

Are we building competitive and liveable cities?



Guidelines for developing
eco-efficient and socially inclusive infrastructure



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THE EARTH INSTITUTE COLUMBIA UNIVERSITY

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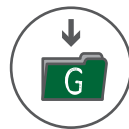
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Are we building competitive and liveable cities?

Guidelines for developing eco-efficient and socially inclusive infrastructure

Increase your city's competitiveness and quality of life through environmental improvements:

Responding to the challenges posed by rapid urbanization, globalization and climate change requires an urgent shift in the way urban infrastructure is planned, designed and managed: it must be eco-efficient and socially inclusive.



Eco-efficient and socially inclusive infrastructure can:

- be a driver of economic growth and competitiveness
- increase employment opportunities
- contribute to poverty alleviation
- improve quality of life
- enhance energy security
- improve the environment
- avoid future costs and risks.



Do more with less

Eco-efficiency is a management philosophy that encourages municipalities, businesses and communities to seek environmental improvements that generate parallel economic and social benefits. Doing this in an inclusive way guarantees equal opportunities for all people.



Deliver services to all

Applied to infrastructure, the concepts of eco-efficiency and inclusiveness are concerned with expanding the access to and quality of services, such as housing, transport, energy, water and waste treatment, while reducing costs and environmental problems, such as pollution, inefficient energy use and traffic congestion.



Achieve win-win situations

Infrastructure systems need to be rethought and redeveloped according to eco-efficiency and inclusive principles and criteria. Essential strategies for cities to achieve win-win situations and develop into attractive, competitive and liveable places are leadership, long-term vision, integration across sectors and institutions, public participation and building the business case for eco-efficient solutions.



Dr. Noeleen Heyzer
 Under-Secretary-General of the United Nations
 and Executive Secretary of
 United Nations Economic and Social Commission for Asia and the Pacific
 (UN-ESCAP)

The Asia-Pacific region is experiencing rapid urbanization. By 2030 2.6 billion people, or 50% of the population in the region, will be living in cities and towns – twice as many as in the year 2000. Just to put this number into perspective, we need to provide jobs, housing, energy, water, transport, education and health infrastructure for an additional 120,000 people – every day – for the next 20 years. This is a daunting challenge, considering that many governments are finding it difficult to meet even the needs of existing urban populations. At the same time, urban governance landscapes and institutional requirements are evolving. Local authorities are now required to cover a broad range of specialties, including housing, infrastructure, social and community services, local economic development, environmental protection and even climate change.

These Guidelines aim to provide practical tools to city planners and decision makers for addressing these challenges. By reforming urban planning and infrastructure design according to the principles of eco-efficiency and social inclusiveness we can lay the foundations for competitive, vibrant and liveable cities.

Dr. Noeleen Heyzer
 Under-Secretary-General of the United Nations
 and Executive Secretary of ESCAP



Alicia Bárcena
 Under-Secretary-General of the United Nations
 and Executive Secretary of
 United Nations Economic Commission for Latin America and the Caribbean
 (UN-ECLAC)

The Economic Commission for Latin America and the Caribbean (ECLAC) has long devoted substantial research efforts to the crucial relationship between sustainable growth, social welfare and economic development.

The issue of eco-efficiency has continued to gain prominence in Latin America and the Caribbean. Latin America is the most urbanized region in the world, with approximately 76% of its population living in urban areas. With cities growing so rapidly, the region is at an important crossroads in terms of urban development and its future will depend heavily upon the real, long-term sustainability of urban systems. The adoption of eco-efficiency as a core urban value will require a thoroughgoing change in the way cities function and develop. This will hinge upon cohesive decision-making which takes into account urban growth as a whole and the long-term implications of both public and private decision-making.

This project aims to deliver important information, methodologies and guidelines for use by city planners and other prominent decision makers throughout Latin America and the Caribbean and Asia, applying eco-efficient criteria to reduce emissions, save energy and natural resources, and enhance social inclusion. ECLAC views this project as an important milestone in the ongoing efforts surrounding eco-efficiency and sustainable urbanization. We look forward to continuing the global dialogue on urban and regional eco-efficiency and to exchanging experiences in order to learn from each other's know-how and expertise.

Alicia Bárcena
 Under-Secretary-General of the United Nations
 and Executive Secretary of ECLAC



Dr. Joan Clos,
Under-Secretary-General of the United Nations
and Executive Director of
United Nations Human Settlements Programme
(UN-HABITAT)

Urbanization is characterized by the demographic and economic dominance and transformation of cities. We also witness the rapid spatial expansion of many urban settlements, leading to the emergence of more megacities and mega-urban regions. For many local governments the resulting challenges, such as extremely high demand for infrastructure investments, are amplified by persistent local issues such as rising informality, poverty and inequality within cities as well as global forces, including globalization, climate change and increasing natural and human-caused disasters and conflicts and high energy costs.

These guidelines use sustainable urban infrastructure as the entry point for building sustainable cities. Sustainable urban infrastructure can only be built if we reconsider our strategic view of urbanization – if we rethink the future of cities. A new strategy based on more effective urban planning, strengthened local institutions and governance processes as well as enhanced economic contribution of cities is needed. Only Infrastructure that is energy and eco-efficient, that serves the economic development of cities and supports the betterment of all citizens can be sustainable.

Dr. Joan Clos
Under-Secretary-General of the United Nations
and Executive Director of UN-HABITAT



Dhaka, Bangladesh

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Purpose of the guidelines and target audience

The guidelines have been developed to inspire change among local governments (and other actors in the field of urban development) in the planning, designing and managing of urban infrastructure. The goal is to encourage an integrated approach, taking into account principles and criteria of eco-efficiency and social inclusiveness. Such an approach will help decision makers and planners identify and prioritize win-win solutions that lead to improved competitiveness of a city and the quality of life of its inhabitants, including the poor, through environmentally sustainable urban development. Such development boosts a city's attractiveness to both investors and residents. The foremost messages of the guidelines have been extracted for the executive summary to inform mayors and other urban decision makers about pressing urban challenges and strategy options to address them.

The guidelines provide a framework of approaches and tools that can be applied in different degrees of depth and breath, according to the level of resources and capacities of each city. Therefore, they provide a useful reference for any city, regardless of its size or level of development.

How to read these guidelines

The guidelines address why it is important to build urban infrastructure in an eco-efficient and inclusive way (part 1), what strategies planners can use to ensure eco-efficient and inclusive outcomes (part 2) and how they can use the strategies throughout a strategic planning cycle (part 3). These chapters build on best practices examples, some of which are further described in part 4.

The guidelines are developed in the context of the project Eco-efficient and sustainable urban infrastructure development in Asia and Latin America, funded by the Development Account of the United Nations. The guidelines reflect knowledge accrued in the course of the project through analytical studies, meetings of experts, case studies and pilot projects. Since the geographical scope of the project was confined to Asia and Latin America, examples, case studies and good practices mentioned in the publication refer to these two regions.

The ideas and strategies contained here are also used in a training supplement for urban decision makers and planners, intended for use with the guidelines. The guidelines, its executive summary and the training module are available online at:

www.unescap.org/esd/environment/infra/

www.eclac.cl/ecoeficiencia/default.asp?idioma=IN

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1 Addressing the urban challenge



Dhaka, Bangladesh

WHY do we need eco-efficient and socially inclusive urban infrastructure?

Delivering services to all people in a time of rapid urbanization and severe environmental challenges is critical.

The way we design, plan and build our cities and their infrastructure is critical for developing competitive and liveable cities. Cities are already suffering from severe environmental problems, such as pollution, congestion and excessive waste, while the basic needs of hundreds of millions of urban residents are yet to be met. The unprecedented urbanization imposes an even greater challenge for providing adequate housing, energy, water, sanitation and mobility to all.

Cities are at a crossroads. Choices made in urban infrastructure development today will determine the success of cities in delivering services to everyone while growing competitively within a protected environment for decades to come.

Decision makers need to adapt as much as infrastructure – choices made need to be based on eco-efficient and socially inclusive principles and criteria in order to realize necessary win-win situations, and to build competitive and liveable cities through environmental improvements.

Box 1

Introduction to the concepts of eco-efficiency and social inclusiveness

Eco-efficiency basically means “doing more with less”. It is a management philosophy that encourages municipalities, communities and businesses to seek out environmental improvements that generate parallel economic benefits.¹

Social inclusiveness refers to treating all people in a city equally in their access to work and services, such as public transport and health care. “Inclusive” generally refers to planning and decision-making processes that include a broad range of people from across a city, ranging from experts to ordinary residents, with the aim of considering their inputs and reaching mutual agreement.²

Together, these concepts maximize economic, environmental and social benefits.

1.1 Why focus on cities?

Cities of hope, cities of despair

Contemporary urban challenges ask for an approach that address economic, social and environmental problems at once.

- ↘ Cities grow very fast.
- ↘ Cities are centres of economic development.
- ↘ Cities concentrate poverty.
- ↘ Cities are responsible for creating most of the waste and pollution.

Urbanization

Towards a global city

Urbanization is an increasingly significant trend and is bound to have a crucial impact on economic, social and environmental development. The proportion of people living in urban areas has been steadily increasing over the past few decades and is projected to continue expanding. In 2030, some 2.6 billion people will live in cities and towns across Asia and the Pacific.³ This is equivalent to adding an entire new city of 3.5 million people, approximately the size of Singapore, every month for the next 20 years.⁴ In Latin America and the Caribbean, 80% of the population already lives in cities. Although this is the largest proportion in the world, this figure is projected to grow to 85% by 2030,⁵ adding pressure to cities with already saturated infrastructure.

Economic prosperity

Cities as engines of growth

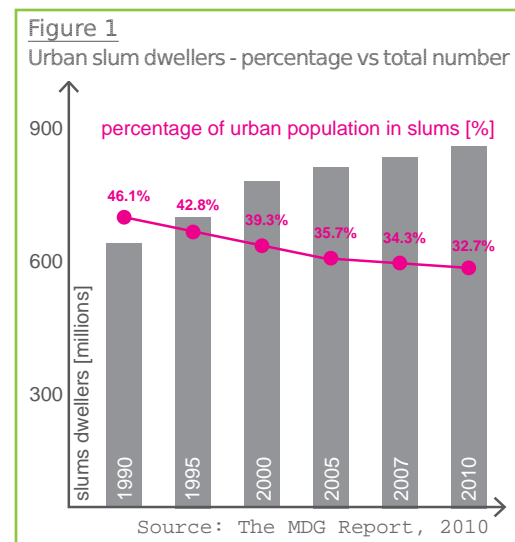
The prosperity of nations is closely linked with the way the growth of their cities is shaped. People dwell in cities as do enterprises, which are responsible for a great share of the national gross domestic product (GDP).⁶ In Asia, more than 80% of the region's GDP is produced in cities and towns;⁷ Bangkok alone accounts for 38% of Thailand's GDP.⁸ In Latin America and the Caribbean, city economies can be bigger than some neighbouring national economies. The GDP of Buenos Aires,⁹ for instance, is three times bigger than the national GDP of Ecuador.¹⁰

Social inclusiveness

Urbanization of poverty and access to basic services

We live in cities because they offer us access to employment, education, health care, goods and services. In other words, cities are centres of development. However, life in a city is not equal for all of its residents. Approximately 30% of urban residents in Asia and 23% in Latin America and the Caribbean still live in slums¹¹ - without access to basic services, such as housing, clean water and sanitation. The number of people living in urban slums in India,¹² for instance, exceeds 100 million - which is more than the entire population of the Philippines.¹³ In Brazil, 45 million people live in slums¹⁴ - almost three times the entire population of Chile.

Even though the percentage of people living in slums is decreasing, the total numbers in the developing world are still rising due to the population growth.



Environmental sustainability

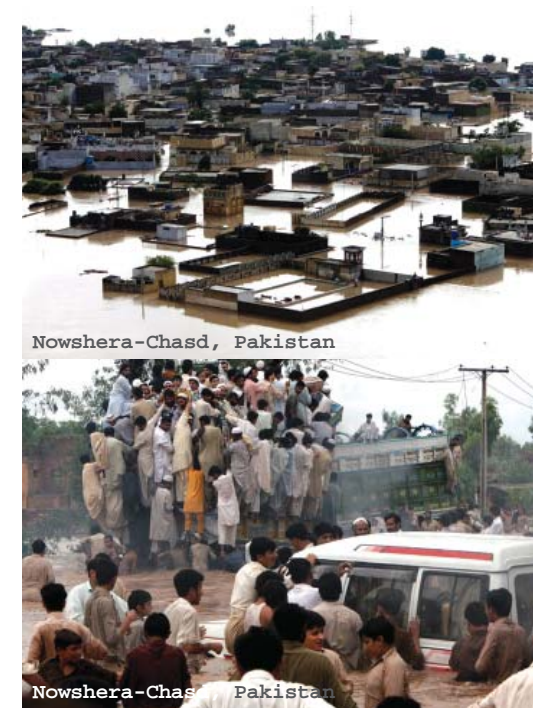
Huge ecological footprints

Cities occupy 3% of the Earth's land surface, house half of the human population, use 75% of the resources and account for approximately 70% of the CO₂ emissions¹⁵ - cities have enormous ecological footprints.

Due to the rapid urbanization that we are currently experiencing, these footprints are expanding and putting unmanageable pressure on the planet. The environmental health of cities goes well beyond local environmental problems (such as air pollution or waste) and affects issues of national or even global relevance (such as energy security or climate change).

Unprecedented challenge

These trends present a tremendous challenge to policy makers and planners in Asia and Latin America who need to provide essential services to a fast-expanding urban population and maintain national competitiveness in the global economy while minimizing their ecological footprints. The way in which urban infrastructure is built and operated now will be a deciding factor in whether Asian and Latin American cities can meet the challenge.



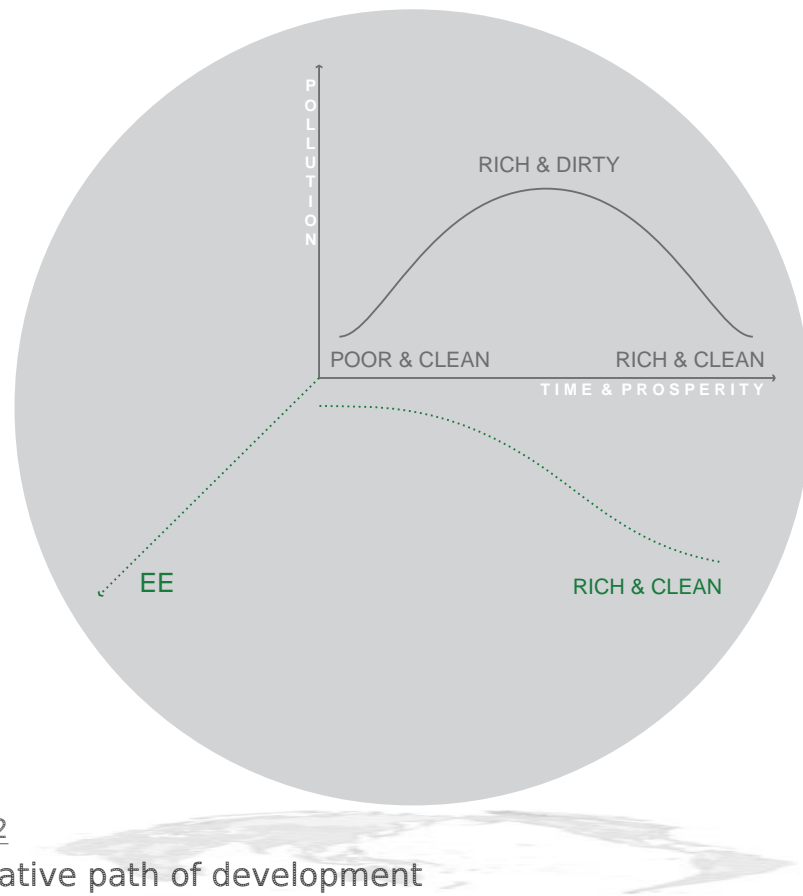


Figure 2

Alternative path of development

With regard to pollution, it has been suggested that countries progress through an “Inverted U curve” of environmental development or **Environmental Kuznets curve**. “They start poor and clean, then they industrialize and get rich and dirty, and then they are rich enough so that they can afford pollution control so they ultimately end up rich and clean” as von Weizsacker said.¹⁶ This implies that even though a city may be facing serious environmental problems now, it may eventually outgrow and overcome these problems if its economy can keep growing. As Newton has warned, some policy makers in developing countries have interpreted such results as conveying a message about priorities: “Grow first, clean up later”. But this is likely to be “blind optimism”.¹⁷

Furthermore, the “Grow first, clean up later” approach may lead to irreplaceable degradation of the natural environment.

It is necessary to find an **alternative axis** that would not tie prosperity with pollution. Developing countries would ideally avoid “Rich and Dirty” phase and go into “Rich and Clean” phase via an alternative path of development.

