies implemented in the baseline and low-carbon scenarios.

The approach can be expressed mathematically as follows:

$$MAC_{OptionA} = \frac{NPV_{OptionA} - NPV_{Baseline-OptionA}}{ER_{OptionA}}$$

Where:

<table>
<thead>
<tr>
<th>MAC_{OptionA}</th>
<th>The marginal abatement cost of the low-carbon option “A”</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV_{OptionA}</td>
<td>The net present value of the low-carbon option “A”</td>
</tr>
<tr>
<td>NPV_{Baseline-OptionA}</td>
<td>The net present value of the baseline situation of the low-carbon option “A”</td>
</tr>
<tr>
<td>ER_{OptionA}</td>
<td>Emissions reduction or GHG abatement by implementation of the low-carbon option “A”</td>
</tr>
</tbody>
</table>

22 http://esmap.org/MACTool
23 The baseline situation for a low-carbon option is defined as the situation or the option that would have existed in the absence of the low-carbon option for that specified sector.
The net present value of the low-carbon option and the baseline alternative will be calculated using standard financial models, using the following formulations, with alterations specific to project/options for each case:

\[
NPV_i = \frac{\text{CAPEX}_i \times \frac{(1 + r)^t}{1 - (1 + r)^{-t}} + \text{OPEX}_i - \text{REV}_i}{(1 + r)^t}
\]

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPEX</td>
<td>Capital expenditure for the option “i”</td>
</tr>
<tr>
<td>OPEX</td>
<td>Operation expenditure for the option “i”</td>
</tr>
<tr>
<td>r</td>
<td>Discount factor</td>
</tr>
<tr>
<td>t</td>
<td>Lifetime of the technology</td>
</tr>
<tr>
<td>REV</td>
<td>Revenue from the option “i”</td>
</tr>
</tbody>
</table>

The revenue from the low-carbon option will be cash inflow as a result of sale of product, for example sale of power in the case of a renewable energy project or super critical power project.

In calculating the net present value of the options, the projected value of the energy can be used. The projection can be done on the basis of the appropriate escalation factors.

The emissions reduction or GHG abatement by implementation of the low-carbon option will be calculated as a product of appropriate emission factors with:

- energy-saving potential calculated based on standard methodology of UNFCCC, IPCC, or similar standard international methodologies for energy-efficiency projects;
- total power generated by the power generating station, in case of the implementation of an energy-efficient power generation project or renewable-energy-based power generation project; and
- total amount of avoided process emissions for industrial process change or product change projects.
Therefore, for calculation of the emission reduction or GHG emission reduction, the energy-saving potential, power-generation potential, or avoided process emissions needs to be estimated. These values can be further used for the development of the MACC.

Development of the MACC serves as an economic analysis of the low-carbon scenario. It reveals both the economic costs and benefits of moving toward a lower-carbon-development pathway. It also helps analyze and assess the conditions under which the proposed low-carbon options could be effectively implemented.

The MACC provides a two-level assessment:

1. A cost-benefit analysis comparing individual low-carbon options to the baseline scenario; and

2. An assessment of the conditions under which the proposed low-carbon options could become attractive to investors in lieu of the more carbon-intensive options found in the reference scenario.

The MACC can be used to prioritize the low-carbon options and analyze GHG mitigation policies. This MACC represents in graphic form the economic attractiveness of the low-carbon option in light of its potential mitigation size. The area under the curve therefore represents the total cost or benefit that can be achieved by implementation of the low-carbon option over and above the baseline alternative.

In the second approach, the curve represents the investor’s perspective on the low-carbon options. The incentives that would be required for the proposed low-carbon options to become attractive to the country’s investors are estimated, and the minimum internal rate of return is computed for each of the options, considering the capital investments, operational costs, and the revenue from the project. Then the incentive that would be required to take the IRR above the minimum expected return level is estimated. The minimum expected return level is considered to be the benchmark for investment. The expected return varies across sectors, and thus the benchmark IRR will be different for different sectors in the country.
The market incentive is determined as the USD per tCO$_2$e that would make the NPV of the low-carbon options equal to zero, using the benchmark IRR as the discount rate. While low-carbon options with an IRR above benchmark will be attractive without any incentive, those with IRRs below benchmark will require additional incentives. The level of such incentives represents the break-even carbon price.

When the break-even carbon price for a low-carbon option is negative, implementation of such a measure is attractive. The area under the curve in this MACC represents the total volume of incentive that will be required to implement the low-carbon options. Figure 13 shows the typical output from a MACC analysis.

**Figure 13: Typical output of Marginal Abatement Cost Curve analysis**
| সময়   | ট্রাঙ্কফর্মারস নং-১, ২০ এম, ভি, এ | ট্রাঙ্কফর্মারস নং-২, ২০ | এমপিয়ারস | মেঘাওয়াট | মেঘাভার | এমপিয়ারস | লাল | হলুদ | নীল |
|--------|--------------------------------|------------------------|-------------|------------|-----------|-------------|-----|      |      |
| ০০৩০   |                                |                        |             |            |           |             |     |      |      |
| ০১০০   |                                |                        |             |            |           |             |     |      |      |
| ০১৩০   |                                |                        |             |            |           |             |     |      |      |
| ০২০০   |                                |                        |             |            |           |             |     |      |      |
| ০২৩০   |                                |                        |             |            |           |             |     |      |      |
| ০৩০০   |                                |                        |             |            |           |             |     |      |      |
TOOL 4: DRAFT TOR TO CARRY OUT AN ENERGY AUDIT IN AN ECONOMIC ZONE

Background

[Provide introductory details of the economic zone, including its geographic location, overall land area, and any other physical attributes, such as proximity to a major port, etc. Include date of establishment of the zone, types and numbers of enterprises present, annual physical output of the enterprise, total volume of exports/imports, both in physical and monetary terms, and employment data, among others.]

