Low Emission Development Strategies (LEDS) for the Transport Sector

INTRODUCTION

As cities continue to grow, especially in developing countries, there is an increasing need for sustainable transportation that is safe, reliable, and affordable. A low emission development strategy for the transport sector can achieve reduced greenhouse gas (GHG) emissions and a sustainable transport system that supports economic growth and other social and environmental co-benefits.

This document is a guide for identifying, selecting, designing, and implementing Low Emission Development Strategies (LEDS) for the transport sector.

Transportation is a complex system that can be organized into three analytical components: institutional, modal, and technological (Figure 1). The institutional component of a transport system is composed of economic and regulatory policies and planning institutions. This document focuses on four types of land transport modes:

- ***Non-motorized transport –*** *walking, cycling*
- ***Private motorized vehicles***
- ***Public transport –*** *bus, rail*
- ***Freight transport***

Lastly, the technology components ensure the effectiveness and efficiency of the multimodal transport system. These include vehicle and fuel technologies, system infrastructure, and innovative tools and organizations.

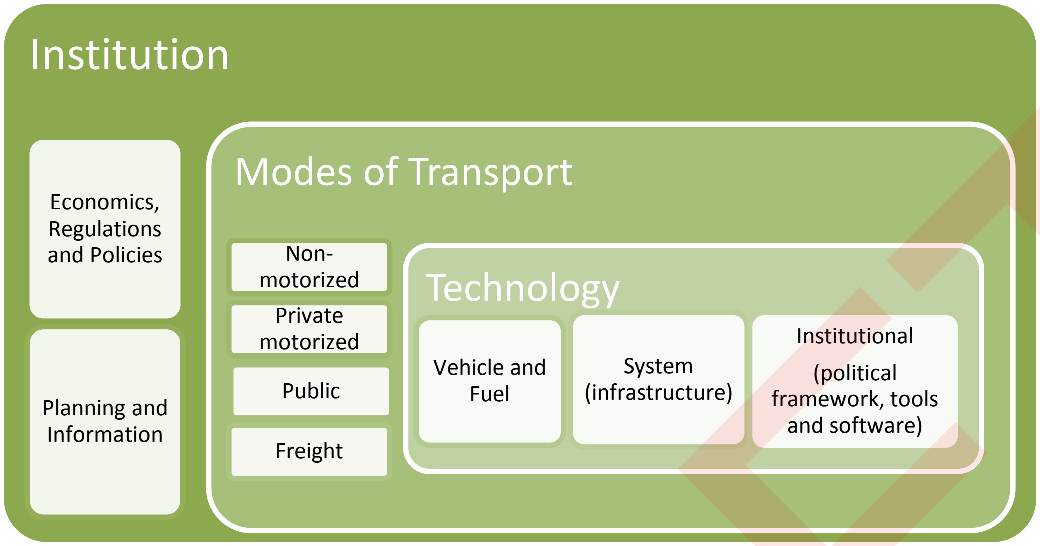


Figure 1: Components of a transport system

WHY IS SUSTAINABLE TRANSPORT IMPORTANT?

- ✓ Transportation is fundamental to **economic development** and growth.

Transportation impacts economic growth by facilitating trade, the delivery of goods and services, and by enabling access to employment, education, and health services. Transport systems connect people and businesses to domestic and international markets. In urban areas, sustainable transport has the potential to enhance economic growth by removing barriers that a typical transport system can cause, including increased congestion. Decreasing congestion can increase opportunities, decrease the cost of economic activity, raise standards of living, and be crucial in developing cities, where population growth tends to exceed economic growth. Additionally, effective, sustainable transport systems contribute to a country's economic vitality by connecting rural areas with one another and with urban centers, which is particularly important because per capita output of cities is significantly higher than that in non-urban areas.

Figure 2 highlights the economic benefits of well-designed, sustainable transport systems.

Enabling mobility, which in turn promotes production, and employment (direct and indirect), and thereby generates income.

Establishing networks between economic entities.

Expanding market size through improved economies of scale in production, distribution, and consumption.

Increasing productivity through the facilitation of a broader array of inputs to production (raw materials, parts, labor, energy) and outputs (goods and services).

Enhancing efficiency through time and costs savings for passengers and freight, and avoiding and reducing traffic congestion.

Ensuring security of energy supply through avoidance or reduction in overall energy demand.

Decreasing negative health effects through improved air quality and reducing traffic accidents.