May we argue that **Eco-efficiency** is that new axis?

1.2 Why focus on infrastructure?

Shaping our cities, shaping our lives

Infrastructure determines the competitiveness, liveability and environmental health of cities.

↘ There is a strong correlation between the infrastructure and environmental health, economic competitiveness and the quality of life in our cities.

↘ Infrastructure has a long lifespan and once built, it locks cities into consumption and production patterns for decades. These patterns can have positive or negative outcomes, depending on how the infrastructure is designed.

↘ Both Asia and Latin America need to invest heavily in the coming years in infrastructure development to achieve and sustain socio-economic development goals.

Infrastructure provides the foundation for our socio-economic systems. It affects economic competitiveness, social inclusiveness, quality of life and environmental health. Its influence can be direct and indirect, immediate and long term. In most cases, it is the direct and immediate contribution of infrastructure to economic growth that receives the attention of policy makers, at the expense of long-term environmental protection – often perceived as a trade-off. Yet, environmental sustainability directly links to both economic competitiveness and quality of life.

Transport infrastructure, for example, is one of the drivers shaping cities and determining the urban landscape, which in turn has implications on energy use and greenhouse gas emissions. It is also a defining element in the liveability and competitiveness of a particular city.

Urban planning and design can have great influence on energy consumption and greenhouse gas emissions. Developing car-centred transport infrastructure leads to urban sprawl, which in turn leads to car-dependent development and, thus, higher energy consumption and more greenhouse gas emissions. On the other hand, building a city around public transport networks can help maintain high densities, making public transport accessible and commercially viable, and thus reducing energy consumption and greenhouse gas emissions. Japan's urban areas are around five times denser than, for instance, Canada's, and the use of energy per capita in Japan is around 40% of Canada's.¹⁸

Urban sprawl has been a trend mainly associated with North American cities but is quickly extending to many developing countries. Asian cities have very high densities and low per-capita energy consumption. Thus, they have the potential to be very healthy. However, rapid urbanizing and motorizing coupled with a prioritizing of car-centred infrastructure (rather than public transport) is leading to unhealthy urban development in many Asian cities.

Improper planning and urban design also adds to environmental degradation. Such is the case around several cities in Latin America where significant damage has been caused to environmentally sensitive areas. These include Panama City, Panama, and its surrounding Canal Zone, Caracas, Venezuela, and its adjacent coastline, San José, Costa Rica, and its mountainous area and São Paulo, Brazil, and its water basins.¹⁹

Infrastructure developments tend to be very resource intensive and generate pollution throughout their life cycle. The buildings and construction sector, for example, accounts for the largest share of natural resource use.¹⁸ Buildings contribute up to 30% of global annual greenhouse gas emissions and consume up to 40% of all energy.²⁰ The transport sector accounts for 23% of global energy-related CO₂ emissions, and it is the fastest-growing source of emissions in developing countries.²¹

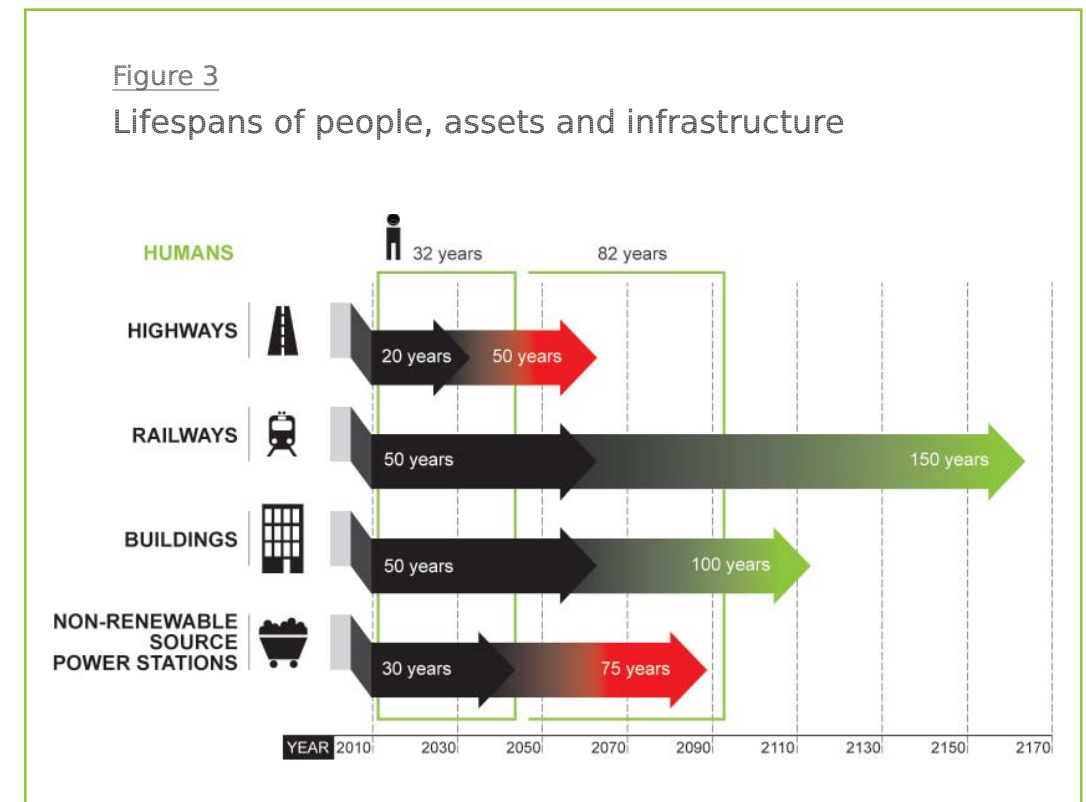
These are not just environmental problems: higher energy consumption means higher

energy bills, which in the long term has a negative impact on energy security and economic competitiveness. The same holds true for other effects of untenable urban infrastructure development, such as traffic congestion. Many cities in both Asia and Latin America suffer from traffic congestion, the cost of which can be as high as 10% of the city's GDP, as is the case in Lima, Peru. Traffic congestion in Bangkok is responsible for a loss of 6% of its GDP and 2.1% of the whole nation's annual GDP.

Lock-in effect

A crucial issue with infrastructure is that it has a long life span, as shown in figure 3. It locks cities into consumption and production patterns for decades because infrastructure is difficult and costly to modify once it is built.

To support the increase in motorization, transport infrastructure investments over the next 5-10 years will lock in transport-related CO₂ emission patterns for the coming 20-30 years in Asia.²² If business-as-usual practices continue, greenhouse gas emissions from buildings will more than double in the next 20 years.²³



Cities at a crossroads

Both regions (Asia-pacific and Latin America and the Caribbean) need to invest heavily in the coming years in infrastructure development to meet and sustain socio-economic development goals. **Infrastructure investments in Asia must reach an estimated US\$10 trillion over the next 10 years,**²⁴ while **Latin America and the Caribbean need to invest US\$1.3 trillion over the next 10 years.**²⁵ Choices made today will determine the competitiveness, quality of life and environmental tenacity of cities in both regions for decades to come.

Despite the degree of poverty, inequalities and environmental degradation that characterizes the current state of cities, urbanization can be positive and can be a

great contributor to ecologically innovative development. By concentrating people and resources, cities can provide the necessary economies of scale and solutions for delivering the required goods and services to the population at affordable prices and with lower environmental impact. Cities concentrate poverty, but they also represent the best hope of escaping it. Cities can create environmental problems, but they can also provide solutions.²⁵

How do we exploit the positive possibilities? How can we turn challenges into opportunities? Investing in eco-efficient infrastructure can make a phenomenal difference in whether cities in Asia and Latin America become inclusive and liveable.

1.3 Why focus on eco-efficiency? Doing more with less

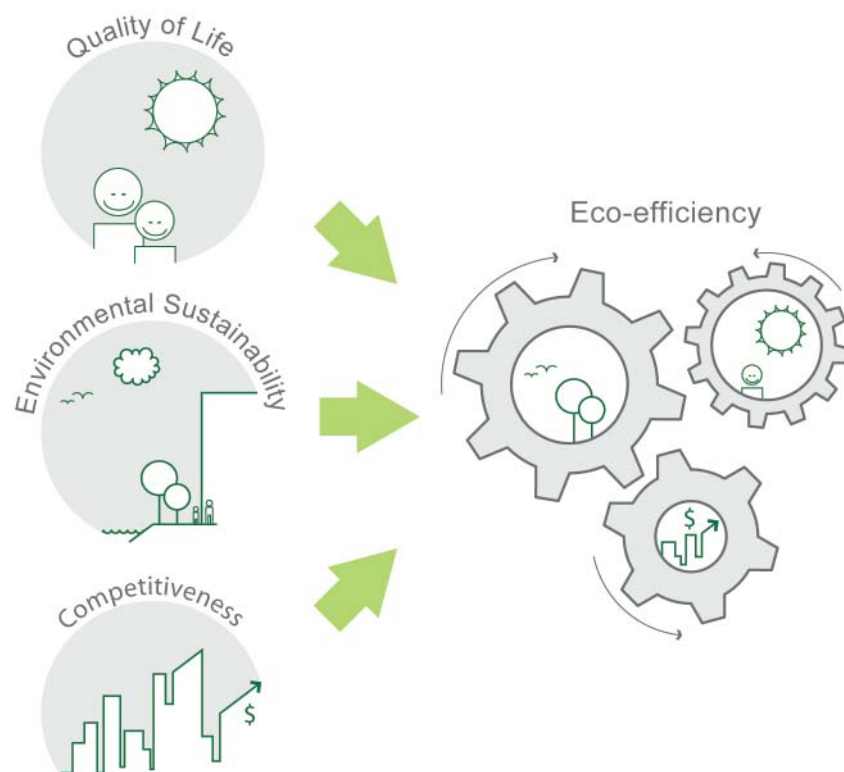
We need to design and develop urban infrastructure that is sustainably eco-efficient.

- The concept of eco-efficiency seeks to develop synergies between the economy and the environment rather than just balance the trade-offs.
- An eco-efficient approach to urban infrastructure development can help governments save precious financial resources.
- Eco-efficiency can wisely drive green growth and green economies.

Figure 4
Business-as-usual vs. Eco-efficient and inclusive urban development



Figure 5
Eco-Efficiency Principles



Box 2

The concept of Eco-efficiency

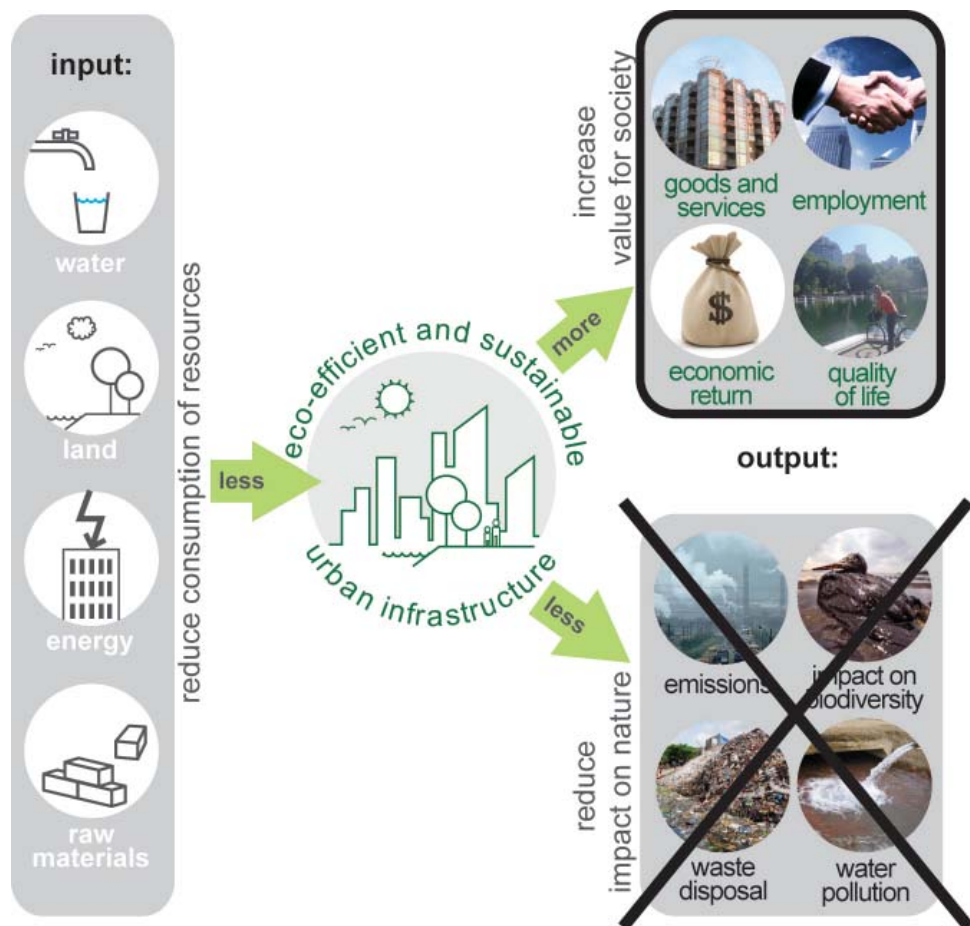
As defined by the World Business Council for Sustainable Development, “eco-efficiency” is achieved by the delivery of competitively-priced goods and services that satisfy human needs and generate better quality of life while progressively reducing ecological impacts and resource intensity throughout the life cycle to a level at least in line with the Earth’s estimated carrying capacity. In short, it is concerned with **creating more value with less impact**.

Eco-efficiency is a management philosophy that encourages businesses to search for environmental improvements that yield parallel economic benefits. It focuses on business opportunities and allows companies to become more environmentally responsible and more profitable. It fosters innovation and thus growth and competitiveness. Eco-efficiency calls for businesses to achieve more value from lower inputs of materials and energy and with reduced emissions. It is concerned with three broad objectives:

1. **Reducing the consumption of resources.**
This includes minimizing the use of energy, materials, water and land, enhancing recyclability and product durability and closing the loop of material production and consumption.
2. **Reducing the impact on nature.**
This includes minimizing air emissions, water discharges, waste disposal and the dispersion of toxic substances as well as fostering the sustainable use of renewable resources.
3. **Increasing product or service value.**
This means providing more benefits to customers through product functionality, flexibility and modularity, providing additional services and focusing on selling the functional needs that customers actually want.

Source: World Business Council for Sustainable Development,
Eco-efficiency: Creating More Value with Less Impact (2000)

Figure 6
Representation of urban metabolism model



Eco-efficiency combines economic efficiency with “ecological efficiency” and essentially means creating more goods and services with ever less use of resources while creating less waste and pollution.²⁷

The concept was developed by the private sector in the early 1990s in an attempt to overcome the apparent conflict between economic profitability and environmental protection (box 2). It focuses on environmental improvements that yield parallel economic benefits – achieving synergies rather than trade-offs.

Eco-efficiency and the city Cities as living organisms

People live in cities to access employment, education, health care, goods and services. Resources like energy, water, raw materials and land are the inputs required to deliver them. Unfortunately, this process produces waste and pollution. The quality of life of all residents as well as the economic competitiveness and environmental health of cities depends on the efficiency of this “urban metabolism”.

Applying the concept of eco-efficiency to urban areas means creating more value for citizens while reducing the use of resources and the production of waste and pollution.