Objective

The objective of the assignment is to perform a comprehensive energy audit of economic zone “X,” to establish a baseline of energy use of its constituent enterprises. The economic zone features enterprises from a variety of sectors that are expected to have different energy-use characteristics. The selected energy auditor will be expected to perform a bottom-up analysis at the enterprise level and then consolidate the results at the zone level to arrive at an overall understanding of all types of energy use and consumption patterns.

The idea behind the audit is to lay the groundwork for a future assignment that will analyze the baseline energy use in zone X to identify cost-effective opportunities for enhancing the energy efficiency of the zone. Detailed TORs for this follow-up assignment will be floated separately after successful completion of the energy audit assignment.
Scope of Work

The broad scope of the audit exercise is as follows:

Energy Survey

[If there are a large number of enterprises in the economic zone, a survey could first be conducted to gather energy consumption data and then a detailed audit of only a sample set of enterprises could be conducted. However, if the number of enterprises is reasonably small, a comprehensive audit could be performed on all enterprises, in which case this step need not be included as part of the TOR.]

1. Design and circulate an energy survey questionnaire among all enterprises in the zone to gather energy consumption data from all enterprises.

2. Based on the gathered data, select the top 20 percent of the enterprises in terms of energy consumption and complete the following steps.

Study of Energy-Consuming Devices

- Conduct a thorough assessment of energy use at each plant site and prepare a detailed report on the energy savings potential at the site. The report will also indicate what energy efficiency improvements might be considered, what would be the investment requirement for such improvements, and what would be the payback periods for each of those investments.

- Study equipment constraints that result from operations and maintenance (O&M) limitations.

Study of the Human Aspect in Energy Conservation

- This activity will assess the level of awareness among managers and technicians on the shop floor about energy efficiency issues. If required, the report will propose specific skill enhancement or training programs to improve awareness about energy-efficiency-related issues among the plant professionals.
Financial Analysis

- Payback period will be calculated for each of the investments being proposed, considering the real cost of money and net present value of the investment made.
- The study will indicate any risk and uncertainty associated with the investment decision and also suggest appropriate risk mitigation strategies and the cost of these mitigation actions.

Field Study

This will involve a thorough review of the present electricity, fuel oil, and estimation of energy consumption in various load centers, including lighting, air-conditioning, pumps and motors, boilers and furnaces, compressors, blowers, conveyors, etc. The specific activities are explained below.

1. Electrical Distribution System
   a. Review of present electrical distribution, such as Single Line Diagram (SLD), transformer loading, cable loading, normal and emergency loads, and electricity distribution in different equipment
   b. Study of reactive power management and options for power factor improvement
   c. Exploration of the energy conservation options in the electrical distribution system

   a. Review of present HVAC system, including central AC, window AC, split AC, package AC, water coolers, air heaters, etc.
   b. Performance assessment of window AC, split AC, and package AC systems
   c. Performance assessment of chillers, cooling towers, air handling units (AHUs), and cold insulation systems of central AC
   d. Analysis of HVAC performance, including estimation of energy effi-
ciency ratio (EER, i.e. KW/TR), condenser water pumps, AHUs, etc., and comparison of the operating data with the design data

e. Exploration of the energy conservation options in HVAC systems

3. Lighting System

a. Review of present lighting systems, lighting inventories, etc.
b. Estimation of lighting load at various locations, including different floors, outside (campus) light, pump house, and other important locations
c. Detailed survey of luminous intensity at various locations and comparison with acceptable standards
d. Study of present lighting control systems and recommendations for improvement
e. Analysis of lighting performance indices, including lux/m$^2$, lux/watt, lux/watt/m$^2$, and comparison with norms of high-rise buildings
f. Exploration of the energy conservation options in lighting system

4. Diesel Generator (DG) Sets

a. Review of DG set operation
b. Performance assessment of DG sets in terms of specific fuel consumption (SFC, i.e. kWh/Lt)
c. Exploration of the energy conservation options in DG sets

5. Water Pumping System

a. Review of water pumping, storage, and distribution systems
b. Performance assessment of all major water pumps, i.e. power consumption vs. flow delivered, estimation of pump efficiency, etc.
c. Exploration of the energy conservation options in water pumping systems

6. Motor Load Survey

a. Motor load survey of all drives to estimate the overall plant load factor
of the motor drives

b. Exploration of the energy conservation options in electric drive systems, evaluation of all meters, etc.

7. Energy Monitoring & Accounting System

a. Detailed review of present energy monitoring and accounting system in terms of metering, record keeping, data logging, periodic performance analysis, time efficiency, etc.

b. Recommendations for effective energy monitoring and accounting system

8. Compressed Air System

a. Check of desired pneumatic drop against actual

b. Compressor efficiencies test

c. Recommendations on ways to reduce leakage below seven percent

Expected Outcome

The report will seek to establish an equipment-level, enterprise-level, and zone-level profile of energy use for zone X.