Figure 2: Economic benefits of a sustainable transport system

A low-emission transportation system is also less likely to be dependent on oil for fuel and therefore should benefit national balance of payments and help insulate domestic markets from volatile swings in global commodity prices that can skew a country's priorities and wreak economic havoc on its economic aspirations.

- ✓ Sustainable transport enables **mobility** and improves **accessibility.**

Sustainable transport systems that provide access to jobs and services save time and strengthen and improve the livability and economic options of communities. Well-designed transport systems are safe and affordable and thereby broaden access to employment opportunities, reduce commuting times, and provide access to health, education, and other social services.

A sustainable transport system:

✓ Is **affordable**
✓ Is **convenient**, connecting important destinations in a network
✓ Creates a **healthy and safe** local environment
✓ Preserves ecosystem health and **limits GHGs**
✓ **Supports economic development** and growth
✓ Is **equitable**
✓ Respects and **preserves local cultural** and **natural** landmarks

✓ Sustainable transport impacts **quality of life, health,** and **safety**.

Integrated sustainable transport systems can improve the quality of life for communities, decrease air pollution, encourage active living, and reduce traffic accidents and fatalities. By reducing dependence on private vehicles, traffic congestion and noise pollution are alleviated, and transport-related emissions decrease. The decrease in air pollution improves air quality and citizens' health. In addition, well-designed, sustainable transport systems can reduce the number of traffic accidents and traffic-related fatalities, improving overall safety in a community.

✓ Sustainable transport can mitigate the effects of **climate change.**

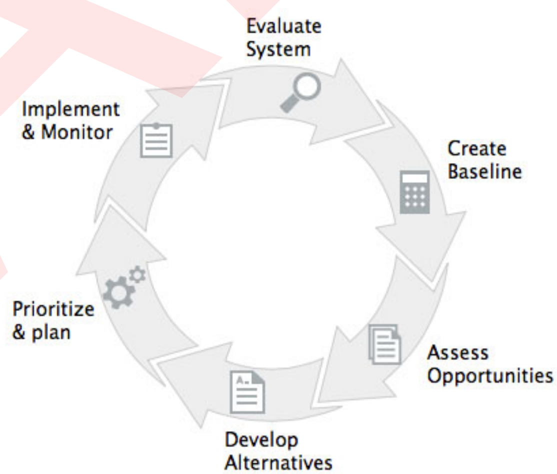
The transport sector represents about **15% of global greenhouse gas emissions** and 23% of global CO_2 emissions from fuels combustion (OECD/ITF, 2010). GHG emissions from transport have risen faster than those from all other sectors and are projected to rise more rapidly in the future if current trends continue in the next decades.

Between 2010 and 2030, transport-related GHG emissions are projected to increase by 30% (IEA, 2012). Much of this increase is anticipated to come from the developing world, with road transport (passengers and freight) responsible for 73% of the transport sector GHG emissions (IEA, 2012).

The next section provides guidance on how to design LEDS for the transport sector.

THE KEY ACTIONS FOR DEVELOPING LOW-EMISSION TRANSPORT SYSTEMS

The systematic development of LEDS allows for efficient and certain gains. The LEDS Framework sets forth the recommended key actions to develop and implement transport LEDS. A low emission development strategy is not a fixed process. The application of these actions must be flexible in adapting to a variety of existing and planned economic, social, and environmental conditions and strategies. Thus each implementing agency should customize its LEDS implementation framework by selectively choosing the resources needed to achieve a comprehensive, integrated, and stakeholder-based action plan for its transport sector. The actions described in this implementation framework are provided as guidance rather than as a prescriptive methodology.



Action 1: Evaluate the Existing System

The first step in LEDS development is to assess the status of existing transport systems. Transport systems refer to the infrastructure, vehicles, and management of all modes and routes of travel to move people and goods. A transport system is composed of the infrastructure network (e.g., roads, highways, rails, air and sea ports, fueling pipelines and stations), the vehicular components (e.g., scooters, cars, trucks, buses, trains, aircraft, ships), and regulatory and planning instruments (e.g., financial mechanisms and standards for maintenance, safety, quality, environmental impact) that allow the entire system to function.