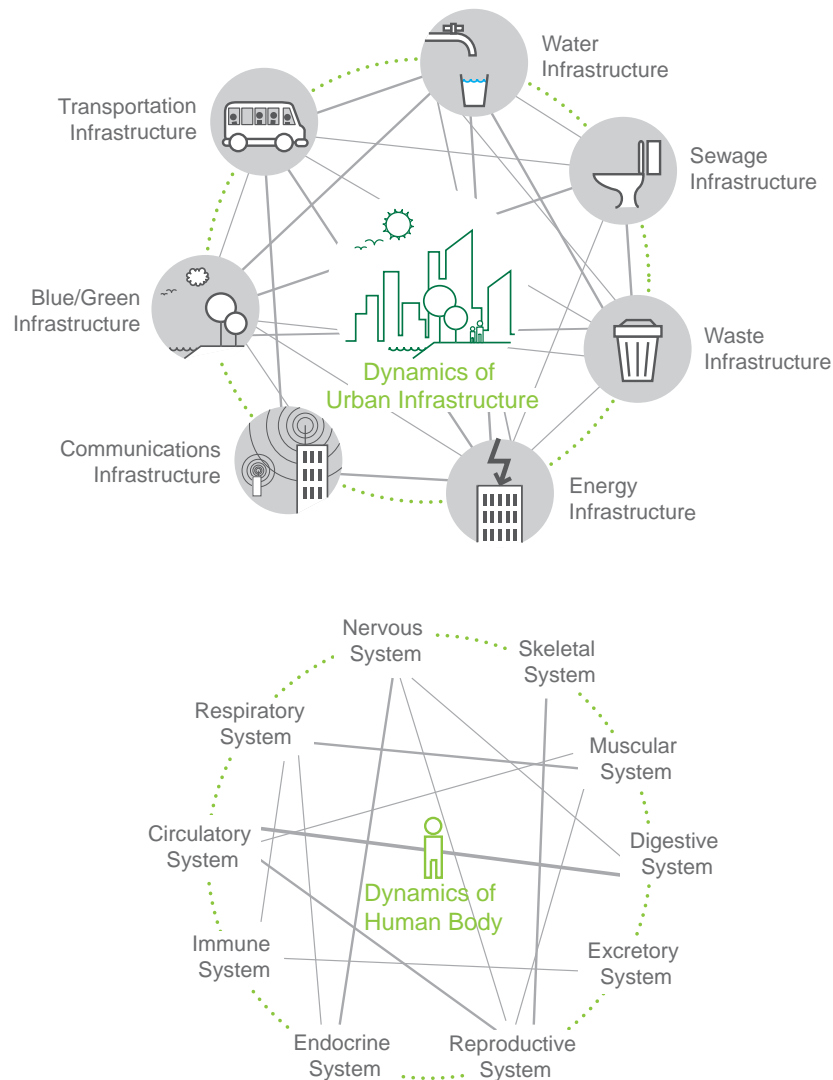
Eco-efficiency can be of great relevance to governments in Asia and Latin America because they need to invest massively in infrastructure development to support economic, social and environmental objectives with limited budgets. Because eco-efficiency is concerned with environmental improvements that yield parallel economic benefits, an eco-efficient approach to urban infrastructure development can help governments maximize precious financial resources. It is also attractive for the private sector and can help leverage private investment.

There are three principles for eco-efficient urban development:

1. Maximize quality of life
2. Maximize competitiveness
3. Maximize environmental sustainability

These principles are not in conflict and can reinforce each other.

Figure 7
 The illustration of a healthy city: The comparison of systems of infrastructure to the systems of human body



Are win-win solutions possible?

Is it possible to pursue approaches to urban infrastructure development that promote environmental protection while enhancing economic competitiveness and quality of life? Let us consider two things:

First, environmental protection and sustainability, economic competitiveness and quality of life are related to one another. The costs of traffic congestion and poor quality infrastructure are among the main factors negatively influencing the economic competitiveness of cities, while higher environmental quality and a more sustainable spatial design approach (through the development of green areas or urban congestion-reduction measures, for example) enhance the liveability of a city and thus its attractiveness to foreign direct investment.²⁸

Second, there is not only one approach to urban infrastructure development. There are numerous policy options available for pursuing eco-efficient infrastructure development with varying economic, social and environmental impacts. Policy makers can choose the options that maximize economic, social and environmental returns.

An eco-efficient approach to urban infrastructure development seeks to highlight these multiple returns and help prioritize policy options that lead to win-win scenarios.

The following chapters spotlight what should be done to adopt an eco-efficient approach and how to put it into practice.





Strategic principles



Phnom Penh, Cambodia

WHAT can we do to build infrastructure eco-efficiently and inclusively?

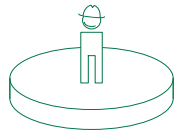
To ensure that cities develop as attractive, competitive and liveable places, a major shift is needed in the way urban infrastructure is planned, designed and managed – we need to be eco-efficient and inclusive.

Eco-efficiency will not occur automatically. Governments need to require it and should consider the following six strategic principles to ensure eco-efficient and inclusive outcomes in the process of planning and developing urban infrastructure:

- **Lead the change.**
Put sustainable urban infrastructure on top of your agenda.
- **Bridge the gap.**
Link short-term goals to long-term vision.
- **Link sector and actors.**
Integrate across sectors and between institutions.
- **Recognize the value of sustainable infrastructure.**
Consider all values (monetary and not) of sustainable infrastructure.
- **Turn “green” into a business opportunity.**
Build the business case for eco-efficient solutions.
- **Build the city for people together with the people.**
Sustainable outcomes can be achieved only through broad-based participation.

2.1 Lead the change

Put eco-efficient infrastructure and inclusive planning at the top of your agenda.



"When the best leader's work is done, the people say: we did it ourselves!"

Lao Tzu,
Chinese Taoist philosopher

Why is leadership important

Political commitment and leadership is essential for moving beyond ad-hoc decision making and sector-specific policies, allowing local governments to respond to city challenges and creating opportunities for the long-term planning.

Local leaders are in the unique position to see what can be life enhancing within the city as a whole. They can link pivotal issues and actors, inspire long-term thinking and planning and involve the people who comprise the city. Local leaders are the gatekeepers to a city's vitality; they are the ones who initiate or critically support the planning processes and safeguard their transparency.

Eco-efficient infrastructure approaches can deliver win-win situations. Leaders who take the lead may encounter initial resistance from a number of people who doubt the benefits or fear that they – or their city – will be worsening. Strong leadership and determination from political leaders, the mayors above all, are required to push the eco-efficient infrastructure agenda forward.

Why an eco-efficient agenda can be meaningful for leaders

Making unpopular decisions for the long-term benefit of a city requires courage. But it can be rewarding as well. Political leaders can become champions of eco-efficient cities. Experiences in Seoul, Republic of Korea, or Curitiba, Brazil, (boxes 3 and 4) demonstrate that in spite of initial resistance, eco-efficient infrastructure projects can be very successful, not only in terms of positive environmental outcomes but also in increasing the popularity of the specific mayor or a politician pushing the agenda.

How to exercise leadership

Exercising leadership does not mean being the only one to act. More to the point, it means inspiring others to act. Political leaders can become champions in promoting eco-efficient infrastructure in many ways. They can initiate change by placing eco-efficient infrastructure high on their agenda. They can create consensus by helping forge a shared vision for the city around the principles of environmental sustainability. They can prioritize eco-efficient infrastructure projects. They can set up participatory processes and align everyone involved towards the right objectives. They can

allocate resources where they are needed. They can also empower people to make a difference and allow them to act as catalysts. They can set up partnerships and take responsibility for ensuring that those collaborations deliver. They can promote transparency and accountability.

How to engage leadership

Although political leaders can become champions in promoting sustainable approaches, eco-efficient urban infrastructure projects may not be their primary responsibility. Technical officers thus can become the "backstage" leaders, engaging and supporting leadership among local politicians. They can raise the awareness of politicians on eco-efficient urban infrastructure interventions and advocate their importance. They can offer technical solutions and information on costs, benefits and feasibility of various options. They can identify and build supportive partnerships,

organize public awareness campaigns and mobilize public participation.

How it can be done easier

Empowering: Leaders can delegate responsibilities to partners to create a shared effort between political parties, government, the private sector and civil society. This is an important precondition for success. It draws various actors into the process and thus creates broad ownership.

Encourage leadership: Technical officers have a responsibility in supporting and promoting the leadership of their local politicians. Their role is to understand and deliver opportunities for a business case, with tailor-made actions and strategies, and to identify supportive partnerships, all at the politically opportune moment.



Box 3

Lee Myung Bak

From a visionary mayor of Seoul to president of the Republic of Korea

Lee Myung Bak might not be president of the Republic of Korea today had he thought differently about infrastructure development as the mayor of Seoul. Two decisions taken to balance environmental imperatives with development needs of a city were turning points in catapulting him to the country's helm. In 2003, Mr. Lee pushed first to restore the Cheonggyecheon waterway and then to reform Seoul's public transportation system.

As part of a new commitment to make the city more ecologically mindful, the controversial decision was made to rethink the expressway that covered the nearly dried up historic Cheonggyecheon stream. The highway was taken down, leaving the vehicular traffic to disperse and making a way for a public space thoroughfare and restoration of the 5.8 km waterway.

The Cheonggyecheon project initially encountered strong resistance from thousands of shop owners. But a well-managed negotiation process ensued between the Government and merchants. The Seoul Development Institute buffeted the talks with evidence from studies, first released in 2003¹ and then 2005,² that projected the restoration would create 300,000 jobs in construction, real estate and retail industries. In terms of environmental benefits, the waterway would help cool areas overheated by sun-baked asphalt and nourish the green areas that attract wildlife as well as pedestrians. An impact evaluation later showed that ecosystems along the Cheonggyecheon had been greatly enriched. The waterway has become a major tourist attraction, drawing more than 40 million visitors in the first year it opened. Nowadays, the 90,000 people who daily visit the Cheonggyecheon's banks have revitalized the nearby shops and restaurants.

Mr. Lee also took the lead in revamping Seoul's public transportation system after many other attempts failed to ease the congested and car-dominated road network. At his instigation, a consensus-based decision-making model led to the breaking of a vicious cycle of transit-network decay that had been ongoing since the mid 1980s, despite high levels of investment and enormous physical and economic growth. Previous attempts to reform the network were not only unsuccessful but even exacerbated existing problems, in part due to the use of a "top-down" approach to project development and implementation, which was poorly received or even resisted by certain groups. It was also unsuccessful due to the lack of an integrated planning approach, which resulted in a sprawling and

increasingly congested car-dominated road network that was in conflict with the mass transit system. The ambitious Lee-led reforms that began in 2004 resulted in a long-term multimodal transit network that is widely popular due to less congestion, better safety and cleaner air (see box 7 for more details).



Cheonggyecheon, Seoul, Republic of Korea



Seoul, Republic of Korea



Seoul, Republic of Korea

Box 4**Jaime Lerner****A popular Brazilian mayor who helped planners worldwide see what's possible³**

Jaime Lerner has a funny way with words and a visionary way with cities. Yes, he was an architect and an urban planner when he became mayor of Brazil's seventh-largest city, Curitiba (and Latin America's twentieth-largest city). But he had what any good mayor should have: a sense of urgency that a city has to be more liveable and the conviction it can be done without a lot of finances and in less than three years. The amazing thing about Mr Lerner's sensibility is he had it more than 40 years ago, when he began the first of his three terms as Curitiba's mayor before moving on to govern Parana State in 1995. He was a pioneer back then, reinventing urban space and changing the way city planners worldwide see what's possible in the metropolitan landscape.

"The city is not the problem, it's the solution. And it's a solution for the problem of climate change," he told an enraptured audience during an inspirational talk in 2007.

Even though the southern Brazilian city grew from around 400,000 to almost 2 million people in 50 years, Curitiba did not experience typical urban expansion problems, such as increased pollution, congestion, reduced public space or inefficient public transport. On the contrary, the city performed well due to the efficient urban management and development practises Mr. Lerner ushered in, thereby increasing the quality of life. The average green area per person expanded as parks and public spaces were developed. He encouraged people "to live closer to where they work and work closer to where they live". By first teaching children to separate garbage, who then taught their parents, Curitiba now has the world's highest recycling rate, at 70%.

Through Mr Lerner's planning, the city addressed its potentially costly flooding problem by turning vulnerable areas into parks and by creating aesthetic water reservoirs to catch floodwaters. As a mayor, Mr. Lerner "transformed a gridlocked commercial artery into a spacious pedestrian zone over a long weekend, before sceptical merchants had time to finish reading their Monday papers". He has become a hero to the growing ranks of municipal planners seeking greener, more liveable cities. Nowadays, he finds mayors are often pessimistic about their cities, worrying about scale and finances. Mr. Lerner advises: "Creativity starts when you cut a zero from your budget – and if you cut two zeroes, it's much better."

For a city to be a solution, Mr. Lerner believes it needs "an equation of core responsibility" and a design of how to maximize space. It's not enough to have green buildings, new materials and new sources of energy, he says. It also requires having a "concept of the city". He has inspired unique solutions to vexing urban problems, including a garbage-for-food programme in which Curitiba's exchanged bags of trash for bags of groceries and trimming parkland grasses with herds of sheep. He built an opera house of wire. He introduced the metronized bus rapid transit system (BRT), with sheltered boarding tubes that enable off-board-fare-collection resulting in improved boarding speed. Bus-only lanes improved the navigation of the traffic congestion. Curitiba's RIT was the first BRT system implemented in the world. This practice was later adopted by at least 83 cities around world. In 1974, Mr. Lerner started the public transport system with 25,000 passengers a day and by 2007 it accommodated 2.2 million a day. "If you want a sustainable world, don't forget the cities," he implores.

Curitiba has embraced eco-efficiency principles in urban development and planning and is a successful example of a competitive and liveable city for other cities around the world. The actions of Jaime Lerner exemplify the values of envisioned leadership. In 1990, he received the United Nations Environmental Award, followed by the Child and Peace Award from UNICEF in 1996 and the 2001 World Technology Award for Transportation.

A good indication of the successfulness of Jaime Lerner's practices is the fact that 99% of the Curitiba's actually want to live in their city and would never consider leaving.

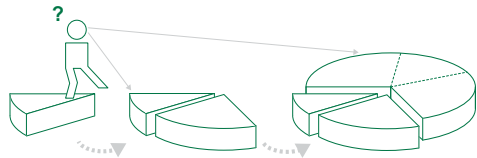


Jaime Lerner



2.2 Bridge the gap

Link short-term goals to long-term vision.



“If we are facing in the right direction, all we have to do is keep on walking”

Buddhist proverb

One of the reasons why eco-efficient approaches are often not prioritized is because of the time gap between the costs, mainly observed in the short term and the benefits, mainly observed in the long term.

Short-term results are important. They are important for residents, who need to see interventions improving their daily lives. They are also important for politicians, who need to show tangible results within their mandates to win re-election.

But competitive and liveable cities are not built overnight through quick fixes. They are built through actions that produce long-term and sustainable benefits. Because infrastructure has a long life span, these actions need to be planned and carried out in such a way that anticipates future needs. This requires not only policies that provide short-term solutions (such as expanding roads to ease traffic congestion) but also those that provide long-term solutions (such as changing land use and developing a public transportation network).

So how can city officials bridge the gap between short-term costs and long-term benefits?

First, it takes a **shared long-term vision** that promotes the well-being of all people in the city and is based on enhancing the city’s eco-efficiency. Such a vision will help prioritize policies and projects that provide long-term and cost-effective solutions. It will also bring together and motivate residents, business people and civil servants around a common purpose.

Second, that vision needs to be translated into action and the short-term goals linked with medium- and long-term objectives through **proper planning**. Pursuing projects that provide long-term solutions requires a change in planning practices, from current policy, which is typically led by short-term goals and one planning period after the other, to what is known as “transition management”, with short-term goals linked to long-term goals that are driven by a strong vision. This allows breaking down ambitious long-term projects into deliverables that are workable over a short-term political cycles.

Box 5

Vision of Ecopolis Ulsan: Harmonizing economic development with ecological conservation in Ulsan, Republic of Korea⁴

Environmentally, Ulsan has known both a dark and bright side, said its mayor in 2008, Bak Maeng-Woo. Within two decades, Ulsan developed from a small city to the largest industrial metropolis within the Republic of Korea as well as a leading industrial and economic centre in the Asia-Pacific region. But the growth exacted a heavy price: the city was smothered with environmental pollution and its ecosystem suffered from degradation. In the 1990s, local and national government leaders recognized the city and its people were choking, and so too would their growth soon. They pushed to rebalance the industrializing ambitions with the environmental realities. In doing so, they redesigned their city, envisioning a harmonious relationship between economic development and ecological conservation and management. To make the city-wide transformation, they pulled in a range of actors to take charge of the vision, leading new projects with new environmental regulations and mechanisms as their tools.

A series of regulatory mechanisms and participatory measures, ranging from reviving water courses, protecting fragile ecosystems and eliminating pollutants along with maintaining a thriving industrial sector, ensured the regeneration of Ulsan as an environmentally healthy city. As a result, salmon, migrating birds and otters have returned to the city’s main river. Air quality has reached the country’s best levels. Green spaces have significantly increased and the rivers and coastal ecosystems, once dying under the urbanization process, are showing signs of revival. Even environmental policies have changed; the monitoring and crackdowns have been replaced with voluntary participation systems.

A remarkable milestone was the adoption of the Ecopolis Ulsan Declaration in 2004 by the city government, business people, ordinary residents and NGOs, which provided the basis for making Ulsan a world-class eco-industrial city. The declaration shifted the city’s paradigm from growth-first ideology to an “ecopolis” archetype. In doing so, the environment became a top priority in all city development plans.



Box 6**Bridging short-term political agendas with one long-term vision in Bogotá, Colombia⁵**

Using unorthodox methods within ten years, two charismatic mayors turned one of the world's most dangerous cities into an inclusive and competitive model city, populated by caring citizens.

When Antanas Mockus became mayor of Bogotá in 1995, he focused on changing the lives of the people and hopefully their sense of morality. Under his leadership, the homicide rate fell by more than 50% as did traffic fatalities. Potable water was provided to all homes, an increase of 79%, while overall water use dropped by 40%. Colombia law prohibits individuals from filling the mayor post for two consecutive terms, so Mr. Mockus had to step down after one three-year term.