Timeline

The whole assignment is expected to last about ___ months.
Background

[Provide introductory details of the economic zone, including its geographic location, overall land area, and any other physical attributes, such as proximity to a major port, etc. Include date of establishment of the zone, types and numbers of enterprises present, annual physical output of the enterprise, total volume of exports/imports, both in physical and monetary terms, if any, and employment data, among others.]

Objective

The objective of the assignment is to build on the outcome of a comprehensive energy audit report and identify cost-effective opportunities for reducing the energy-use-related GHG emissions in economic zone “X.” The exercise of identifying these “low-carbon interventions” will necessarily have to bring into consideration the following two possibilities:

► reduction of GHG emissions through implementation of energy-efficiency measures; and

► reduction of GHG emissions through implementation of clean, alternative energy options.

It is expected that once the low-carbon interventions are identified, a follow-up assignment may be initiated to provide implementation support to enterprises willing to implement the identified measures.
Scope of Work

The broad scope of work will involve the following:

- **Analysis of the energy audit outcomes:** The first task of the assignment will be to analyze the complete set of energy data generated through the audit exercise, to develop a comprehensive understanding of the energy use profile of the zone X. Based on the energy audit outcome, the consultant will identify a sample set of enterprises that they think will best represent the energy profile of the zone.

- **Projection of GHG emissions:** The consultant will be required to do a five-year business-as-usual (BAU) projection of energy-related GHG emissions for the zone. The exercise will draw heavily on the energy audit data and involve active consultation with the zone authority to incorporate reasonable estimations about projected growth of operations of the zonal enterprises.

- **Field visit:** The consultant will have to perform field visits to the chosen sample of enterprises to get a better understanding of their energy consumption patterns. This step is designed to familiarize the consultant with the ground realities related to the energy profile of zone X.

- **Identification of low-carbon interventions:** Based on the previous two steps, the consultant will identify a broad set of low-carbon measures, which will then have to be prioritized on the basis of their potential impact on avoiding GHG emissions, estimated financial costs, technological maturity, and assessment of implementation capacity in the zone X. Active consultation with the sample enterprises is deemed necessary at this stage to validate the acceptability of the identified broad measures.

- **Detailed analysis of low-carbon interventions:** The prioritized set of low-carbon interventions will be subjected to detailed analysis, which will include thorough pre-feasibility assessments of the requisite technologies, including implementation economics, GHG abatement potential, and market readiness. As part of the detailed analysis, the consultant is also expected to build scenarios of the possible impact of implementation of the prioritized
set of interventions on zone GHG emissions.

- **Development of business models for implementation of low-carbon interventions at the individual enterprise level:** The consultant will draw out the business model for implementing one or more measures at the chosen sample set of enterprises, including the identification of technology suppliers and implementation partners. The consultant will also advise on innovative mechanisms to finance the chosen interventions, including CDM and leveraging of available fiscal assistance.

- **Policy Analysis Expert:** The consultant must engage a senior policy analysis expert with at least five years of relevant work experience in analyzing the policy environment for low-carbon business model implementations. The expert will help the implementation team understand the policy implications of low-carbon projects and advise economic zone authorities in conceptualizing a better policy environment that will help the businesses proactively pursue low-carbon initiatives in the zone.

**Expected Outcome**

The report will seek to establish business cases for implementation of low-carbon interventions in specific enterprises in zone X that will not only help reduce GHG emissions but also improve energy efficiency. These business cases will have to be well-supplemented by a feasibility analysis to support their economic and financial viability.

**Timeline**

The whole assignment is expected to last about ______ months.
INTRODUCTION

Background

Economic zones such as Export Processing Zones and Economic Zones are well-established centers of foreign investment, trade promotion, industrial development, and job creation, and have contributed immensely to the economic growth of developing economies. However, with rising energy scarcity and global climate change concerns, the traditional carbon-intensive growth model of these economic zones is not sustainable in the long run. Enterprises within these economic zones should adopt energy- and resource-efficient production techniques and engage in best-in-class operating practices to improve productivity and reduce waste. There are several international industrial energy performance standards available that enterprises can consider when planning for low-carbon initiatives within a zone. Two such standards are:

3. **ISO 50001:2011 - Energy management systems – Requirements with guidance for use.** This standard presents requirements for energy management systems (EMS) and establishes a framework for industrial plants, commercial facilities, and entire organizations to manage energy.

4. **ISO 14000: 2004- Environmental management systems – Requirements with guidance for use.** This standard provides practical tools for companies and organizations looking to identify and control their environmental impact and improve their environmental performance. It maps out a framework that a company or organization can follow to establish an effective environmental management system. Benefits of using ISO 14001:2004 can include reduced waste management costs, savings in consumption of energy and materials, lower distribution costs, etc.

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24 These guidelines are modified from an actual case involving transformation of an EPZ into an LCZ.
Governments and zone authorities can support such low-carbon endeavors through policy and regulatory intervention, institutional capacity building, knowledge and information support, and investment in building low-carbon infrastructure in the zones.