To begin the strategic development process, research and evaluate existing transport information and data, including:

- ***Demand for transport services***—geographic population distribution, household incomes (and correlation with location), private motorized vehicle ownership by type (e.g., cars, trucks), vehicle miles traveled per capita, non-motorized transport, and travel patterns
- ***Supply of transport infrastructure and services***—types, conditions, cost efficiency, performance, and accessibility and location of existing systems, including roads, rails, mass transit routes and stations, and airports and marine ports
- ***Government institutions with jurisdiction over transport systems and relevant laws, policies, and frameworks***—regulatory, planning, and financial authorities
- ***Regulations and policies***—emissions limits, safety standards, speed limits, parking, road space allocation, production processes
- ***Financing mechanisms***—fuel taxes, road pricing, subsidies, purchase taxes, fees and levies, emissions trading
- ***Land use plans***—land use policies, practices, strategies, and programs

Develop BAU Scenario

Action 2: Create a Baseline

To track the status of strategic emissions and development improvements, baselines that measure current transport demand, supply, GHG emissions, and land use must be established and projected for several decades. The assumptions used in developing these "business as usual" (BAU), or no-action-taken, transport sector scenarios will build on and contribute to the broader BAU scenario developed in the country's overall strategic plans, including projections of the economy, population, development (e.g., income, health indicators) energy demand and supply, land use, and GHG emissions. Development of the transport BAU scenario, which assumes no low-emission transport system development and continuation of existing transport emissions trends, should be a collaborative process involving researchers, planners, and decision-makers. Together, these stakeholders must review existing transport scenarios and data, leading to a consensus long-term vision of "no action" for the transport sector and associated GHG emissions.

To estimate GHG emissions of the existing transport system, a good approach is the ASIF methodology developed by Schipper et al. and explained in *Measuring the Carbon Dioxide Impacts of Urban Transport Projects in Developing Countries*. The ASIF framework defines the four principal drivers of GHG emissions that come from the transport sector. These four components drive transport energy consumption and emissions and are where mitigation efforts should be focused: activity, structure, energy intensity, and carbon intensity.

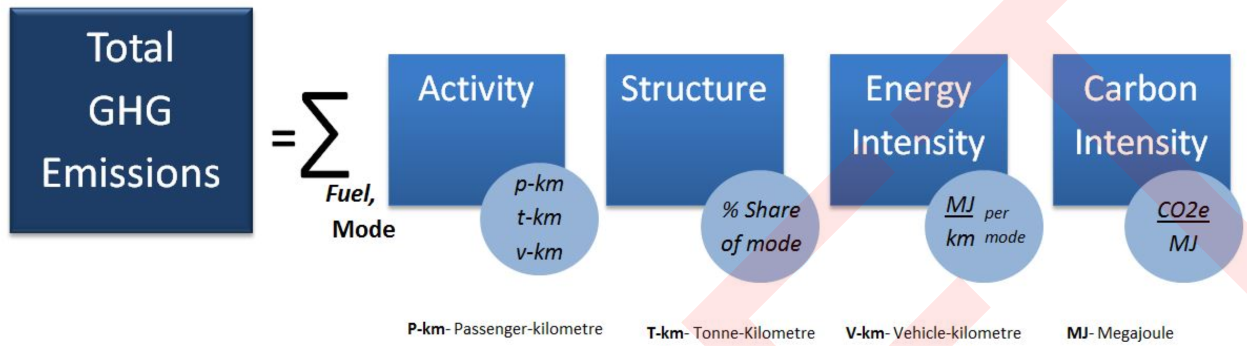


Figure 3: ASIF formula

Source: Authors based on Schipper and Marie-Lilliu, 1999

There are multiple factors influencing each variable of the ASIF framework; therefore, it is important to understand how each variable interacts and how policy measures can have contradictory effects on other variables. Categories of projects to address each component can be identified using the framework, including the responsibilities and key roles of each stakeholder.

Examples of factors that influence each variable include:

A = a function of [population, demographics, income, economy, urban form and size]

S = a function of [income, motorization rate, infrastructure provision, service provision, relative costs, urban form and size]

I = a function of [vehicle technology, driving cycles]

F = a function of [carbon content of fuels, potential for alternative fuel types] (Schipper, L. et al., 2000).

The ASIF framework is the foundation for the Avoid-Shift-Improve (ASI) strategy framework, which defines three principal ways to reduce GHG emissions from transport on the demand side and can help assess opportunities for sustainable transport development.

Assess Opportunities

Action 3: Assess Opportunities

A **holistic assessment** of transport development opportunities facilitates the ability to meet growing transport demand with less environmental impact. The ASIF framework explained in Action 2 is the foundation for the **Avoid-Shift-Improve** (ASI) strategy framework, which identifies the three primary ways to reduce GHG emissions from transport. The ASI strategy framework widens the focus of transport development beyond conventional technologies to include solutions that consider the policies and behaviors driving the demand for transport. Utilizing the ASI strategy framework enables stakeholders to consider more sustainable transport solutions and thus more effectively achieve their strategic low-emission transport development objectives.