Fortunately, he was followed by Enrique Peñalosa. By then Bogotá was a safer, more liveable city, attracting more international investment. Mr. Peñalosa used this as a basis to implement his philosophy on how to rebuild a city: redesign Bogotá not primarily on economic principles of profit but on those of social equity and quality of life. He started the construction of a new rapid bus system Transmilenio, built many public parks and libraries and installed bike paths in the poorest areas of the city. By the end of his first term, the work was still in progress and the city had become a huge construction site, leaving voters impatient, which endangered the continuation of his initiatives. Then Mr. Mockus stepped back into the arena, promising to continue the physical projects Mr. Peñalosa had started in return for his political support. This turned out to be a crucial step to bridging the short-term agendas with the long-term goal of redesigning the city and the quality of life for its people.

**Box 7****Breaking a vicious cycle of inefficiency with bus reform in Seoul, Republic of Korea**

By 2004, decay had severely stunted the Korean capital's transit network, a hobbling of the system that had been ongoing since the mid 1980s despite high levels of investment and enormous physical and economic growth. Previous reform attempts were unsuccessful, partly due to the lack of an integrated planning approach, which had enabled a sprawling and increasingly congested and car-dominated road network that competed with, rather than complemented, alternative means of mass transit.⁶

Looking at the transit network, the Goh Kun administration could see it was moving the country in a non-competitive direction. A new wave of reform was needed and local government officials began overhauling the Seoul bus transit network, the first of many breakthroughs to upgrade and optimize the city's infrastructure and planning systems. The reforms not only continued but expanded under successive administrations, notably when Lee Myung Bak took the helm as mayor.

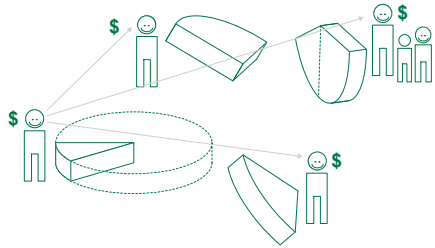
The 2004 reforms under the leadership of Mr. Lee began with the formation of a consultative group, called the Citizens Collaborative Council, to develop a long-term solution to the city's transit problems while ensuring that no one party was significantly disadvantaged by such a solution. The result of this consensus-based decision-making model was a series of reforms that were both ambitious in their scope and scale yet also workable over the short-term political cycle.

The next reforms focused on the bus system and incorporated the creation of dedicated median-strip bus lanes; a hybrid model of centralized public management and coordination and private ownership; an optimized route network with dedicated, color-coded buses; and a unified "smart card" fare system. The bus fleet became subject to stringent safety and performance standards and is currently being upgraded with natural gas-fuelled vehicles.

Today the Seoul bus system forms the backbone of an integrated multi-mode transit network that enjoys broadly bipartisan political support as well as record levels of patronage across the board as well as significantly more manageable levels of traffic congestion, improved safety and commuting time and reduced greenhouse gas emissions.⁷

2.3 Link sectors and actors

Integrate across sectors and between institutions.



“There is no ideal system except integration.”

Jaime Lerner,
former mayor of Curitiba

Sector policies and actors continue to be the primary drivers of infrastructure development. Unfortunately, different government bodies, at both the national and local levels, and the private sector focus on small “parts” of their city without knowing what is happening in the other part. Eco-efficient needs cannot be created in fragments – a tactical approach is needed in which strategies and ideas are combined to efficiently develop a city that excels in competitiveness and quality of life. That approach relies on integrated policies and appropriate institutional arrangements and coordinating mechanisms. This topic is further elaborated in Annex 4.

The responsibilities of local authorities are broadening due to decentralization and globalization. Local authorities now find themselves in multi-actor arenas and are required to cover a broad range of specialties, including housing, infrastructure, social and community services, local economic development and environmental protection. The multidimensional and cross-cutting nature of urban issues and challenges require an integrated perspective on urban

management. Although local authorities are structured along vertical department lines, urban challenges are horizontally integrated. To cope with the myriad urban challenges, different departments should work together more closely by integrating physical, socio-cultural and economic aspects of urban planning and development. Most gains in eco-efficiency can be made by institutional and organisational set-ups that enable healthy urban management and by devising integrated solutions among sectors.

An integrated approach

An integrated approach to urban development can be based on a four pillar strategy:⁸

Assets based – as opposed to needs based. Starting development with needs leads to dependency on external resources. It is impossible to promote development based on deficiencies only. Thus starting with assets and opportunities enables “development from within”, promotes partnerships to collaboratively take on issues of importance to the community and creates opportunities for growth.

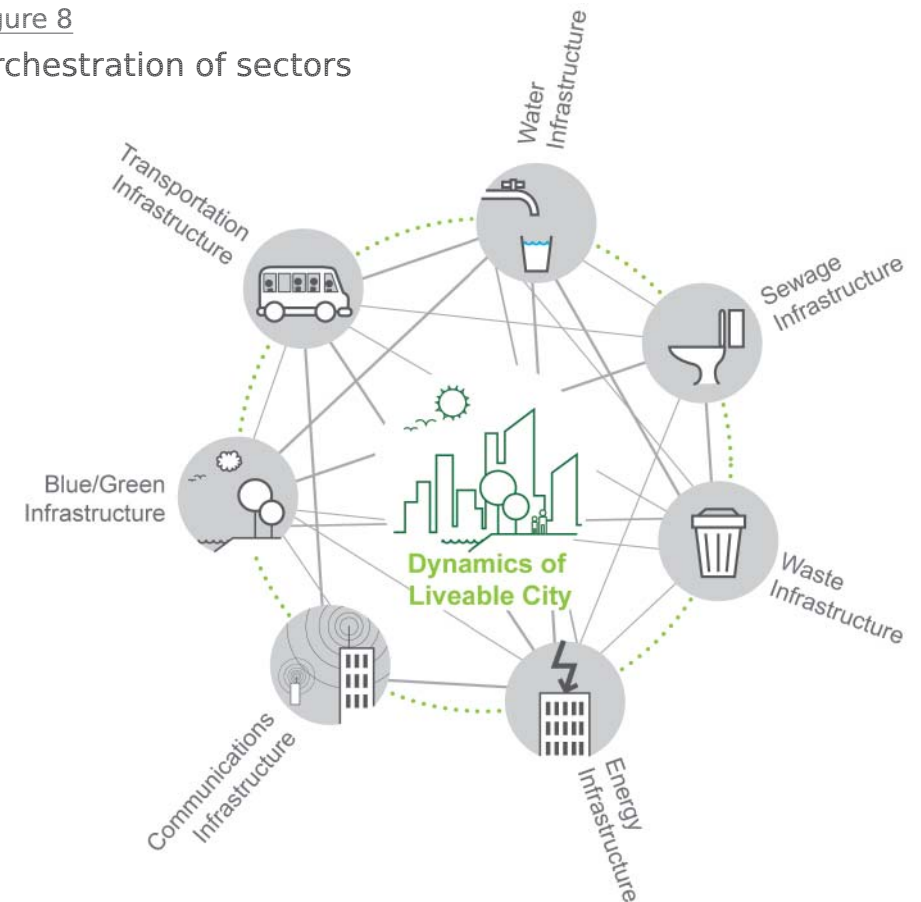
Horizontal integration – between sectors. This enables local authorities to identify new opportunities for growth within the interface between sectors and to address development challenges that are cross-cutting.

Vertical integration – between institutions and actors. This is required for the design and execution of policies and strategies and derived from a decentralized, multi-actor arena. Vertical integration has two dimensions: top-down (e.g. from national to local government, from city

agencies to community boards) and bottom-up (e.g. from local government to national, from community boards to city agencies).

Implementation and management platforms – to upgrade local capacities to initiate, lead and sustain development. Municipalities can take a pivotal role in promoting eco-efficient urban infrastructure. Their level of governance allows for horizontal and vertical integration as well as leveraging city assets.

Figure 8
Orchestration of sectors



Box 8**An ideal platform for introducing eco-efficient measures in La Serena-Coquimbo, Chile⁹**

In Chile, institutions are decentralized so that regional governments can more acutely implement national policies and programmes and help assure their success. This requires representatives of the national Government, known as the regional ministerial secretaries, to coordinate directly with the governor and to some extent with the mayors in each region. The governor then coordinates with all the regional ministerial secretaries. In turn, each of the regional ministerial secretaries “translates” national sector policies to each region. This leads to strong sector and territorial coordination at a regional level, ensuring effective policy execution.

That responsibility is transferred not only in its exercise (as is the case with the delegation of powers) but in its decision-making power, based on hierarchical norms. It implies that the sector unit receiving the policy directives has its own particular power of delegation and decision making. Under decentralized systems, a regional organisational unit can perform one or both of the following actions: It can create further subunits located outside an agency’s headquarters location, without affecting the organization system. This is called “organic decentralization”. Or regional organisational units can delegate or reassign duties between units within the same organisational institution. This is called “functional decentralization”.

In La Serena-Coquimbo, the Land Use Committee and Projects is a valued actor in the transportation system planning processes. This extends mostly to the implementing stage, where the Coordination Unit of Urban Roads, which operates at the initiative of the Ministry of Planning, manages the allocation of investment resources and monitors the progress. This institutional framework was developed under the leadership of SECTRA (the Transportation Planning Office), and although no legal framework exists, its effects on the development and implementing of urban transport plans has been extremely positive.

The advantage of a planning process like this is both the technical tools and, more fundamentally, the involvement of all parties who have responsibilities in developing the urban transport system. These parties are organized under the Land Use Committee and Projects and define planning scenarios and investment priorities.

Box 9**Linking companies to reduce costs and emissions in Ulsan, Republic of Korea¹⁰**

In an eco-industrial park, the waste generated by one company is used as a resource for another, leading to a clear business case for the environmental and social benefits. The eco-industrial park in Ulsan, Republic of Korea, demonstrates how linking various actors can promote eco-efficiency and generate win-win situations.

The exchange of steam between the Sung-am municipal waste incineration facility and Hyosung Company, for instance, generated a profit of around US\$7 million. With an initial investment of US\$5 million, the payback period was less than 9 months. The Hyosung Company decided to invest part of the profits to construct a new production unit, resulting in a major social benefit: the engagement of 140 additional employees.

Key to the success of the initiative was the collaboration between the local government and businesses and the establishment of the Ulsan Eco-center. This centre brought together industry practitioners and academic experts to encourage networking among businesses and to provide technical advice. The local initiatives were developed under the Government’s Eco-Industrial Park Master Plan.



EIP Ulsan, Republic of Korea

2.4 Recognize the value of sustainable infrastructure

Consider all social, environmental and “hidden” economic value of eco-efficient infrastructure.



Current infrastructure approaches are generally biased towards unsustainable approaches. Environmental and social costs and benefits are often not factored into decision making. Thus one of the major contemporary planning concerns is to do justice to the specific values that people associate with a city. These days, “green” has become a major value, not only from an environmental point of view but increasingly because of the social and economic benefits. The benefits are both tangible and intangible, some can be monetized, others cannot.

Developing blue-green infrastructure (waterways and parks), for instance, has environmental and social benefits and can also create economic benefits. Research in the Netherlands¹¹ has shown that housing prices increased by 4-8% on homes located close to open spaces. In Ulsan in the Republic of Korea, the environmental restoration of the Taehwa River led to increased land prices in adjacent areas (< 1,500 m) of 30-40%, while the price of land in other parts of the city increased by

“Our waterways and reservoirs should do more than meet our water needs. They should enhance our living environment and lifestyle.”

Lee, Hsien Loong,
Prime Minister of Singapore

only 10%.¹² The city administration of Beijing initiated nine financially viable urban water rehabilitation projects in preparation for the 2008 Olympic Games in 2008; it experienced a payback of about 95% on the investment as a result of increased land value of adjacent properties.¹³

Environmentally, blue-green infrastructure helps mitigate the urban heat-island effect, lowers energy demand required for cooling and cleans the air, making the city more liveable. Socially, blue-green infrastructure improves the quality of life because it offers a place for people to enjoy recreation, relax and simply socialize. In some cases, preserving the natural environment can be a source of competitiveness and economic growth, as illustrated by the case of Suncheon City (box 13). This topic is further elaborated in Annex 4.

Similarly, many eco-efficient infrastructure policies have a range of positive spillovers, or co-benefits, but these may be spread across society and are often not captured in

the business case for specific projects, thus may not be prioritized. Public transport, for example, has numerous co-benefits, such as reduced air pollution, improved road safety, reduced congestion and increased land value. Some of the positive spillovers may be integrated into the business case through appropriate policies and tools. However, this is often not done or cannot be done completely. Although the participation of the private sector can be instrumental and is highly desirable, decisions on this type of project should not be based on the narrow business case of the project itself. Governments need to consider extending a level of support to such projects with a high number of co-benefits, mainly because the party who pays is not always the party who profits.

Governments, both national and local, need to consider environmental and social spillovers, both positive and negative, into their decision making and build the business case for eco-efficient infrastructure development. The multiple values of eco-efficient infrastructure need to be integrated into policy making in a holistic manner, such as in the case of Singapore’s ABC Waters Programme (box 10). Useful tools and mechanisms that help improving integration exist, such as the strategic environmental assessment or integrated assessments, but are often not used or are poorly functional. Achieving eco-efficient infrastructure requires strengthening the use of these tools and mechanisms. Part 3 provides guidance on how to utilize them to promote eco-efficiency.



Water appreciation in Singapore



Water appreciation in Cambodia

Box 10

Singapore’s ABC Programme:

Waterways as a means of improving the quality of life for people and the attractiveness of the city as a whole in Singapore¹⁴

Singapore’s Active, Beautiful and Clean (ABC) Waters Programme shows a remarkable re-orienting of policy and thinking. Moving away from a historically grounded engineering approach that regards infrastructure resources as economic goods, the city-state now embraces many of the principles of eco-efficiency by looking at water as a means to improve the quality of life of Singaporeans and the attractiveness of the city as a whole. Water infrastructure management has been integrated as part of the planning and design of the city so that local communities can enjoy the waterways as engaging features in their urban landscape.

The ABC Waters Programme recognizes that waterways and reservoirs can do more than just meet the city’s water needs. They can provide recreational opportunities (water sports or resting), a venue for cultural events (festivals, performances) or tranquillity for relaxation and community bonding. They also provide indirect economic value in terms of employment (in landscaping or events management), competitiveness (such as attractiveness to foreign direct investment and tourism) and enhancing property values.

Table 1: THE ABC WATERS PROGRAMME: ADDITIONAL VALUE GENERATED THROUGH THE WATER INFRASTRUCTURE

ADDITIONAL VALUES		DESCRIPTION
Social	Educational	“Outdoor classroom” for children to learn about nature, water, as well as environmental stewardship
	Recreational	Include active recreation, e.g. water sports, as well as passive such as walking, resting, etc
	Cultural	As a setting or venue for cultural events
	Wellbeing	Fresh air, sounds of water, etc
Environmental	Ecological	Protect ecological integrity, habitat for biodiversity
	Climate	Improved micro-climatic conditions
	Food crops	Opportunities for urban agriculture
Urban	Aesthetics	Visual and scenic qualities, improved townscapes
	Amenity	Open space, view cones, aspects, etc
	Tourism	Potential to attract tourists
	Lifestyle	Provide lifestyle options e.g. outdoor dining
Eco-nomical	Employment	Provide employment opportunities in landscape, maintenance, events management
	Competitiveness	May contribute to enhancing the city’s attractiveness to external investors and foreign talents
	Property value enhancement	Potential for property value enhancement in adjoining areas

Box 11

Buildings a city on the principles of social equity and quality of life in Bogotá, Colombia¹⁵

Bogotá, Colombia, proves that cities can be reborn by redesigning them not primarily on economic principles of profit but on those of social equity and quality of life. The city developed a public transport system that included bike lanes and pedestrian-friendly sidewalks. Existing public parks were improved and new ones developed, also in the poorer areas of the city. Efforts were made to connect the slums to the inner city. In short, Bogotá developed infrastructure that benefitted all its inhabitants, especially the poor, resulting in the creation of one of the most competitive and liveable cities in Latin America.



Bike lanes in Bogotá, Colombia



Bogotá, Colombia



Transmilenio BRT Bogotá, Colombia

2.5 Turn “green” into a business opportunity

Build the business case for eco-efficient solutions.



“The concept of incentivizing clean energy so that it’s cheaper, more effective kind of energy is one that is proven to work and is actually a market-based approach.”

Barack Obama

Investing in eco-efficient infrastructure promotes economic growth, creates jobs and generates profits. But governments (both national and local) need to stimulate the enabling conditions. Infrastructure projects generally have large spillover costs and benefits. These are typically not reflected in market prices and thus in business cases. Additionally, operation and maintenance are often neglected in traditional infrastructure procurement modalities, whereas these stages present significant opportunities for improving eco-efficiency. This calls for a life-cycle approach and a better integrating of the different stages of infrastructure development.