Through a set of well-planned activities, an existing economic zone can be transformed into a low-carbon zone. Improving the energy and environmental performance of enterprises at this scale would make a significant contribution to the enterprises and the zone management and to sustainable development of the surrounding community. The resulting economic zone would have a more sustainable community of enterprises, supporting each other’s business successes. New services offered by the zone authority would yield opportunities for new revenue streams. At the same time, for newly planned economic zones, low-carbon considerations should be integrated into site development, infrastructure, and industrial planning activities from the start.

A low-carbon zone is a means of improving the sustainability of industry through local and regional action, thus creating a position of leadership and leverage for the region’s industrial community. In brief, a low-carbon zone seeks to achieve:

- resource efficiency in energy, materials, and water, with the cost savings gained through higher efficiency;
- cleaner production through good operation, reduction and substitution of waste materials, separation of by-product or residual materials, etc.;
- use of renewable energy and materials to replace fossil fuel sources and finite material supplies;
- rehabilitation of existing buildings to higher energy and environmental standards and use of green architecture and engineering in new facility and infrastructure design;
- continuous enhancement of resource and energy efficiency in unit process, and at the plant and economic zone level through industrial symbiosis;
climate-friendly site planning and industry allocation based on a clear understanding of the availability of cleaner and non-conventional resources and the feasibility of mobilizing those resources across the zone area (applicable for new economic zones); and

a new climate-friendly brand of economic zone that attracts investment from the world’s leading companies.

Low-Carbon Zones are continually transforming systems that seek to gain multiple benefits from each activity. For instance, an integrated resource recovery and industrial symbiosis system increases industrial resource efficiency, lowers environmental degradation, creates opportunities for entrepreneurs and workers, and strengthens the local and national economy.

Purpose of Low-Carbon Zone Guidelines (LCZG)

The purpose of the Low-Carbon Zone Guidelines (LCZG) is to promote the development of low-carbon zones or the transformation of existing EZs under a zone authority, and to streamline the role of the zone authority to facilitate implementation of the guidelines.

The LCZG is the official document that would be implemented by the zone authority. Conformity to the guidelines can help ensure a low-carbon transformation of the EPZs, EZs, High Tech Parks, Industrial Estates, Clusters, and Complexes and enable the enterprises in these zones to operate in a more resource-efficient and climate-friendly fashion.

For new and upcoming EPZs (if any), EZs, High Tech Parks, Industrial Estates, Industrial Clusters, or Complexes, the Guidelines can be also referenced to enable planning, development, and deployment of low-carbon infrastructure, technologies, processes, and practices.
CHAPTER 1: GENERAL PROVISIONS

Item 1: Key Definitions

[1.1.] ‘Guidelines’ mean indication of policy direction or procedure by which to determine or encourage, on a voluntary basis, a course of actions for regulators as well as the private sector.

[1.2.] ‘LCZG’ stands for ‘Low-Carbon Guidelines,’ which are a voluntary set of Guidelines to be followed by the economic zone’s authority and enterprises in the economic zone. The LCZG aims at streamlining a particular set of actions, such as use of energy efficient technologies, processes and practices, use of renewable technology, etc., in order to achieve lower GHG emissions in the economic zone. Guidelines are not legally binding or mandatory.

[1.3.] ‘Roadmap’ means a detailed plan of actions to guide progress toward a specific goal/target. A Low-Carbon Roadmap in the context of an economic zone refers to detailed technical and financial analysis of the identified GHG mitigation levers, policies, and regulatory actions that will enable implementation of these levers, and a monitoring and review framework to ensure that these levers generate desired outcomes.

[1.4.] ‘Rule’ means a standard for different activities. In the guidelines, it refers to any directive or authoritative regulation concerning particular methods or procedures for solid/liquid/gaseous emissions and consumption of resources that is issued by a relevant authority with the power to make rules.

[1.5.] ‘Industrial/economic zone or cluster’ is a geographic region with groups of inter-related or non-inter-related industries/businesses that drive wealth creation in a region.

[1.6.] ‘Green Cell’ is a proposed institutional structure aimed at facilitating low-carbon transformation of economic zones. The Green Cell will formulate the
TOOLBOX

guidelines/rules for the enterprises, help them implement low-carbon measures and finally monitor progress toward the overall green transformation of the zone.

[1.7.] ‘Energy’ means the electricity, steam or heat, gas, petroleum product, coal, peat-coal, nuclear, biomass, bio-fuel, bio-gas, hydro-power, solar, wind, geothermal, hydrogen cell, tidal and wave, or any other form of energy.

[1.8.] ‘Greenhouse gases’ (GHG) are gases in the atmosphere that absorb and emit radiation within the thermal infrared range, causing the greenhouse effect, which leads to climate change. The Kyoto Protocol recognizes six such GHGs that are emitted due to anthropogenic activities: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFC), hydrofluorocarbons (HFC), and sulphur hexafluoride (SF₆).

[1.9.] ‘Energy audit’ means verification, monitoring, and analysis of machinery, appliances, and the processes of utilization of energy entity and determination of its efficiency.

[1.10.] ‘Industrial symbiosis’ refers to the collective collaboration of industry, for example the sharing of services, utilities, and by-product resources among diverse industrial actors in order to add value, reduce costs, and improve the environment. Industrial symbiosis aims to develop industrial ecosystems that behave in a similar way to natural ecosystems, wherein everything gets recycled.