The ASI strategy framework can guide economies to **avoid** the demand for transport, **shift** transport systems to less carbon-intensive modes, and **improve** transport infrastructure, technology, and policies. To achieve a cost-efficient shift to low-emission transport development, one must assess opportunities under all three facets of the ASI strategy framework (Figure 4).

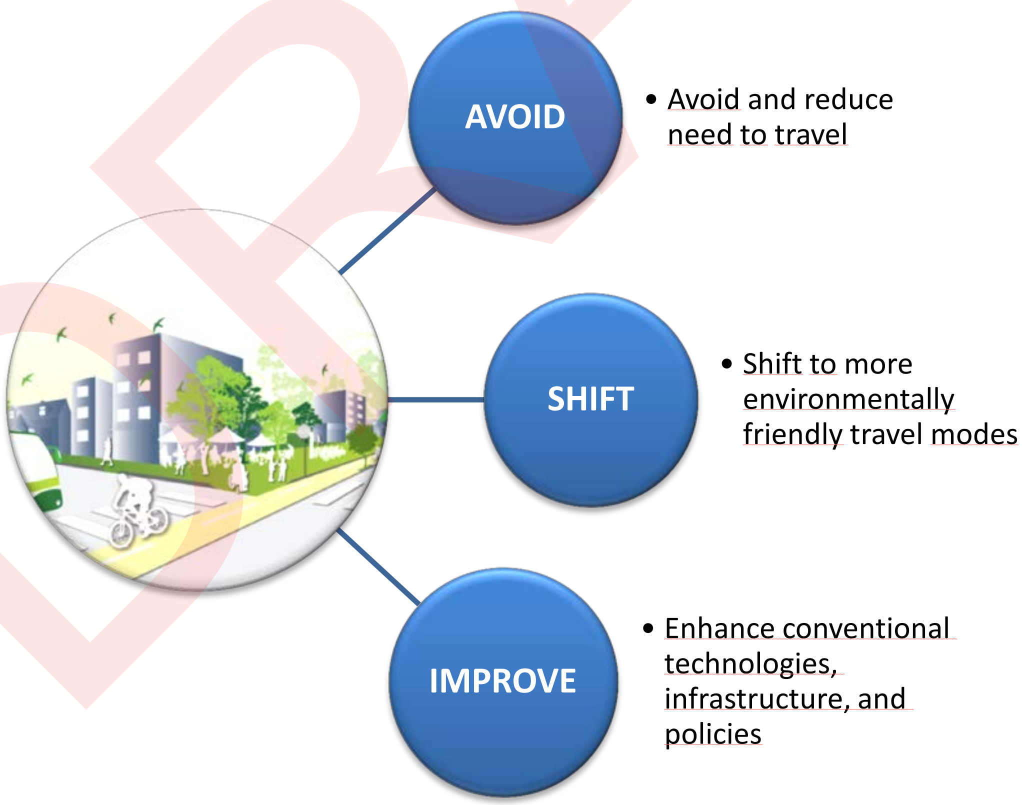


Figure 4: Avoid-Shift-Improve (ASI) strategy framework

Strategy 1: Avoid travel and reduce travel demand

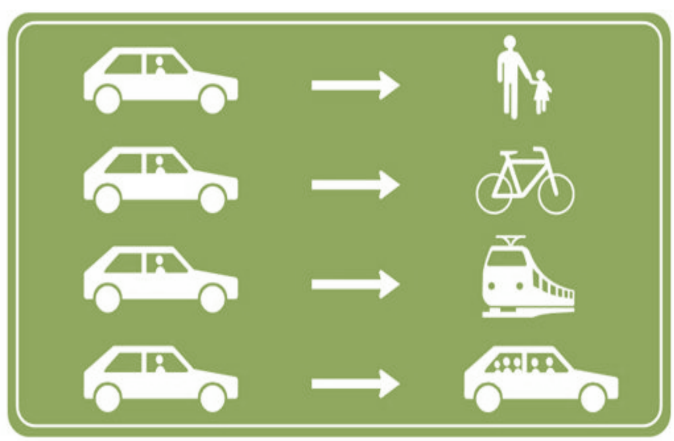
The first strategy of the ASI approach is to avoid travel by reducing or eliminating as many trips as possible by integrating land use planning, transport demand management, and transport infrastructure planning. This integration of planning can lead to convenient access to jobs, goods, and services. It also can result in reduced road vehicle use while preserving space for public and/or non-motorized transit, thereby sustainably reducing the number of trips taken and the associated GHG emissions.