The private sector can be the main driver for developing eco-efficient infrastructure. But it won’t happen as long as business-as-usual practices are more profitable than eco-efficient ones.

Governments need to tilt the balance in favour of sustainable practices and channel private-sector investment into eco-efficient infrastructure projects. In other words, governments need to build the business case for eco-efficient infrastructure.

Table 2

Examples of policy instruments for building the business case for eco-efficient infrastructure in selected sectors

SECTOR	REGULATORY INSTRUMENTS	ECONOMIC INSTRUMENTS	INFORMATION INSTRUMENTS
Transport	<ul style="list-style-type: none"> - Restrict parking - Restrict access - Restrict car ownership - Fuel standards - Vehicle emission standards - Vehicle inspection and maintenance regimes 	<ul style="list-style-type: none"> - Congestion charging - Parking fees - Fuel taxes - Vehicle taxes - Subsidies for public-transport 	<ul style="list-style-type: none"> - Awareness campaigns/ Marketing for public transport and non-motorized transport - Traffic monitoring systems - Labeling cards according to environmental standards - Car-free days
Green building	<ul style="list-style-type: none"> - Upgrade building codes to reflect green building criteria - Mandate retrofit of buildings with poor energy performance - Mandate labeling of energy performance 	<ul style="list-style-type: none"> - Provide incentives to developers (e.g. allow for higher density, or tax exemption) - Provide fiscal incentives to consumers (e.g. loans, tax rebates) - Support energy service companies 	<ul style="list-style-type: none"> - Communicate energy performance information on all new buildings - Initiate public campaign on energy use and saving potential in buildings
Waste	<ul style="list-style-type: none"> - Impose recycling regimes for specific materials - Ban on specific materials (e.g. plastic bags) - Waste treatment laws and standards - Mandatory sanitary landfill standards 	<ul style="list-style-type: none"> - Create market for recycled materials (e.g. through green public procurement) - Impose high costs for waste disposal 	<ul style="list-style-type: none"> - Communication campaigns - Competitions among districts (on waste reduction or recycling targets) - Competitions among schools

Box 12**Saving money with energy-efficient buildings in Dushanbe, Tajikistan¹⁶**

A study on energy savings in public buildings in Dushanbe, Tajikistan, makes a clear business case for green buildings. Public buildings in Dushanbe are subject to high levels of energy loss due to the poor thermal insulation and heating systems. Energy consumption could be reduced by an estimated 30-50% through energy efficiency measures. Nine-storey buildings (360 units) can provide savings of up to 44.7 million kWh of energy per year, equivalent to US\$900,000. The payback time of thermal insulation for wall structures is four years while its lifetime use is over 20 years, making such an investment a clear business opportunity.

Regulations are the most effective tool to encourage energy efficiency of buildings, providing increased comfort to residents and reducing energy costs. Currently, Tajikistan is in the process of creating a regulatory framework for the design of buildings for different functional purposes. These construction codes specify requirements for thermal protection of buildings to save energy while ensuring sanitary and optimal parameters of indoor climate and the durability of the envelopes of buildings and other structures.

Usually techniques and tools focus on energy efficiency targets in the design and construction phase of buildings; and yet, 95% of non-productive losses in heating occur during the operation phase of buildings. Hence, energy saving measures should focus on the existing building stock because this is where most of the targets can be met.



Dushanbe, Tajikistan

Box 13**Restoring a tidal ecosystem to attract tourism in Suncheon City, Republic of Korea**

When neighbouring cities were hurtling into heavy industrialization and reclaiming tidal wetlands to build major petro-chemical complexes and steel mills, Suncheon City on the south coast of the Republic of Korea saw its future more closely tied to nature. Because of that “tree-hugging” position, the city for years was regarded as backward for investing in its ecosystems. But when the economic benefits amounted to US\$100 million annually, it suddenly rose above the other cities in terms of forward thinking for turning its wetlands into a competitive advantage.

Beginning in the late 1990s, the city government and its citizens worked to restore the ecosystem of Suncheon Bay, metamorphosing into a centre of eco-tourism, attracting more than 2.3 million visitors (more than 10 times its population) and creating 6,400 jobs.¹⁷ Of course, not everyone in Suncheon City agreed with the leadership at first, balking at the perceived backwardness. Businesses and landowners initially resisted the plans to relocate commercial areas out of the bay and turn rice fields into a reserve for migratory birds. The critical factor for mobilizing support behind the scheme was strong leadership from the mayor, combined with a firm conviction that a rich and vibrant ecosystem can drive economic growth.

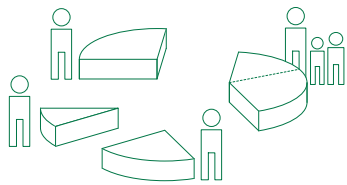
Now Suncheon Bay is one of the world’s five largest coastal wetlands and the first Korean city to be registered to the Ramsar Convention on Wetlands.¹⁸ Suncheon City has also won the silver medal at the International Awards for Liveable Communities (LivCom Awards) for its environmental management and priority on building a liveable community.



Suncheon City, Republic of Korea

2.6 Build the city for people together with the people

A dynamic, liveable city can only be achieved through broad public participation.



“A good city is a good social event. What interests people the most are other people. Build cities for the people.”

Jan Gehl, architect

While strong leadership is required to steer cities in a healthy direction, public participation in planning and designing infrastructure is essential to actually move the engine of change. Public participation is the process in which all parties, politicians, city officials, civil servants, business people, entrepreneurs, workers, homemakers, clergy, teachers and all other urban inhabitants are involved in the decision-making processes. Public participation invokes many benefits, but there are three reasons for considering participatory approaches to urban infrastructure development.¹⁹

First, the participation of all parties, including communities, can improve the quality of planning and decision making and facilitate the execution of actions. In fact, without the participation of a wide range of parties, it may not be possible to explore the available options and accomplish difficult policy choices, such as demand-management measures in a transport-development strategy.

Second, participatory approaches to planning provide a better way of dealing with cross-cutting issues. For example, meeting the basic mobility needs of the poor by promoting informal transport (rickshaws and motorbikes that link to transit systems) should be an important consideration in transport development. However, this needs to be carefully balanced against operational and environmental factors. The response requires a creative integrated plan for the whole transport system and its articulation within the overall development process. Participatory approaches provide the institutional framework for the integrated planning needed to address the cross-cutting issues and conflicting development objectives.

Third, the prime element of any infrastructure system is its users. Broad public participation can help ensure that action taken and services provided reflect the needs of people more adequately and that the benefits of development are shared more equally.

Table 3

Benefits of public participation

Participatory approaches are practised at all levels of planning. However, the extent and nature of participation by different parties may vary. Many infrastructure-related projects integrate participatory elements in their set-up. Local government needs to ensure they choose an appropriate level of engagement. For a simple project, an informal meeting might be sufficient, while a complex project requires an extensive participation procedure.

Public participation has many benefits, including:

1. Better planning
2. Better and faster execution
3. Better response to local needs
4. Greater ability to deliver within budget
5. Increased residents' understanding of problems
6. Better support from residents
7. Greater ownership
8. Increased community cohesion
9. Capitalized use of people's experiences and community resources



Surabaya, Indonesia

Box 14**Participatory budgeting in Morón, Argentina²⁰**

In Morón, Argentina, butchers, bakers and bureaucrats alike decide how public resources will be spent. Through a participatory budgeting programme initiated in 2006, the inhabitants of each city district determine the priorities in their neighbourhoods and make proposals to tackle those issues. Over the past five years, the programme has contributed towards improving public information access and led to more than 163 urban, cultural, sport, environmental, sanitary and housing initiatives after they were popularly approved through a participatory process.

Participatory budgeting is framed within a decentralization process that began in Morón in 2000 and is carried out through seven Community Management Units (UGC is its Spanish acronym), which govern a district. Every district in Morón, delimited according to the jurisdiction of the UGCs, can make use of a portion of the total budget. That portion is determined by the number of inhabitants and by their socio-economic situation. Such criteria promote equity and transparency, which are essential in this type of participatory process.



Morón, Argentina

Box 15**Communities work together to reduce waste in Surabaya, Indonesia²¹**

When communities joined solid waste-management activities in Surabaya, Indonesia, the city managed to reduce more than 20% of the total waste generated (from 1,500 to 1,150 tons per day) over a period of 4 years (2004-2008) by promoting the composting of organic waste.

The city established 13 composting centres that process large volumes of organic waste from vegetable markets and street sweeping. The centres distributed 19,000 compost baskets to households without charge through environmental cadres established in each community. These community cadres are supervised and monitored by PKK, a women's group, and other NGOs. The NGOs along with a private company and a local newspaper organized a community-based waste reduction and clean-up campaign. As a result, the city achieved a significant reduction in the amount of waste generated and related waste management expenses and grew a glossier green once the compost was spread over city parks and other green areas along the main streets. The initiative created jobs at the composting centres, improved the hygienic and aesthetic conditions of the city and strengthened the sense of community among the residents participating in the waste-management scheme.



local composting

3

Strategic planning



HOW can we plan infrastructure in an eco-efficient and inclusive way?

Strategic planning helps decision makers and planners to identify and prioritize actions that lead to socially, economically and environmentally vibrant cities.

- Strategic planning enables communities to get involved and better manage change for the good of their needs and their future.
- Strategic planning enables local governments to invest spending on actions with multiple benefits and allows them to present a stronger business case to funders and financiers.
- Getting the planning process started requires leadership.
- Keeping the planning process going requires vision and objectives that do not rely on individuals, personalities or a short-term political agenda.
- Identifying win-win solutions requires strong inter-sector cooperation mechanisms that feed sectoral objectives into city-wide objectives.
- Identifying appropriate actions requires the recognition of the values of local natural and human assets.

Box 16: Why strategic planning?

What is strategic planning?

“Strategic planning is a systematic decision-making process that focuses attention on important issues and on how to resolve them. Strategic planning provides a general framework for action: a way to determine priorities, make wise choices and allocate scarce resources (e.g., time, money, skills) to achieve agreed-upon objectives.”¹

Why is strategic planning relevant?

All planning – spatial, economic, sectoral, environmental, or organizational – is more effective if it is strategic. Strategic planning has become an important tool for local governments in ensuring efficiency and effectiveness in policy design and implementation, including for infrastructure. Strategic planning helps move away from ad-hoc and short-term decision-making. Strategic planning helps making the best long-term decisions. Strategic planning ensures that a city vision gets translated into objectives, which in turn provide criteria to select win-win policies. Moreover, it ensures the right timing and maximizing of public-private cooperation and public participation.

Strategic planning is an iterative process. Therefore, it is a tool for local governments to adapt to new circumstances and that keeps the living conditions of residents continuously improving.

Eco-efficient and inclusive infrastructure planning and development

The issue is no longer about how to construct infrastructure but how to ensure that developments benefit all citizens, including the poor and marginalized while minimizing the impact on the environment. This shift in thinking requires placing infrastructure development practices well within the broader framework of eco-efficiency and inclusive planning and development. This in turn demands a strategic approach to infrastructure planning and development that implies careful consideration of the various win-win solutions. It demands

“catching” and mobilizing different views and sources towards a common vision and goals and objectives aspired to achieve. This is possible only when the various parties join forces to make a difference in the quality of life in their cities, towns and settlements.

Engaging in a strategic planning process for eco-efficient infrastructure development, at a minimum, offers a way to improve the necessary interaction among business, government, labourers and the poor. In particular, because the concept of eco-efficiency was developed by the private sector, it is easy to attract the attention of and engage businesses to collaborate towards change that is eco-efficient and environmentally protective. If done well, it provides a way to achieve competitive advantages, identify cooperative opportunities for win-win solutions, craft innovative options and generate actions and strategies that better achieve local priorities. More practically, it can provide better information for decision-making by highlighting the real costs and benefits of various alternatives.

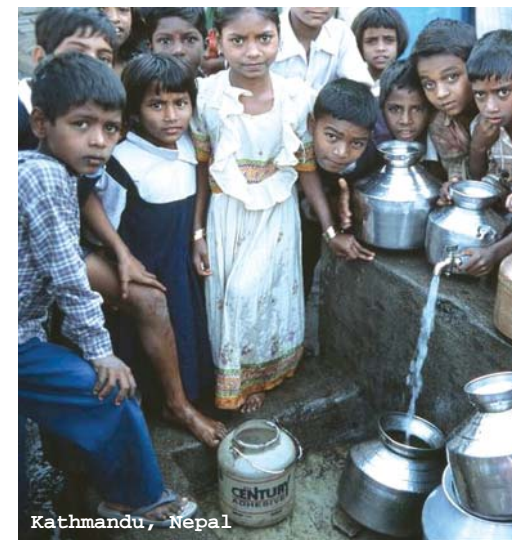
The planning framework

By taking a strategic approach, eco-efficient and inclusive planning can, and should, improve and be integrated with existing planning and development activities across all sectors. To do so, eco-efficiency principles and objectives need to be considered during all stages of the planning process. The six strategic principles presented in part 2 provide guidance on what should be done to ensure eco-efficient and inclusive outcomes and thus, build competitive and liveable cities. During the different planning stages, the relevant principles are highlighted.

This part of the planning framework is organized around a four-stage strategic planning approach that addresses four essential questions:

1. Where are we now?
2. Where do we want to go?
3. How do we get there?
4. Are we getting there?

Answering each of these questions involves a number of steps that takes you through the strategic planning process. Each of the ten steps is broken down into more detailed tasks, as figure 9 illustrates.



Kathmandu, Nepal

Box 17

The planning framework

STAGE A: Where are we now?

Step 1 GET STARTED Page 66

Get organized and secure commitment, form an executive committee and a planning team, evaluate capacities, plan the process.

Step 2 IDENTIFY STAKEHOLDERS Page 68

Identify stakeholders, establish the stakeholder group, ensure smooth communication, make a plan for engagement.

Step 3 ANALYSE AND ASSESS Page 73

Create a profile of the city, identify legal frameworks and drivers of infrastructure development, conduct and eco-efficiency assessment.

STAGE B: Where do we want to go?

Step 4 ESTABLISH A VISION Page 82

Review main challenges, collect ideas, formulate a vision.

Step 5 SET OBJECTIVES Page 84

Identify and organize issues, restate issues as objectives, ensure that they are eco-efficient, select indicators.

STAGE C: How do we get there?

Step 6 IDENTIFY ACTIONS AND STRATEGIES Page 92

Generate action ideas to achieve your objectives, organize, screen and rank actions, develop strategies.

Step SELECT ACTIONS Page 98

Assess consequences of actions, prioritize best actions and strategies, assess mainstreaming opportunities and refine actions and strategies.

Step IMPLEMENT ACTIONS Page 107

Identify and address institutional and governance gaps, identify lead agency, mainstream actions into established plans, programmes and processes, develop an action plan.

STAGE D: Are we getting there?

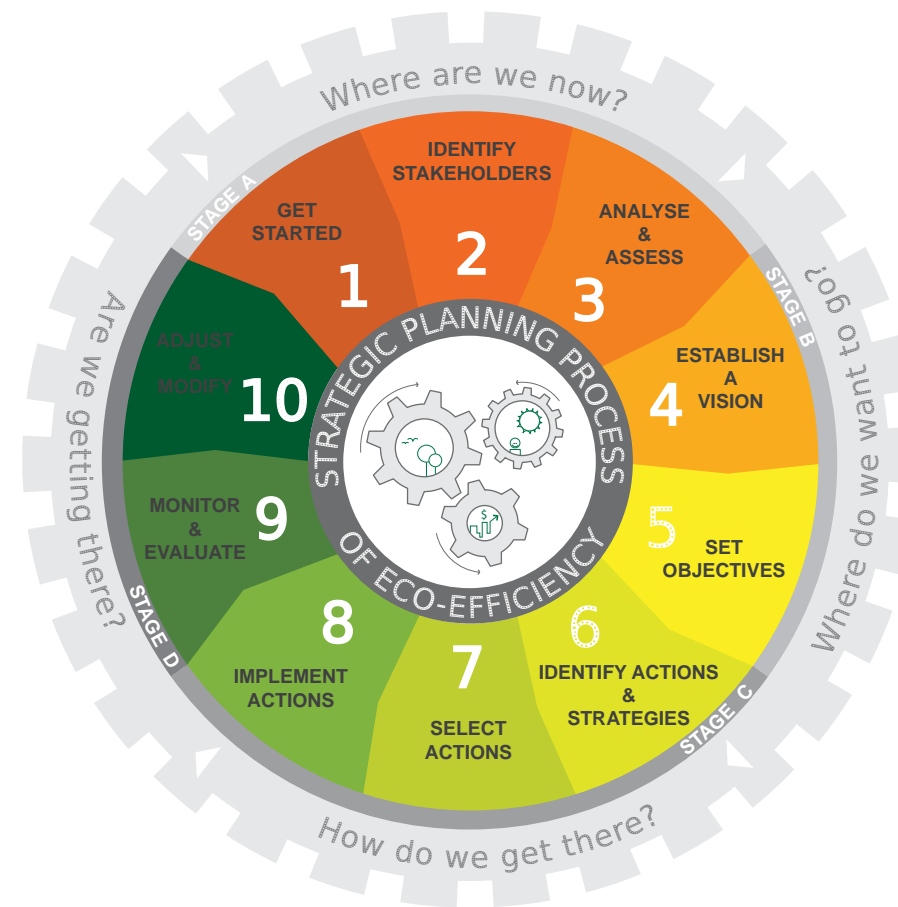
Step 9 MONITOR AND EVALUATE Page 112

Prepare a monitoring and evaluation framework and a work plan, decide whom to involve, when and how to document and report, evaluate results.