[1.11.] ‘Kyoto Protocol’ is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for certain industrialized countries and the European community for reducing greenhouse gas (GHG) emissions. Under the treaty, countries must meet their targets primarily through national measures. However, the Kyoto Protocol offers them an additional means of meeting their targets by way of three market-based mechanisms: emissions trading, the clean development mechanism (CDM), and joint implementation (JI).
**[1.12.]** ‘Clean Development Mechanism (CDM)’ is a flexibility mechanism under the Kyoto Protocol that allows emissions-reduction projects in developing countries to earn carbon credits or certified emission reduction (CER) credits, each equivalent to one tonne of CO$_2$. These CERs can then be traded and sold, and used by industrialized countries to meet a part of their emissions reduction targets under the Kyoto Protocol. The mechanism stimulates sustainable development and emissions reductions, while giving industrialized countries some flexibility in how they meet their emissions reduction limitation targets.

**[1.13.]** ‘Programme of Activities (PoA)’ is a modality of project development under CDM of UNFCCC that allows replicable projects with low and physically spread-out GHG emissions into CDM. This type of project often generates higher sustainable benefits but is too small to pay back the transaction cost involved in the CDM process.

**[1.14.]** ‘Life-cycle GHG impact’ is an estimation of the GHG emissions throughout the full life-cycle (i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling) of a product or system (cradle to grave GHG analysis).

**[1.15.]** ‘ESCO’ stands for ‘energy service company,’ which is an entity that provides a broad range of comprehensive energy solutions, including design and implementation of energy-saving projects, energy conservation, energy infrastructure outsourcing, power generation and energy supply, and risk management to ensure energy savings. The savings in energy costs are often used to pay back the capital investment of the project over a five-to-20-year period, or reinvested into the building to allow for capital upgrades that may otherwise be infeasible. If the project does not provide returns on the investment, the ESCO is often responsible for paying the difference.

**[1.16.]** ‘HVAC’ stands for heating, ventilation, and air-conditioning and is the technology of indoor and automotive environmental comfort. HVAC systems can be designed to optimize energy efficiency.
‘International boiler and pressure vessel code’ (BPVC) is approved and adopted by the governing council of the American Society of Mechanical Engineers (ASME). The license for access to the standards is provided by the American National Standards Institute (ANSI). These are internationally accepted standards and codes for boiler design, operation, and maintenance.

‘Waste heat recovery’ denotes recovery of heat from hot waste streams with high energy content, such as hot flue gases (exhaust) from diesel generator.

‘Zero waste’ is a concept involving the elimination of all discharges to land, water, or air that are detrimental to the environment and human/animal/plant health. It means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them in landfills.

CHAPTER 2: LOW-CARBON ZONE

Item 2: Low-Carbon Zone Policy Framework

The zone authority shall develop a roadmap for low-carbon transformation of the EZ and review its progress annually based on EZ-wide specific GHG emission reduction.

Under the provisions of the zone authority act, the zone authority shall develop and implement LCZG to enable transformation of the existing zones into low-carbon zones. The zone authority shall also develop institutional mechanisms to facilitate such transformation and provide one-stop support for the enterprises in the EZs to promote the LCZG and jointly achieve the objective in the Low-Carbon Zone Roadmap developed by the zone authority.

The zone authority shall examine the present situation of the GHG emissions, energy and water consumption, and waste management activities in the EZ.
[2.4.] The zone authority shall conduct or facilitate awareness-generation, focused training, and capacity-development programs for the zone authority staff and also for the enterprises in the zone. Training for the zone authority staff shall focus on imparting operational and management best practices on GHG mitigation, energy savings, water and waste management and related issues, methods of conducting energy audits, and providing energy or GHG, water and waste related performance improvement suggestions to the enterprises.

[2.5.] The zone authority shall set up a ‘Green-Cell’ to provide institutional support to the enterprises in terms of technical, informational, and knowledge services. This Green Cell shall also help the industries access finance for implementing low-carbon projects and connect the enterprises to technology suppliers, equipment vendors, and engineering consultants. The Green Cell may also assist in clean technology transfers.

[2.6.] The zone authority shall set a voluntary GHG emissions reduction target for the entire zone and annually monitor progress toward this goal by setting appropriate performance standards, such as GHG intensity (tCO$_2$e/ tons of production) and energy intensity (kWh/ tons of production or kCal/ tons of production). In setting such energy- and/or GHG-related performance standards, the zone authority shall consult several national, regional, and sectoral studies commissioned by the government, donor agencies, research institutes, and other non-governmental agencies.

Item 3: Monitoring, Reporting, and Evaluation Mechanism

[3.1.] The zone authority shall develop and circulate specific formats and protocols$^{25}$ to each enterprise in the EZs to gather information on total energy consumption (kWh, kJ), specific energy consumption (kWh/tons of production, kJ/tons of production), specific water consumption (cu meter/ton of production),

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$^{25}$ Specific formats and protocol can be adopted from energy efficiency programs or policy frameworks, to be introduced by national government agencies, wherever it is appropriate.
and other relevant utility and production data as deemed necessary to track and monitor energy and GHG performance of the enterprises.

[3.2.] All enterprises shall monitor and report their energy and GHG performance in the pre-circulated format to the zone authority at regular intervals as decided by the zone authority.

[3.3.] To make the monitoring, reporting, and review mechanism work efficiently, the zone authority will implement and operate an EZ-wide information system that will:

a. support inter-enterprise communications;

b. provide a centralized data acquisition and analysis system to monitor energy, GHG, and water flow data; and

c. inform enterprises on local and national situations related to energy and environmental issues.