Specific strategies to avoid unnecessary trips include:

- ✓ ***Mixed high-density spatial planning***
- ✓ ***Telecommuting/cyber-meetings***
- ✓ ***Smart logistics***

Strategy #2: Shift to lower-emission transport modes

Another strategy to explore is to shift to more environmentally friendly modes of transport, such as non-motorized transport, mass transit, and car sharing. Shifting how people travel or how freight is moved can reduce the overall fuel use and emissions per capita.



NON-MOTORIZED TRANSPORT:

- ✓ *Pedestrian*
- ✓ *Bicycle*

PUBLIC TRANSPORT:

- ✓ *Bus*
- ✓ *Train*
- ✓ *Bus rapid transit (BRT) systems*

CARPOOLING and RIDESHARING

- ✓ *Carpool/rideshare for vehicular commuting/travel*

Strategy #3: Improve technologies

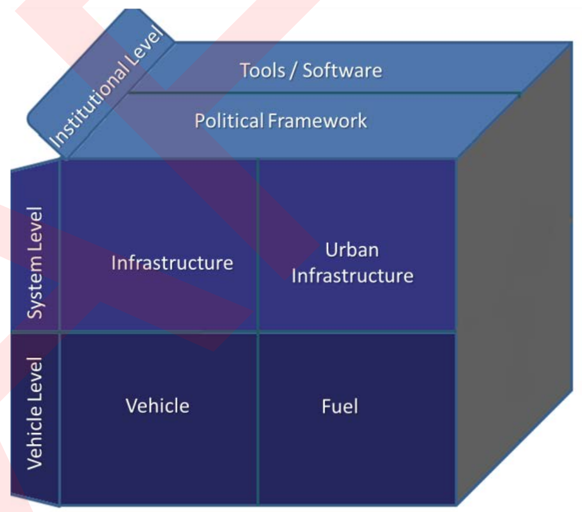


Figure 5: Transport technology framework

Under the ASI framework, the conventional interpretation of transport technology is broadened beyond traditional improvements to vehicles, devices, and fuels. Improvements made to technologies under this framework include the vehicle level, system level, and institutional level (UNFCCC, 2009). Balancing improvements made across all three levels can temper the typical high costs associated with transitioning to newer vehicle technologies. Each low-emission technology improvement example described below applies to the public transport sector as well as for public and private fleets. Also, not all examples are optimal for every transport system; therefore, researchers, planners, and decision-makers should focus on cost-effective and domestically available solutions.

Vehicle Level

- ✓ *Vehicle*: examples of low-emission improvements include cleaner or more efficient conventional petroleum-based systems, such as hybrid-electric and dual-fuel vehicles; non-petroleum fuel vehicles such as natural gas, hydrogen fuel cell, and battery electric vehicles; and component improvements

- ✓ *Fuel*: examples of low-emission improvements include cleaner-burning or low-sulfur conventional petroleum fuels; alternative fuels such as biofuels (ethanol and biodiesel), natural gas, and propane; fuel-cell systems that run on hydrogen, and rechargeable battery systems that are charged by electricity (preferably renewably sourced)

System Level

- ✓ *Infrastructure*: technology improvement examples include reserving or reclaiming space for non-motorized transport modes, reserving or reclaiming space for mass transit modes, park and ride offerings, vehicle parking distribution, reducing demand for private vehicle ownership through short-term rental bike-share and car-share systems, and real-time parking/traffic information systems
- ✓ *Urban planning*: examples include mixed-use and dense development along multimodal transport routes, and transit-oriented development

Institutional Level

- ✓ *Political framework*: improvement examples include transport-influenced land-use planning and zoning, economic and fiscal instruments (e.g., fuel taxation, congestion pricing, parking tariffs, low-emission vehicle tax incentives, alternative fuel production subsidies), and public awareness marketing campaigns
- ✓ *Tools and software*: examples include scenario tools and models (e.g., land-use transport integrated (LUTI) models), mobile device applications (e.g., map of mass transit system, car-sharing tools), software tools (e.g., traffic demand management tools), and website forums to organize and publicize non-motorized transport options and events

Action 4: Develop Alternatives

After careful consideration of the various low-emission transport development opportunities that stem from the ASI framework, integration of those opportunities into alternative transport development scenarios, and then comparing those scenarios to the BAU scenario, is crucial to deploying an effective transport LEDS.