Step 10 ADJUST AND MODIFY Page 114

Figure 9

Four stages and ten steps of the strategic planning process



Each city is unique in terms of its development level, pace of growth, capacities, governance, leadership and policies. The strategic planning framework respects this uniqueness and provides a flexible tool that can be applied by any city, regardless of its size or level of development.

Strategic planning is not a new approach. It has been used for many decades by a number of actors to tackle challenges of a very diverse nature. This includes businesses, government agencies, local governments and NGOs. Strategic planning has proven effective, and there is considerable knowledge available on the approach.

These guidelines build on that knowledge and on the experience of ESCAP and UN-HABITAT in applying the strategic planning approach in a variety of challenging planning processes, including water and energy resource management, disaster risk management, local economic development and climate change.

Although all the steps of the planning process are explained, particular emphasis is placed on the aspects that are new and specific to these guidelines, namely: how to assess the eco-efficiency of urban infrastructure, how to develop objectives and targets based on eco-efficiency principles and criteria and how to prioritize actions and strategies to improve the eco-efficiency of infrastructure. The user is invited to refer to publications such as “Promoting Local Economic Development through Strategic Planning”² and “Planning

for Climate Change”³, which have been the main sources for designing stages, steps and tasks in this planning document, for more detailed guidance on the other steps.

Complementary training supplement and practical planning tools

A separate training workbook with practical planning tools and training exercises has been developed for use during trainings of 1-2 weeks. The training supplement will be available as of November 2011 and can be downloaded at the following website addresses, along with information about training activities in both Asia and Latin America.

www.unescap.org/esd/environment/infra/
www.eclac.cl/ecoeficiencia/default.asp?idioma=IN



Time requirements of strategic planning

One of the challenges to understanding strategic planning is determining how much time is required for each step and how each step varies. The first point is that there are no rules regarding time requirements for each step of the process – each is different (although after thinking through the process, it is important to establish deadlines for completing each step).⁴

Table 4: STRATEGIC PLANNING PROCESS

STAGE	STEP #	STEP	POTENTIAL TIME REQUIRED
A	1	GET STARTED	Typically, 1 to 6 months . If strategic planning is new, this step could take months.
	2	IDENTIFY STAKEHOLDERS	Could take a half-day session or up to several months , ongoing over the course of the project.
	3	ANALYSE AND ASSESS	A half-day kick-off workshop followed by 3 months to a year of study. External technical support may be required.
B	4	ESTABLISH A VISION	Could take a half-day workshop with stakeholders or up to a month or more; more time required if broad public involvement is included.
	5	SET OBJECTIVES	Initial object can be formulated in a one-day workshop. Often, however, this takes several meetings.
C	6	IDENTIFY ACTIONS AND STRATEGIES	Initial identification of options can be done in a one- to two-day workshop . Study and evaluation, depending on detail, can take 1 day to several months .
	7	SELECT ACTIONS	Depending on the extent of the evaluation, from a half-day workshop with stakeholders to 1 month or more for impact assessments.
	8	IMPLEMENT ACTIONS	The development of an action plan can be straightforward, but the time for actual execution depends on the project specifications.
D	9	MONITOR AND EVALUATE	Initial framework could be developed in a one-day workshop to determine the “who, what, when” of monitoring and evaluation. A date for a full evaluation should also be set.
	10	ADJUST AND MODIFY	As plans and impacts evolve and change over time, adjustments in plans may be required.

Source: Adapted from UN-HABITAT and EPI, Promoting Local Economic Development through Strategic Planning. Vol. 2: Manual (2005).

STAGE A: WHERE ARE WE NOW?

Commitment from the top and from key actors is essential in order to effectively carry out the planning process and to implement the chosen actions and strategies.

Broad-based participation is essential in order to ensure that the outcomes respond to the needs of the people affected and to create support for implementation.

Baseline data on the eco-efficiency of the city's infrastructure is needed in order to develop appropriate actions and strategies.

This stage includes three planning steps and will help you answer these questions:

STEP 1:

Are you ready to start the planning process?

STEP 2:

Who needs to be involved in the process and how?

STEP 3:

What is happening in your city and how eco-efficient is it?

➤ **Initiate the process, get commitment from pivotal actors and secure the necessary resources.**

Corresponds with the strategic principle 1:
Lead the change.

➤ **Use the expertise from different sectors and understand different needs.**

Corresponds with the strategic principle 3:
Link sectors with actors.

➤ **Map the assets of local areas.**

Corresponds with the strategic principle 4:
Recognize the value of sustainable infrastructure.

➤ **Assess the barriers and opportunities for actors to start developing infrastructure in an eco-efficient way.**

Corresponds with the strategic principle 5:
Turn “green” into a business opportunity.

➤ **Drive the planning process together and ensure local circumstances are understood and needs are heard.**

Corresponds with the strategic principle 6:
Build the city for people, together with the people.

After this stage, you'll have an overall picture of what is happening in your city and what can be done to make improvements. Actors who can drive necessary change are identified and can now be engaged.

STEP 1: PLAN THE PROCESS

Are you ready to start the planning process?



The following tasks can help you to plan the process:

Task 1.1: Get organized and secure commitment

Task 1.2: Form an executive committee

Task 1.3: Form a core planning team and ensure capacity to handle the planning process

Task 1.4: Plan the process

Task 1.1:

Get organized and secure commitment

Strategic principle 1 (lead the change) underlines the role of leadership in ensuring eco-efficient outcomes. Strong and sustained commitment from the top is essential to effectively carry out the planning process and to implement the chosen strategies and policies. Eco-efficient and inclusive urban infrastructure development requires cooperation among a wide range of actors who have different perspectives and may disagree on certain issues. Strong commitment from the top focuses the actors on

common deliverables and can help overcome disagreements. To be effective, strategic planning requires a champion. Experience reveals that the best results are achieved when this champion is the mayor (see boxes 3 and 4). Other actors, however, can also act as champions and drive the process. In any case, the planning process requires the commitment of key players, such as council members, department heads and senior planning officials. There may be need, therefore, to first sell the idea of eco-efficient and inclusive infrastructure to politicians, senior officials and other actors.

To help assess what should be done, consider the following questions:

Who is going to lead the effort?

- If the local government is going to initiate the process, which departments will be involved in addition to the planning department (or equivalent)?
- If the project is driven by an external organization (donor agency, international NGO), who is the local government liaison and contact? If it is an outside group, what power will it have? What will its mandate be?

Whoever initiates the process, formal agreements or new structures might need to be created to direct, plan and fund the process.

Task 1.2:

Form an executive committee

Once pivotal players are committed, formalize their role with an executive committee, possibly chaired by the mayor, to oversee the planning process. The executive committee can help build relationships with important groups, source and secure needed funding, and provide

additional technical and human resources to the process.

Task 1.3:

Form a core planning team and ensure capacity to handle the planning process

The actual planning process needs to be carried out by a more technical core planning team. The executive committee shall nominate a designated department to form a team and lead the process. There is a need to assess competencies available to handle the process vis-à-vis the competencies required and identify suitable team members. The team members can be from the designated department or from different departments and organizations. Given the cross-sector nature of the issues under analysis, it is likely that the core planning team will require expertise to be pulled from different areas, as stressed in strategic principle 3 (link sectors and actors).

To ensure that the lead department and core planning team is capable of handling the planning process, it is needed to assess competencies available to handle the process vis-à-vis the competencies required and identify suitable team members. If capacities are

lacking, it may be necessary to hire someone with specific expertise to keep the process going or to provide (technical or capacity) support throughout the planning process.

Task 1.4:

Plan the process

Before the planning process can start, the scope and expectations of that process need to be clarified and the resources required to complete it must be available. In particular, it is important to decide whether the city intends to go through the entire process or only some of its components. To design the planning process, the following questions should be answered:

- What is the scope of the project?
- What is the time frame?
- What resources are needed (time, money, efforts, skills)?
- Where is the funding for the planning process coming from?
- Where is the funding for implementing coming from?
- What are the logistical and human resource challenges within the local context?
- Is there a higher-level government programme that could support the city's initiative?

Checklist:

Are you ready to start the planning process?

- ✓ There is organization and leadership to support the process.
- ✓ There is commitment to complete and implement the plan.
- ✓ A core team has been formed and/or the individuals responsible identified.
- ✓ It is clear if outside expertise is required.
- ✓ Resources have been secured – funding, times, human resources.
- ✓ The scope has been defined.
- ✓ Constraints, strengths, weaknesses, opportunities and threats to the planning process have been identified and addressed.

STEP 2: IDENTIFY STAKEHOLDERS

Who needs to be involved in the process and how?



To appropriately respond to cross-cutting issues and ensure that actions taken reflect the real needs of city residents, a participative approach to planning and developing infrastructure is required. As underlined in strategic principle 6 (build the city for people, together with the people), involving a wide range of parties in the planning and development of infrastructure can improve the quality of the planning process while creating support for achieving certain actions and for politicians promoting them.

A well-designed participatory process also involves engaging actors within the local government. Inter-department cooperation and collaboration are crucial for successful planning, considering many departments will be involved in executing eco-efficient

infrastructure development projects (for instance, planning, design, finance, transport, buildings, waste, water, health and environmental protection).

The following tasks can help you to engage the right people:

Task 2.1: **Identify actors**

Task 2.2: **Establish a stakeholder group**

Task 2.3: **Ensure smooth communication**

Task 2.4: **Make a plan for engagement**

Task 2.1:

Identify actors

Ideally, a planning process incorporates participation in all stages (planning and decision making) of actors with i) different interests in the issue, ii) formal positions (local authorities), iii) control over resources (money and knowledge) and iv) power to support or prevent interventions.⁵ The eventual representation of different interest groups, however, will depend on the manageability of local governments and the willingness of those individuals to engage.

The following stakeholder groups should be considered for involvement because of their potentially crucial contribution in infrastructure development (design, finance, build, maintain, operate, demolish) and influence over its eco-efficiency:

- **Public (government and other) authorities**

Local government bodies are involved in different aspects of infrastructure development (supplier, regulator and coordinator).

- **Business owners, associations and specialists**
Business owners and specialists can help with financing and improving the efficiency of infrastructure development projects. Labour organizations can be included to mobilize more employers as well as employees and improve the quality of work.

- **Communities and area groups**

Local (informal) leaders from communities and NGOs should be included for critical insight (local needs and challenges) and support for the process, including from the most marginalized groups.

The participation of different actors ultimately depends on their willingness to get involved; certainly the greater the effect (impact) of an infrastructure development project on their personal world, the greater will be their willingness to join the process. But there are many people willing to share their expertise and get involved because of their commitment to a greater purpose. If you understand the reasons for people to engage, you will better understand who should be involved. The following categorized reasons can help understand why individuals would want to participate:⁶

- Proximity: people who work, live or spend time in the area designated for a project.
- Economic: people whose business, livelihood, cost of living or property value might be affected.
- Use: people who use or may use infrastructure or other facilities that will be affected.
- Social and environmental: people who may

be affected by secondary impacts.

- Values: people who have a political, moral or religious interest in the project or its effects.
- Legal mandate: people who are legally required to be involved in the process.

For an overview of actors and their potential contribution to the eco-efficiency of infrastructure development project through their involvement, refer to annex 1.

It is important to realize that the eco-efficiency of infrastructure is mainly determined during the planning and design phase. In this phase decisions are made about the form and function of urban areas and infrastructure, and thus about the effects of design in terms of use of land (e.g. density), materials, water and energy. In other words, this is when the energy use of a building over its lifespan (build, maintain, operate, demolish) is determined. In order to avoid future costs and risks and maximize social benefits, all parties who can influence the eco-efficiency of a building during its life should be involved during the design phase. This is illustrated in table 5 with an example related to buildings.



Singapore

**Table 5:
WHY REPRESENTATION IS NEEDED
FOR EACH STAGE OF INFRASTRUCTURE
DEVELOPMENT**

Design ▽	Do not focus on initial construction costs only but also on long-term costs (maintenance and operation) related to the use of land, materials, energy and water. Involve financiers, builders, maintainers, operators and demolishers.
Finance ▽	By establishing a contract with financiers, constructors, maintainers and operators, a building can be designed in such a way that the use of materials, energy, water, etc. will be minimized over its life-span. This will lead to less overall costs and social benefits such as reduced energy consumption costs and enhanced comfort of living due to improved insulations. Looking at the long-term cost impacts of local renewable energy production and the use of eco-materials can make their use profitable.
Build ▽	
Maintain ▽	
Operate ▽	
Dispose ▽	Costs can be minimized when the design of the building allows for changing function (flexible design) or waste can be reused, recycled and easily taken out of the building.

The following questions can help to identify who should be involved and why:

- Have all relevant actors been identified? Consider their:

- stake in the issues (developers to make profit or neighbourhood groups to increase local quality of life)
- formal position (local authorities from different sectors)
- control over relevant resources (money or knowledge)
- power to support or prevent interventions (activist).

- Are the different actor categories (public, business and communities) well represented?
- Are the people who have a role at some point in the development (design, finance, build, maintain, operate, demolish) of infrastructure well represented?
- Are the people who can drive (political will, interest, credibility, skills, experience) eco-efficient infrastructure projects involved?
- Are often-underrepresented groups involved?
- Who else should be at the table?

Task 2.2:

Establish a stakeholder group

Assembling an optimal-sized stakeholder group can be done through a common-sense assessment of who is needed based on the guidance provided above and how many are needed (in terms of effectiveness). If a group is too large, it is difficult to move forward, and some participants might feel that their voices are lost in a crowd. If it is too small, groups might be unrepresented, which could lead to a lack of support.

Eventually, structuring a stakeholder participation process basically means defining roles and responsibilities, which should be to:

- represent local government departments and/or agencies
- represent broader community interests and interest groups, including vulnerable groups
- ensure that any engagement process is inclusive and draws in the parties most affected by the planned interventions
- act as community ambassadors, messengers or public liaisons for the project, consulting with local government staff, public and other constituents (informally and formally)
- provide reports and decisions of the group to other partner groups and departments within the local government
- provide local knowledge and input for determining eco-efficient infrastructure development impacts
- define priorities and assess potential trade-offs
- achieve buy-in and commitment from important partners for implementing climate change actions.

Once the stakeholder group is established, a comprehensive first meeting should be held to introduce the members to the project and ensure their role in the planning process is clear (an advisory group providing decision support).

Task 2.3:

Ensure smooth communication

To maximize effective and efficient communication between the stakeholder group members, a set of agreed-upon rules

should be created, regarding, for instance:

- confidentiality
- communication
- entering and leaving the process.

By answering the following questions, any expectations of the group's members can be addressed:

- What is the group empowered to do (such as give advice and make recommendations)?
- What process resources does the group have (what is the budget for renting space, group administration, technical support, etc.)?
- What implementing resources does the group have, or might have, to work with (are there local or national government funds, donor funds, etc.)?
- Are there time constraints?
- What are the reporting procedures?
- What are the roles and responsibilities of each member of the group?
- Can new members join part-way through? If so, what is the process?

Task 2.4:

Make a plan for engagement

Local governments should make a plan for participation focused on engaging pivotal actors at the right moments and with appropriate actions. Choices depend on understanding timing, budget, constraints and objectives. The plan should give shape to the process (public consultation) and direct the process (decision-making and implementing). Table 6 shows the range of public involvement and related possible actions.

Table 6: THE RANGE OF COMMUNITY ENGAGEMENT OPTIONS IN THE DECISION-MAKING PROCESS⁷
(INCREASED LEVEL OF ENGAGEMENT)

	INFORMING	CONSULTING	ADVISING	CO-PRODUCING	CO-DECIDING
Description	Inform all involved actors	Discuss with actors	Consider input from all involved actors	Jointly agree on solutions	Leave the planning to involved actors
Goal	Enhance involved actors' understanding	Obtain all actors' feedback	Ensure that actors' concerns and aspirations are considered	Develop alternatives and solutions in partnership	Place final decision making in hands of all actors
Promise to involved actors	"We will keep you informed"	"We will acknowledge your concerns"	"We will work with you so that your concerns are reflected"	"We will incorporate your advice"	"We will implement what you decide"
Example tools	Fact sheets Web sites Open houses Press release Public announcements	Public comment Focus groups Surveys Public meetings	Workshops Deliberative polling	Citizen advisory committee Consensus building Participatory decision making	Citizen jury Ballots Delegated decisions

Source: UN-HABITAT and EPI, Promoting Local Economic Development through Strategic Planning. Vol.2: Manual (2005).