CHAPTER 3: ENERGY EFFICIENCY

Item 4: Use of Energy Efficient Technologies, Processes, and Practices

[4.1.] Enterprises can adopt retrofit and/or process improvement and/or equipment modernization measures to reduce specific energy consumption (kWh/tons of production, KJ/tons of production, etc.) of their operations and report on a yearly basis their specific energy performance to energy regulatory authorities and other relevant authorities through the stipulated reporting format.

[4.2.] LCZG recommends that each enterprise demonstrate a specific energy improvement (decrease in energy consumption per unit of production) of 1% every year up to two years from the adoption of the Guidelines and report the improvement to the energy regulatory authority and other relevant authorities.
on an annual basis. This specific energy improvement target will be revised by the energy regulatory authority and other relevant authorities after two years, based on a review of each enterprise’s performance.

[4.3] During planning and construction of new factories and buildings in existing EZs or during the development of a new EPZ, both enterprises and the zone authority shall include energy efficiency and low GHG emissions as important considerations for site development, building construction, infrastructure laying, technology selection, equipment purchase, and operational planning.

Item 5: Energy Audit

[5.1.] Enterprises having an electrical load of 200 kVA or more and steam consumption of 5 TPH or more are strongly recommended to conduct an energy audit and submit the energy audit report and energy efficiency improvement plan to the energy regulatory authority and other relevant authorities every year.

[5.2.] Enterprises emitting more than 25,000 tonnes of CO\textsubscript{2}e per year should cooperate with the zone authority to quantify their direct and indirect emissions amount and sources in accordance with internationally recognized methodologies and good practice.

[5.3.] Enterprises can seek necessary assistance from the zone authority to conduct an energy audit and develop actionable energy efficiency improvement plans in line with the GHG emission reduction target of the zone.

[5.4.] The zone authority shall organize workshops, training, and learning sessions to help enterprises conduct energy audits and adopt best practices in energy efficiency.

[5.5.] The zone authority will collaborate with external partners, such as technology suppliers, engineering consultants, and donor agencies, to create target programs (e.g. boiler efficiency improvement program, lighting efficiency improve-
ment program, motor replacement program, etc). These programs shall focus on creating awareness, disseminating best practices, providing technical consultation and guidance, and helping enterprises to implement projects by facilitating industrial symbiosis, ESCO, and CDM projects.

**Item 6: Energy Efficiency in Air Conditioning**

**[6.1.]** Enterprises whose air-conditioning requirement in factory and building premises is more than 500 TR can generate an air-conditioning effect utilizing the waste heat available from their manufacturing process (for example, by installing a vapor absorption machine) subject to availability of the right quality and quantity of waste heat. In case no waste heat source is available, the enterprises can generate the air-conditioning effect using steam available from a centralized steam network or steam from other enterprises.

**[6.2.]** Enterprises are recommended to procure energy efficient air conditioning machines and operate them efficiently, to minimize the wastage of energy.

**Item 7: Use of Energy Efficient Lighting**

**[7.1.]** New enterprises are strongly recommended to use LED lamps in all buildings, factories and spaces (such as corridors or washrooms) where there is no fixed luminance level requirement.

**[7.2.]** Enterprises with existing buildings, factories, and spaces (such as corridors or washrooms) where there is no fixed luminance level requirement are strongly recommended to replace existing lamps with LED lamps in the next three years. Enterprises should also consider maximum usage of daylight instead of electric lamps, light coloring of floors and walls, etc. in these areas of no fixed luminance level.

**[7.3.]** The zone authority shall facilitate the process by organizing workshops
and consultation sessions to help enterprises phase out the existing lights and install LED lights.

**Item 8: Energy Efficient Use of Boilers**

[8.1.] Proper operation and maintenance is key to energy efficient use of boilers. Enterprises are recommended to maintain separate logs to monitor boiler operating performance, such as steam generation, fuel consumption, inlet air flow, exhaust gas temperature etc.

[8.2.] Each operating boiler(s) of the enterprises is recommended to undergo a boiler efficiency measurement (direct or indirect method) every year by a national testing agency and submit the test report to the zone authority. (For more information on direct and indirect methods of boiler efficiency measurement, please see the additional tools at http://bit.ly/lczhandbook)

**Item 9: Energy Efficient Steam Distribution System**

[9.1.] Enterprises shall maintain an energy efficient steam distribution system by taking preventive actions to reduce losses and leakages from flanges, elbows, valves, and unions and steam traps.

[9.2.] Enterprises shall attempt to minimize thermal losses from steam generation and distribution systems by using better insulation materials and maintaining insulation on a periodic basis.

[9.3.] The zone authority shall carry out regular capacity building and knowledge transfer sessions in the EZs. This will help the enterprises to gain access to the latest technologies and equipment/technology suppliers for energy efficient equipment.
CHAPTER 4: ENERGY SUPPLY (POWER AND HEAT GENERATION)

Item 10: Waste Heat Recovery

[10.1.] Enterprises are strongly recommended not to release any waste gas or waste heat to the atmosphere without recovering its heat content to the extent achievable, subject to the availability of techno-commercially feasible solutions to recover this heat. The waste heat can be recovered to generate steam/hot water and/or power and utilized for the enterprises’ own consumption or supplied to other consumers.