As a first step, it is useful to establish short-term and long-term development **objectives** for the transport system. These development objectives should address problems and limitations with the existing transport system, in terms of both infrastructure and policies, as assessed in Action

1. The objectives must also be based on current and projected demand stemming from development in other economic sectors. For example, if industrial development is planned to occur at a certain pace and scale, that scenario would affect the transport development approach necessary to meet the impending growth in demand. These alternative scenarios must be developed from both the perspectives of the consumers (e.g. travelers and merchants) and from those with political and civic responsibility to construct, regulate, maintain, and manage low-emission transport system infrastructure and policies.

Analysis of development objectives should consider why transport system problems arose and why they have not been addressed yet. Barriers to addressing transport sector and system problems may include:

- Rapidly increased demand (resulting from massive urban migration, for example)
- Resource constraints
- Antiquated underlying policies, regulations, and investment programs
- Lack of coordination between government ministries, between national and local governments, and with other transport sector stakeholders such as agriculturalists, business enterprises, and international partners

Additionally, it is appropriate to account for the capacity of transport development strategies to attract private investment and the technical capacity available to implement a project or proposed policy.

The next step, once objectives are defined, is to match objectives with previously identified optimal low-emission transport development opportunities from Action 3 to begin evaluating alternative transport development scenarios for potential implementation. The process of linking objectives with low-emission development options to produce these scenarios should consider technical capacity and cost. At this point, planners should be ready to identify and assess several alternative transport development scenarios in an integrated economy-wide analysis, which then can be compared with the BAU scenario to determine optimal impact based on each alternative scenario.

Prioritize and Plan

Action 5: Prioritize and Plan

Once issues are understood, goals established, and transport scenarios identified and developed for potential application, the next steps are to prioritize those scenarios and adopt a sustainable transport development plan. Alternative low-emission transport development scenarios should be evaluated and prioritized in terms of the following factors:

- ✓ Benefits and costs
- ✓ Economic development impacts
- ✓ GHG emission levels
- ✓ Technical, institutional, and regulatory capacity
- ✓ Market acceptance
- ✓ Barriers to successful deployment (e.g., economic, financial, infrastructure, legal)
- ✓ Applicability of international policy best practices and lessons learned

The transport policies and systems that constitute a well-designed development plan should ensure economic, environmental, and social benefits, including increased employment, enhanced mobility, expanded market access, improved health and safety, reduced congestion, and reduced or avoided emissions. The plans should also estimate certain expected reduced costs by calculating impacts of the newly adopted policies and systems. For example, improved mobility and safety should result in a reduction of the costs associated with congestion and accidents.

To ensure reduced or avoided emissions as part of LEDS, assess the GHG emission results from the various transport development scenarios. To track GHG emissions, local, regional, and national governments can use a variety of GHG accounting tools that collect emissions data on a number of topics:

- Current emissions
- Projections of future emissions for BAU and alternative development scenarios
- Change in emissions from different fuel choices, vehicle technologies, and transport modes

GHG accounting tools can help develop a baseline that emissions from selected mitigation actions can be measured against to determine the success of a project. The Partnership on Sustainable Low Carbon Transport (SLoCaT) offers a list of available tools to assess GHG emissions in the transport sector.

After evaluating the benefits, costs, emissions, and other economic, environmental, and social impacts of the various development scenarios being considered, a distinct transport development plan can be selected and adopted. The final step is to achieve successful LEDS is to plan for implementation and monitor the actual impacts.

Action 6: Implement and Monitor

In this final stage of the LEDS framework, a clear action plan for implementing development projects is initiated. The implementation action plan defines a timetable, roles and responsibilities, financial sources, performance metrics, outreach and partnership activities, and a plan for continuous monitoring and refinement. The action plan should also set regular monitoring of the various projects with progress assessed using objective timelines and critical path milestones. Proper measurement, reporting and verification (MRV) mechanisms should be established. Measuring performance establishes whether a strategic objective is fulfilled.

The importance of the role that strong domestic institutions play in determining successful LEDS implementation cannot be understated. Transport development projects are by nature a collaborative processes because they are typically complex, relatively expensive, and involve many stakeholders (e.g., government ministries, NGOs, consumers, businesses, financial institutions). As such, relevant stakeholders should be sufficiently empowered and included in every step of the LEDS implementation process to secure maximum economic, environmental, and social benefits and hopefully attract sufficient and effective funding mechanisms.