Checklist: Who needs to be involved in the process and how?

Are the following actors part of the stakeholder group?

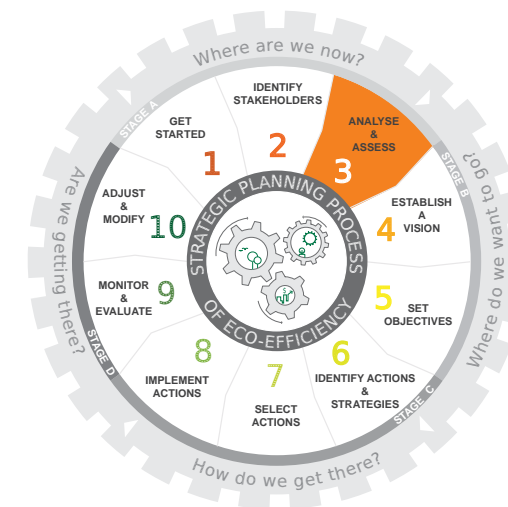
- ✓ Political leaders who can drive the planning process.
- ✓ Decision-makers from different departments and agencies.
- ✓ Individuals or groups affected by development plans.
- ✓ Traditionally under-represented groups.
- ✓ Individuals or groups who are willing or able to play a leadership role in the planning process.

For smooth communication – have the following been determined?

- ✓ Activities to be jointly undertaken.
- ✓ Roles of the participants throughout the process.
- ✓ Standards for information-gathering and sharing.
- ✓ Decision-making methods, including dispute resolution and review.
- ✓ Resources to be provided by each partner.
- ✓ Agreements on how the outcomes of the planning process will be integrated into the planning activities of the municipality.

STEP 3: ANALYSE AND ASSESS

What is happening in your city and how eco-efficient is it?



regulations that promote certain solutions. In other words, these 'shaping' elements can be drivers for eco-efficient infrastructure development, but they also can be barriers. Listing and analysing these elements will help to cobble a vision about a desired future and understand what is needed to make this future a reality.

The following tasks can help you to analyse the situation of your city:

- Task 3.1: Create a profile of the city
- Task 3.2: Identify the legal and regulatory frameworks and drivers of infrastructure development
- Task 3.3: Conduct an eco-efficiency assessment

Task 3.1:

Create a profile of the city

A city profile lists information in a bullet-point format, enabling individuals to get a quick impression of the city situation. A city profile includes general data and economic, social, environmental and institutional aspects:

- basic city data (population, administrative area, GDP/capita, population density, local climate)
- urban challenges or needs (SWOT analysis of economic, social and environmental circumstances and institutional capacity)
- important assets (mapping of available resources in the community and city).

As previously noted, it is impossible to promote development based on deficiencies or needs only. Local assets constitute a rich reservoir of available resources to address the local needs. They are important because

The situation analysis aims at sketching a concise overview of the most important city-wide challenges and opportunities. The information gathered can be used as a basis to develop a city vision (step 4) and set objectives (step 5). This overview is important in order for local governments and other actors to look at the city as a whole and break away from separate systems in the way they think, plan and design.

The situation analysis evaluates the economic, social and environmental circumstances of a city to provide base data to identify eco-efficient solutions. Making these solutions work will eventually depend on the ability of local governments to provide the right platform in terms of institutional arrangements, such as cooperation between different divisions, and the laws and

they rely on community and city assets – not on those found outside of it – and seek to build links among local people, institutions, organizations and opportunities. These local strengths should be mapped in order to collaboratively address issues of importance to the community and local area. This relates to strategic principle 4 (recognize the value of eco-efficient infrastructure), which underlines the importance of considering all values (monetary and non-monetary) when choosing an intervention that has the greatest eco-efficient impact now and in the long term.

Task 3.2:

Identify the legal and regulatory framework and drivers of infrastructure development

This task aims at understanding, from a local government perspective, why certain policies work or not. This can be done by analysing the main barriers and drivers for (eco-efficient) infrastructure development, such as inter-sector cooperation. These drivers and barriers depend first of all on different actors’ willingness to act but can be influenced by local governments through decision-making processes and the legal and regulatory frameworks in place. Thus, to influence the “willingness to act”, first answer the following questions:

- What are the most relevant strategies, policies, laws, regulations and plans governing urban development and infrastructure development in your city? These should include the most relevant regulations at the local, regional and national levels.

- What is the political and decision-making structure in your city and its relationship to the central and regional governments? In particular, what is the level of political independence of the city government?
- Who are the main actors influencing infrastructure development?
- What is the level of private sector participation in infrastructure development in your city?
- What are the attitudes of business owners and residents towards local issues, including perceived problems and opportunities?
- What are the options and barriers for collaboration between different key actors?

Task 3.3:

Conduct an eco-efficiency assessment

This step involves assessing how eco-efficient the city’s infrastructure systems currently are.

Refer to the eco-efficiency diagram for the city, based on the urban metabolism concept shown in part 1, which shows the need to understand what goes into the city (resources) and what goes out (value for society and impact on nature).

Assessing the current eco-efficiency of your city’s infrastructure means answering the question: How efficiently are you using the inputs (resources) in relation to desired outputs (value for society) and undesired effects (impact on nature)?

Table 7: HARNESSING LOCAL ASSETS

PHYSICAL RESOURCES	FORMAL INSTITUTIONS (MUNICIPAL SERVICES, UNIVERSITY)	CIVIL SOCIETY (NGOs, GROUPS)	PERSONAL ASSETS
Natural (land, forests, water)	Agenda/ interest	Agenda/ interest	Personal skills and personal information
Constructed (Buildings, infrastructure)	Capacities	Capacities	Community skills
Created (Waste)	Links	Links	Enterprising interests and experiences

Box 18: How to measure eco-efficiency?

The following ratio is used as a general equation to measure eco-efficiency:

$$\text{eco-efficiency} = \frac{\text{product or service value}}{\text{environmental impact}} \quad [\text{value unit/burden unit}]$$

Often the reverse ratio is used, as a measure of the pollution or resource intensity of the service or product provided:

$$\text{eco-intensity} = \frac{\text{environmental impact}}{\text{product or service value}} \quad [\text{burden unit/value unit}]$$

There should not be, however, a single approach to measuring and reporting eco-efficiency performance. Moreover, the framework should be flexible enough to be widely used, broadly accepted and easily interpreted.

Here are three possible approaches to measuring eco-efficiency:

- Set of simple indicators for each of the three eco-efficiency impact areas (resource use, pollution and value for society)
- Set of eco-efficiency indicators (decoupling ratios)
- An eco-efficiency index

a. Simple indicators

For each of the three main impact areas (resource use, pollution and value for society), you need to identify the variables you want to measure. An example is provided in the table 8.

Table 8: IMPACT VARIABLE TO MEASURE

IMPACT AREA	VARIABLE
Consumption of resources	Energy
	Water
	Materials
	Land
Impact on nature	Emission (air, water, soil)
	Waste
	Biodiversity
	Renewable resources
Value for society	Economic return
	Employment
	Affordability
	Inclusiveness

Scope of the assessment

Once you have chosen the variables for each impact, you should also define the scope of the assessment and define clear system boundaries so that different courses of action can be compared. It is thus necessary to define targets and indicators related to the objectives. For this purpose, the following needs to be defined:



What?

Define what infrastructure system(s) you want to evaluate, such as transport, solid waste management, water or buildings.

Where?

Define the spatial system boundaries for the evaluation, such as region, municipality, district, sector or project.

When?

Define which period(s) of time of the infrastructure's life cycle you want to evaluate, such as planning and construction, operation and maintenance, refurbishment and recycling.

Choosing indicators

Once the scope has been defined, you need to choose indicators for each selected variable. After defining the scope, however, not all variables may have the same relevance. For example, if you consider transport infrastructure, energy consumption and emissions-to-air would be extremely relevant, whereas water consumption may not be relevant. You then select only those variables that have more relevance.

General criteria for choosing indicators include:

- Policy relevance – can it provide a basis for action?
- Simplicity – is it clear and simple to understand?
- Reliability – is it verifiable and reproducible?
- Comparability – can it allow comparisons over time?
- Flexibility – can it accommodate continuous improvements?
- Availability of affordable data.

Table 9: EXAMPLE OF INDICATORS PER IMPACT VARIABLE

IMPACT AREA	VARIABLE	INDICATOR
Consumption of resources	Energy	Total energy use (GWh/year)
	Water	Daily water use (litre/day)
Impact on nature	Emissions to air	CO ₂ emissions (ton/year)
	Waste	Total solid waste (ton/year or m ³ /year)
Value for society	Affordability	Home price(rent) to income ratio (%)
	Access	Tenure type (formal ownership, tenancy, squatters, others, %)

For example, consider the operation and management of residential buildings in a specific district; for this purpose, the above set of indicators could be used. A list of indicators that could be considered for various variables is provided in annex 2.

b. Eco-efficiency indicators (decoupling ratios)

As shown above, eco-efficiency indicators are expressed as a ratio between the value of a good or service and its environmental influence. For communication reasons we suggest to use the inverse ratio (eco-intensity), for which the lower the better.

Choosing eco-intensity indicators requires going through all the steps required for choosing simple indicators explained above and then identifying a measure for the unit of service/value provided.

A measure of the value provided at the city level could be the GDP, for transport could be passenger-km, for buildings could be the floor space, etc. The measure of carbon intensity, for example, would then be ton CO₂/GDP for the city, ton CO₂/passenger-km for transport and ton CO₂/m² for buildings.

Once developed, there is a need to double-check the indicators against the criteria provided above. The exercise of developing eco-efficiency indicators can become quite mechanical and there is a risk of developing indicators that are no longer relevant or simple enough. If some indicators do not meet the criteria, there is a need to find alternatives that do meet the criteria. If no sensible eco-efficiency indicator can be identified for a specific impact sub category, then it may be wise to choose a simple indicator.

c. Eco-efficiency Index

Creating an eco-efficiency index means creating one composite indicator from individual indicators described above. A generic formula for such composite indicator would be:

$$I = \sum_{i=1}^n W_i Y_i$$

where Y_i represents the indicators and W_i the weight assigned to each indicator.

Composite indicators can be very useful to illustrate complex issues, such as urban development. However, composite indicators can send misleading policy messages if they are poorly constructed or misinterpreted.

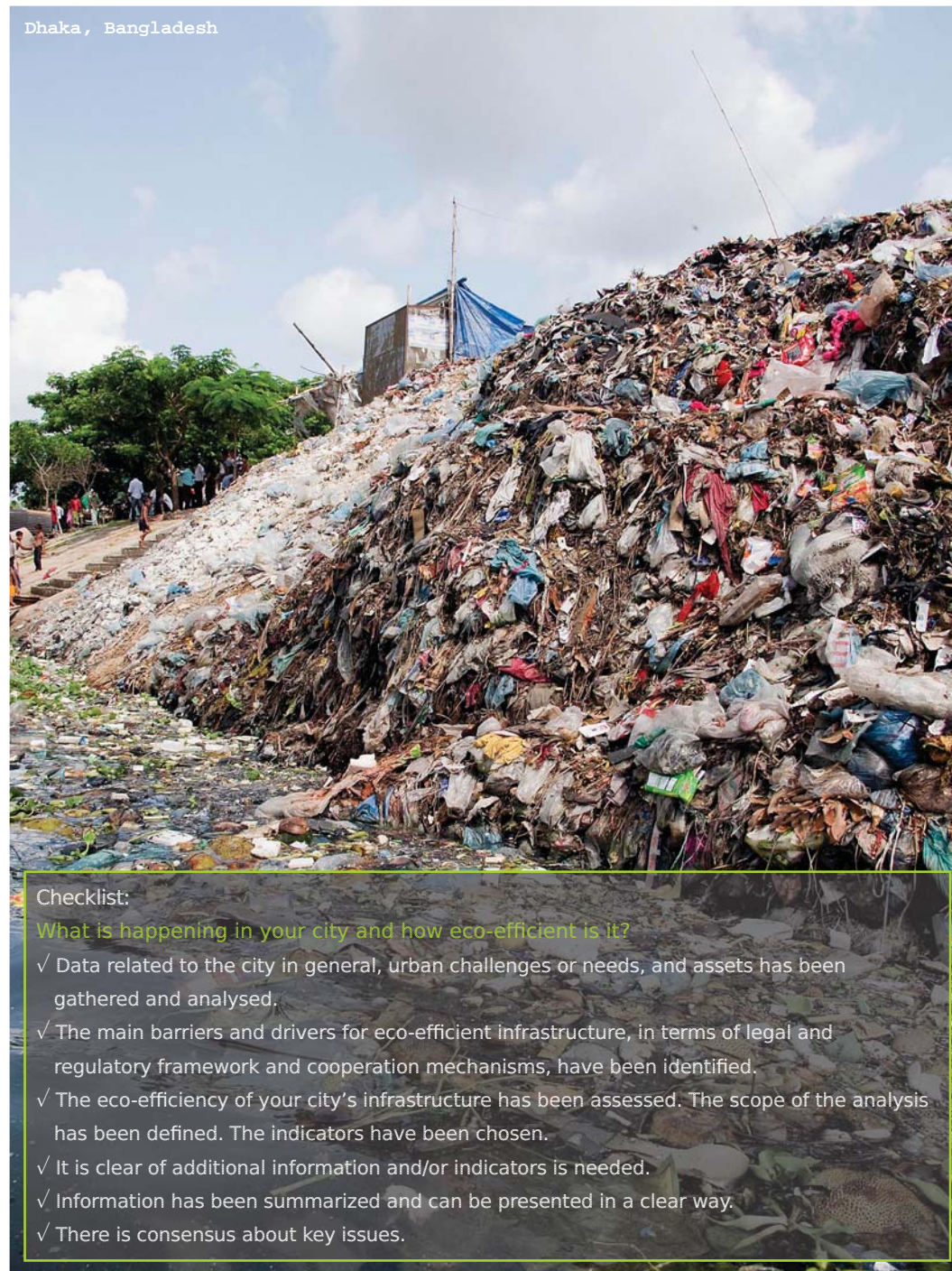
Which approach to choose?

Each approach to measuring and reporting eco-efficiency performance has its own advantages and disadvantages, as illustrated in table 10. The choice of the approach depends on various factors, including the scope of the planning process, data availability, capacities and time. The

first approach is, however, recommended for those cities that have limited or moderate experience with eco-efficiency (or sustainability) assessments, capacities and resources. The second and third approaches are more suitable for cities with more extensive experience with eco-efficiency (or sustainability) assessments and a high level of capacities and resources.

Table 10: ADVANTAGES AND DISADVANTAGES OF EACH APPROACH TO MEASURING AND REPORTING ECO-EFFICIENCY PERFORMANCE

APPROACH	ADVANTAGES	DISADVANTAGES
Simple Indicators	<ul style="list-style-type: none"> • Useful for sectoral performance assessments • Can be developed with available data and easily feed into existing frameworks and processes • Social aspects can be considered within the set of indicators 	<ul style="list-style-type: none"> • A set of disaggregated indicators may fail to show whole-system relationships • May be too similar to a conventional sustainability assessment for stakeholders to see the added value of considering eco-efficiency
Decoupling indicators	<ul style="list-style-type: none"> • Useful for sectoral performance assessments • Can be developed with available data and easily feed into existing frameworks and processes 	<ul style="list-style-type: none"> • A set of disaggregated indicators may fail to show whole-system relationships • Social aspects would need to be considered through a separate set of indicators
Index	<ul style="list-style-type: none"> • Useful for communication and for engaging stakeholders • Allows for integration of social aspects in the eco-efficiency equation 	<ul style="list-style-type: none"> • Difficult to aggregate and weigh indicators because priorities differ and different stakeholders may place different weigh to each issue



Checklist:

What is happening in your city and how eco-efficient is it?

- ✓ Data related to the city in general, urban challenges or needs, and assets has been gathered and analysed.
- ✓ The main barriers and drivers for eco-efficient infrastructure, in terms of legal and regulatory framework and cooperation mechanisms, have been identified.
- ✓ The eco-efficiency of your city's infrastructure has been assessed. The scope of the analysis has been defined. The indicators have been chosen.
- ✓ It is clear of additional information and/or indicators is needed.
- ✓ Information has been summarized and can be presented in a clear way.
- ✓ There is consensus about key issues.

STAGE B: WHERE DO WE WANT TO GO?