[10.2.] Power generators in EZs (centralized and captive) are strongly recommended to optimally recover and reuse heat content of waste gas, subject to availability of commercially feasible technology and provisions for associated infrastructure. The waste heat can be recovered to generate steam/hot water and/or power and supplied and distributed to consumers in the EZ. Surplus steam/hot water or power (if any, after being supplied in the EZ) can be sold to third parties.

[10.3.] The enterprise and/or power generator interested in entering into the cogeneration/heat recovery steam generation, supply, and distribution business (hereby referred to as Steam Generator) should be approved by the relevant authorities before the commencement of its operation.

[10.4] The Steam Generator shall be responsible for operating and maintaining boilers, pipelines, and the entire steam network as per standards provided by the national boiler inspectorate authority. Steam pipelines shall further adhere to international codes and standards, such as ASME and ANSI.

[10.5] Scheduled maintenance of the boiler, steam pipeline, and network shall be performed by the Steam Generator and the same shall be built into the contract between the Steam Generator and the consumers. The Steam Generator should also perform a half-yearly safety audit of the steam generation, supply,
and distribution system. The Steam Generator shall engage a competent agency to perform the safety audit and submit the audit report to the energy regulatory authority and other relevant authority.

**Item 11: Generation and Use of Renewable Energy**

**[11.1.]** Enterprises are recommended to explore opportunities to source and utilize renewable energy resources subject to availability of commercially viable technology, infrastructure, and other support mechanisms. Enterprises can seek technical assistance and facilitation on financial and contractual matters from the energy regulatory authority and other relevant authorities.

**[11.2.]** The Power Generator and enterprises with captive generators more than 1 MWp are encouraged to invest in renewable energy for a minimum of 2% of the total generation capacity by 2015. Over a period of 15 years, the same may be extended to at least 5% of the total power generation capacity.

**[11.3.]** Enterprises, Power Generator, or operator of the Centralized Effluent Treatment Plant (CETP) can deploy commercially viable technology to utilize solid waste (such as CETP sludge and others) as a source of power and heat generation. Enterprises, Power Generator, or CETP operator may seek assistance from the zone authority to enable linkages with agencies that can provide technological knowhow, implementation support, financial assistance etc.

**[11.4.]** The zone authority can install solar panels for street lights and other buildings of the zone authority in the EPZ with automatic dusk-to-dawn operation facility and be responsible for the operation and maintenance of these lights.

**[11.5.]** Pursuant to 11.4, the zone authority may consider the option of connecting the street lights to both solar and grid-connected power. In case solar power falls short of lighting requirements, grid power may be used as back-up, especially during monsoon seasons.
Enterprises can explore the setting up of rooftop solar panels, either to generate electric power (off-grid) or to generate hot water that can be used for process or non-process applications. The zone authority will facilitate linkages with experienced vendors who can provide and install rooftop solar panels.

Enterprises are encouraged to explore the potential for carbon revenue flow for implementation of renewable energy projects.

The zone authority shall arrange regular interactive sessions between the enterprises and (a) technology and equipment suppliers of renewable technology; (b) CDM consultants and experts; and (c) other industries that have successfully implemented CDM projects, to share their experiences.

CHAPTER 5: WASTE MANAGEMENT

Item 12: Solid Waste

Enterprises in the EZ shall try to optimize the total material use and utilize by-product materials and recycled materials subject to the constraints of zone infrastructure and process quality requirement.

Enterprises shall try to maximize waste recycling. The zone authority shall facilitate contracting with vendors and waste handlers to transport recyclable waste generated by enterprises to appropriate recycling facilities.

The zone authority shall coordinate with the Department of Environment (DoE) or other national agencies and research institutes to conduct capacity-building programs for enterprises on best-in-class waste management practices and national waste management guidelines and to support enterprises to treat waste in an environmentally friendly way.
Item 13: Sludge Waste

[13.1.] CETP sludge waste may be re-utilized based on its hazardous characteristics. If the generated sludge from a single CETP unit is insufficient, then the zone authority may take responsibility for accumulating sludge wastes of CETPs of all EZs and delivering it to suitable reuse facilities.

[13.2] The zone authority shall try to facilitate linkages, based on availability, with vendors that collect sludge waste from a single CETP or CETPs/ETPs across EZs. The zone authority shall promote public-private partnerships to attract investment in sludge waste management and re-use infrastructure.

[13.3] Following international practices, the zone authority shall encourage the achievement of ‘zero waste’ status for each of the existing EZs, subject to technological, infrastructural, financial, and informational constraints in each individual EZ.

[13.4] New EZs should be planned and developed to be ‘zero waste’ from the beginning of their operations. The zone authority should facilitate linkages between the new EZ developer(s) and international expert organizations with expertise in waste management.

CHAPTER 6: WATER MANAGEMENT

Item 14: In-factory Water Stream Recycling and Reuse

[14.1.] Enterprises are recommended to maximize the use of recycled water after the water is treated at the CETP or at individual enterprise’s ETP.

[14.2.] Enterprises shall meter and report their annual water consumption to the zone authority.
The zone authority shall coordinate with DoE and/or other national agencies or institutes to conduct capacity-building programs in EZs on advanced techniques and practices on industrial water management.

**Item 15: Groundwater**

**[15.1.]** Enterprises shall minimize groundwater intake. Enterprises that intend to use groundwater shall submit adequate justification to the zone authority for groundwater utilization and submit monthly reports to the zone authority on their groundwater intake quantity.

**[15.2.]** Once a water treatment plant starts operating, enterprises shall stop groundwater extraction. If any enterprise requires groundwater extraction, it must apply for approval from the zone authority. On approval, the zone authority shall apply the regular water tariff to the enterprise.

**Item 16: Rainwater Harvesting**

**[16.1.]** Enterprises shall provide their water demand data to the zone authority on an annual basis.

**[16.2.]** Based on the water demand data submitted by the enterprises, the zone authority shall determine the quantity of rainwater that has to be harvested for any given enterprise.

**[16.3.]** Enterprises can develop a facility for rainwater harvesting and meet the specified percentage (as determined by the zone authority) of their annual water demand through rainwater harvesting.
CHAPTER 7: GREEN BUILDING AND FACTORY

Item 17: Green Building Code

[17.1.] Enterprises shall design new buildings and factories or renovate existing buildings and factories to optimize energy, water, and material use, in order to improve efficiency in their consumption of energy, water, and other resources and materials.

[17.2.] New building designs shall take into account water use efficiency both from process water and facility water and fully capture and use precipitation and run-on water subject to their quality.

[17.3.] Enterprises are encouraged to maximize the usage of green construction materials (low life-cycle GHG impact), subject to their availability in the market, during construction of new buildings.

[17.4.] Enterprises are recommended to maximize the use of renewable energy sources in factories and facility buildings (such as passive solar architecture) subject to constraints of the amount and quality of energy required and location/setting of the EZ.

[17.5.] Enterprises can cover 25% of their net roof area with vegetated roof or high solar reflective index (SRI) material, subject to availability of space and SRI materials, if roof-top solar systems are not to be installed.

[17.6.] Enterprises shall maximize the adoption of retrofit energy efficiency improvement measures in the existing buildings, including insulation of walls and ceilings, upgrading HVAC systems, usage of LEDs, smart switch etc. and optimization of exposure to natural lighting.

[17.7.] The zone authority shall assist enterprises in EZs in knowledge transfer and linkages with green building consultants and vendors.
[17.8.] Until the time that a national green building code is enacted, the zone authority shall provide knowledge/information support and disseminate best practices on green/energy efficient building designs or retrofit. On establishment of a national green building code and a national nodal agency such as a Green Building Council, the zone authority shall coordinate with the nodal agency to conduct capacity development, training, and knowledge dissemination on green building techniques in EZs.

CHAPTER 8: CLEAN DEVELOPMENT MECHANISM AND CARBON CREDITS

Item 18: Explore CDM Potential and Participate in Carbon Market

[18.1.] The zone authority will conduct annual workshops to develop capacity on CDM and also to showcase successful CDM cases from the country. The case studies should discuss the CDM modalities and flow of carbon revenue to the projects. This will also encourage enterprises in CEPZ to explore CDM potential for GHG mitigation projects.

[18.2.] Enterprises shall identify potential CDM projects from the set of energy efficiency and low-carbon initiatives being implemented by them. Enterprises shall seek assistance from the zone authority to connect them with experts and validators who will help them in moving projects through the CDM process (project validation and registration) and realizing further monetary benefits.

[18.3.] The zone authority shall also look into the possibility of developing Programmes of Activities (PoA) for potential CDM projects in collaboration with DoE. This will help reduce CDM transaction costs for individual enterprises.
CHAPTER 9: INSTITUTIONAL SUPPORT

Item 19: Promotion and Facilitation of Energy Efficiency Improvement by BEPZA

[19.1.] The zone authority shall promote ‘Low-Carbon Zone’ as the zone authority brand and leverage the same in investment promotion activities at the national and international level.

[19.2.] The zone authority shall develop a ‘Green-Cell’ at its headquarters and in each EZ. This Green Cell is responsible for:

a. organizing awareness-generation and capacity-building sessions on energy efficient practices in relevant sectors in the EZ;

b. introducing focused EE improvement programs, e.g. a boiler efficiency improvement program, a compressor program, etc., and implement a post-program review mechanism to evaluate the effectiveness of such programs among EZ enterprises;

c. partnering with donor agencies to help companies conduct detailed energy audits;

d. developing new standards, protocols, and guidelines as necessary to improve energy, GHG, and resource performance;

e. providing the necessary technical assistance, knowledge, and information support to industries for reviewing their EE improvement plans, selecting appropriate vendors, implementing technical measures, and reviewing post-implementation performance;

f. facilitating access to finance for EE projects by partnering with banks/FIs or enabling linkages between industries and other national-level or sector-specific funds or programs; and

g. identifying potential options for industrial symbiosis and inter-company collaboration.
[19.3.] The zone authority shall engage in an advocacy effort with the government for new regulations on energy efficiency and clean energy.

[19.4.] The zone authority (with the help of the Green Cell) shall facilitate technology contracts or vendor contracts for low-carbon technology transfer or equipment installation.

[19.5.] The zone authority shall coordinate requirements with local and national-level ministries, agencies, and regulatory bodies.

[19.6.] The zone authority (with the help of the Green Cell) shall facilitate the exchange of ideas, knowledge, technology, and business models that support by-product and resource use and recycling.
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