A strong vision and objectives are crucial for the planning and executing of long-term infrastructure development projects; they function as reference tools for what you want your city to become.

↓ Develop a vision about your desired future for your city and use this as a reference along the development process.

Corresponds with the strategic principle 2:
Bridge the gap.

↓ Develop objectives by considering social, economic and environmental issues.

Corresponds with the strategic principle 3:
Link sectors with actors.

↓ Develop objectives by understanding what value the natural and physical assets add towards enhancing the competitiveness and liveability of your city.

Corresponds with the strategic principle 4:
Recognize the value of sustainable infrastructure.



This stage includes two planning steps and will help you answer these questions:

STEP 4:

How do you want your city to evolve in the future?

STEP 5:

What can make your city evolve the way you want?

After this stage you will have a clear picture of how you want your city to evolve in the future and what should be done to make it happen.

STEP 4: ESTABLISH THE VISION

How do you want your city to evolve in the future?



What is visioning?

Developing a vision means answering the question: Where do you want to go? The response is a statement that describes your desired future state. It points out the most important principles and values that will define your city in the future; it takes the current situation as a starting point and looks ahead to see what needs to be changed. Usually a time period of about 20 years is given. Visioning works because we as human beings respond to the tension that is created between a current situation and a desired future; we want to start working towards the desired future, we want to close the gap and we want to know where we are going and how we are moving forward.

Why is a vision important?

A well-stated vision functions as an important point of reference and a reminder tool that keeps people thinking in broad or system-wide terms throughout the whole process of development. The vision is the starting block to set objectives and plan actions, connecting the strategic principles and core values to practical decision making.

A city vision can be streamlined with the principles of eco-efficiency, considering that a city should be competitive and liveable by making environmental improvements. A city vision can be useful to pull different actors (with different agendas) into one direction for a longer time. If done well, this increases the commitment of different actors towards a certain goal, making it a tool to “bridge the time gap”, as emphasized in strategic principles 2. To maximize the impact of actions in the long term, we need a shared vision among actors, not only within the local government but also the private sector and civil society need to become owners of the project for it to succeed.

How to develop a vision?

There is not one way to develop a vision. However, to guide the collaborative strategic planning process, a vision should be realistic and concrete. The vision that is produced should be short (less than four paragraphs), clear and framed in a specific time.

Generally the process of developing a vision includes the following tasks:

Task 4.1:

Review the main urban challenges and needs in your city, as being done in stage A, step 3.

Task 4.2:

Solicit answers to the following questions using a variety of means such as workshops, focus groups or through surveys:

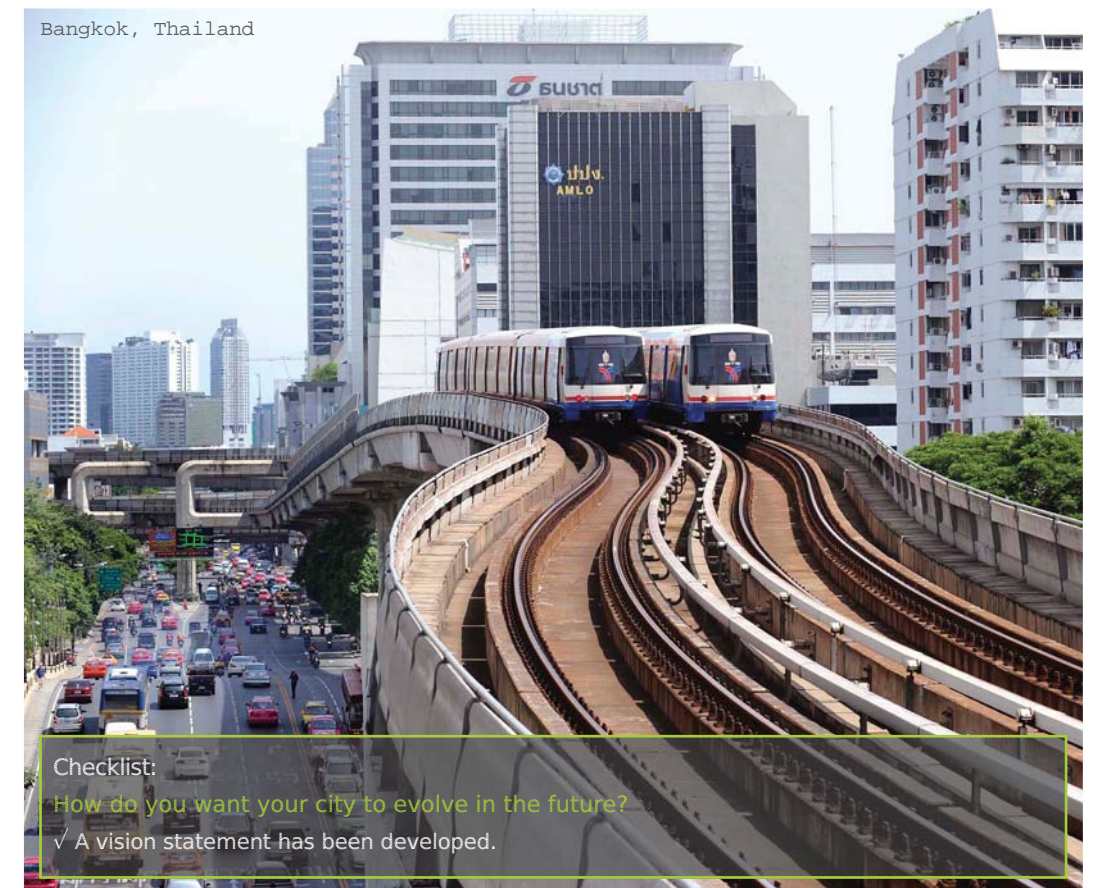
- How do you want your city to evolve in the future?
- What are the most important economic, environmental, social, physical and governmental aspects of your desired future (such

as green spaces, affordable transportation, jobs, income, and poverty reduction)? Re-view the analysis done in stage A, step 3

- What is different about your vision of the future from what you see today?

Task 4.3:

Collect and group similar ideas, agree on themes and develop one or two vision statements.



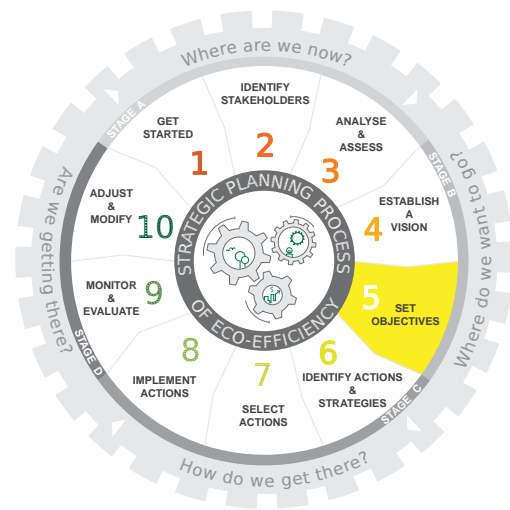
Bangkok, Thailand

Checklist:

- ✓ How do you want your city to evolve in the future?
- ✓ A vision statement has been developed.

STEP 5: IDENTIFY OBJECTIVES

What can make your city evolve the way you want?



Objectives are the basis for defining actions and strategies that lead to increased eco-efficiency. They define priorities in the way infrastructure should be developed. Decisions about new projects will ultimately be made upon the information captured in these objectives. To capture this information for effective use in decision making, objectives should be designed in such a way that actions and strategies can be compared and synergized. This will also allow an evaluation of those action and strategy options. In short, objectives are the core of the decision-making process because the ambitions stated in them will lead to actions to achieve them. Therefore, it needs to be absolutely clear what your objectives are.

Objectives:

- Are means to answering the question: What matters or what is important in developing urban infrastructure in an eco-efficient way?
- Function as a basis for defining actions and strategies for urban infrastructure development; they operate as a checklist to address local (urban) values.
- Exhibit directions of preference that can be compared and synergized.
- Provide criteria to evaluate options for action and strategies.

The following tasks can help you to set objectives:

Task 5.1: **Identify important city issues**

Task 5.2: **Organize issues**

Task 5.3: **Restate issues as objectives**

Task 5.4: **Ensure your objectives are eco-efficient**

Task 5.5: **Select related indicators**

Task 5.1:

Identify important city issues

Objectives can be set if you are fully aware of what is happening in your city or community and what should be improved. In other words, are you aware of the main issues at stake in your city? To identify important issues and set objectives, the vision for the city should be reviewed together with the situation analysis (stage A, step 3). Reviewing this information addresses the question: What can you do to realize your vision given the specific city or community context? To develop a list of objectives that take into account both the vision and the reality of the economic, social and environmental circumstances in your

city, the following questions might be helpful:

- What problems and opportunities do we see in the future?
- What problems do we face in developing infrastructure?
- What economic, social and environmental impacts might infrastructure development have?
- What can the development of infrastructure in an eco-efficient way help address in an area or sector that is important to you?

Answering these questions should be highly participatory (with the stakeholder group), for instance through brainstorming sessions with note cards for each issue. Independent thinking is important for catching all the issues. The answers should therefore not be limited to certain sectors or scales.

Task 5.2:

Organize issues

Once you have identified a list of issues, it is useful to delve more deeply into the “why” behind the issues: Why is the issue important and how does it relate to eco-efficient and inclusive infrastructure development? You’ll have to ensure that you get a good understanding of the underlying causes from effects. What are the actual causes for a certain effect or issue?

To ensure that each objective is well considered, ask:

- Why is this issue important?
- Is it consistent with the vision?
- Is it linked to eco-efficient infrastructure development?

• Does it reflect facts about the city context? Issues that appear frequently and contribute to different problem areas are important to understand because they might indicate necessary actions that can leverage multiple beneficial impacts. For example, issues that contribute to the outcome measures of poverty and quality of life often indicate the barriers to participative planning and the understanding of local needs, which sustain high levels of poverty and exclusion. Questions to consider:

- What are the largest, most important and most frequent issues confronting your area?
- What core sources (20%) are causing most (80%) of the problems?
- Where should we first focus our efforts to achieve the greatest improvements?

Task 5.3:

Restate issues as objectives

Now the issues (concerns, desires, problems and opportunities) have been identified (task 5.1) and organized (task 5.2) they should be grouped and restated as objectives. This is the point where you need to start thinking why the objectives are important to the city or community and which ones matter most in terms of eco-efficiency. During this task, the objectives can be organized as broad objectives (big-picture objectives, end objectives) and specific objectives (supporting, driver, means objectives). This will form the initial (hierarchical) objectives list that is useful for further analysis.

Restating an issue into an objective basically means indicating what you want to do about

the issue by stating a direction of preference (increase, reduce) of objective of importance (poverty, waste, etc).

Task 5.4:

Ensure that your objectives are eco-efficient

Now that the objectives have been organized into broad and specific objectives, it should be ensured that the objectives promote eco-efficiency. To show what elements are important for making the city evolve in an eco-efficient way, we can refer again to the eco-efficiency diagram for the city, based on the urban metabolism concept shown in stage A, step 3.

Broad eco-efficiency objectives

Policymakers and planners who want to apply eco-efficiency criteria to urban infrastructure development should be concerned with the following three broad objectives:

- Reduce the consumption of resources
This includes minimizing the use of energy, materials, water and land.

- Reduce the impact on nature
This includes minimizing air emissions, water discharge, waste disposal and the impact on biodiversity as well as fostering the sustainable use of renewable resources.

- Increase value for society
This means providing more benefits to all parties, including investors and users. This may include return on the investments, employment generation, access to services and resident satisfaction.

Specific eco-efficiency objectives

Specific objectives can be separated from broad objectives. Defining specific objectives for the first two broad objectives is more straightforward because these refer to specific environmental impacts. Defining

specific objectives for the broad objective of increasing value for society is more complex because it involves value judgements and thus a political process.

The final list of objectives should display what matters. If an objective is not on the list, it cannot be significantly affected by infrastructure development or it is not important. Identifying higher-level and lower-level objectives requires contextual information, creativity, a common understanding and strategic thinking. As each objective is discussed, it is wise to ask:

- Why is this objective important to our city development vision?
- What is the relationship (actions from specific objectives or from broad objectives)?

These aspects are important because objectives can also provide the basic set of criteria for monitoring ongoing performance.

Task 5.5:

Select indicators

To measure the performance of the objective you'll need to identify relevant indicators. In other words, the purpose of the indicator is to reflect the achievement of objectives. As such, an indicator is directly linked to its objective and should be impacted by actions undertaken. Indicators are important because they help in making decisions and to monitor the success of actions; they provide a way to evaluate possible actions or strategies, also for the monitoring and evaluation (step 9).

The following questions can help to select the right indicators:

- Are the indicators clearly linked to the objectives?
- Is the scale and impact of actions reflected in the indicator?
- Can the information (indicator) be used as a basis for future action?
- Can information be obtained within the period of time defined by the plan (survey, statistics, expert judgement, local knowledge)?

For choosing indicators, see stage A, task 3. For a list of indicators, see annex 2.

Table 11: EXAMPLE OF ECO-EFFICIENCY OBJECTIVES

BROAD OBJECTIVE	SPECIFIC OBJECTIVE
Reduce consumption of resources	Improve energy-efficiency
	Improve water-use efficiency
	Decrease material intensity
	Maximize productive use of land
Reduce the impact on nature	Increase the share of renewable resources
	Minimize emissions (air, water, soil)
	Minimize waste generation and disposal
	Minimize impact on biodiversity
Increase value for society	Increase access to affordable services
	Increase employment
	Increase economic return



Table 12a: THE BROAD OBJECTIVES, SPECIFIC OBJECTIVES, TARGETS AND INDICATORS
SINGAPORE

PROJECT	BROAD OBJECTIVE	SPECIFIC OBJECTIVE	TARGET/MEANS	INDICATORS/ MEASUREMENT
Active, Beautiful and Clean Waters Programme	Reduce consumption of resources	Reduce use of water and land	Active: Providing new community spaces and bringing people closer to water through recreational activities	Has the programme optimized the use of resources?
	Reduce the impact on nature	Reduce emissions	Beautiful: Developing reservoirs and waterways into vibrant and aesthetically pleasing lifestyle attractions that integrate with parks, estates and even commercial developments	Has the programme reduced negative environmental impacts and created positive impacts on nature, land, water and people?
	Increase value for society	Increase attractiveness; quality of life	Clean: Improving water quality; the aim is also to minimize pollution in the waterways through public education and by building closer people-water relationships	Has the programme made an impact on the community in terms of engaging the stakeholders and influencing the market or community with new ideas?
		Increase the employment		Has the programme Increased product or service value?



Table 12b: THE BROAD OBJECTIVES, SPECIFIC OBJECTIVES, TARGETS AND INDICATORS
ULSAN, REPUBLIC OF KOREA

PROJECT	BROAD OBJECTIVE	SPECIFIC OBJECTIVE	TARGET/MEANS	INDICATORS/ MEASUREMENT
Ulsan Eco-Industrial Park	Reduce consumption of resources	Reduce use of water, land and energy	<ul style="list-style-type: none"> Improved inter-company collaboration within the industrial complex (and within supply chains) Shared services and facilities to lower costs of individual companies 	Economic payback time: <ul style="list-style-type: none"> Change in annual profit (net benefit) Change in the cost of production per unit Change in productivity Return on investment payback period
		Reduce the impact on nature	<ul style="list-style-type: none"> Company-to-company exchanges of material, energy, water and services A cluster of resource-recovery companies use by-products 	Environmental pollutant reduction: <ul style="list-style-type: none"> Change in emissions Change in the emissions per unit production
	Increase value for society	Increase quality of life	<ul style="list-style-type: none"> A cluster of environmental technology and service companies 	Social: <ul style="list-style-type: none"> Job creation and contribution to quality of life in terms of minimized environmental pollution
		Increase employment opportunities and economic return		



Checklist:
What can make your city evolve the way you want?
 ✓ Issues have been restated into broad and specific objectives.
 ✓ Objectives promote eco-efficiency outcomes.
 ✓ The selected indicators are relevant, easy to use and available.

STAGE C: HOW DO WE GET THERE?

Identifying eco-efficient actions allows highlighting those interventions that generate multiple benefits. In order to realize synergies, though, actions need to be packaged and sequenced into effective strategies.

- **Combine actions into effective strategies.**
Corresponds with the strategic principle 3:
Link sectors with actors.
- **Recognize the multiple benefits of certain actions and strategies.** Corresponds with the strategic principle 4:
Recognize the value of sustainable infrastructure.
- **Provide the conditions for the private sector to start developing infrastructure in an eco-efficient way.**
Corresponds with the strategic principle 5:
Turn “green” into a business opportunity.



This stage includes three planning steps and will help planners answer these questions:

STEP 6:

What actions can make your objectives a reality?
How can you combine action into effective strategies?

STEP 7:

How can you prioritize actions and strategies with the biggest impact?
How do you evaluate them?

STEP 8:

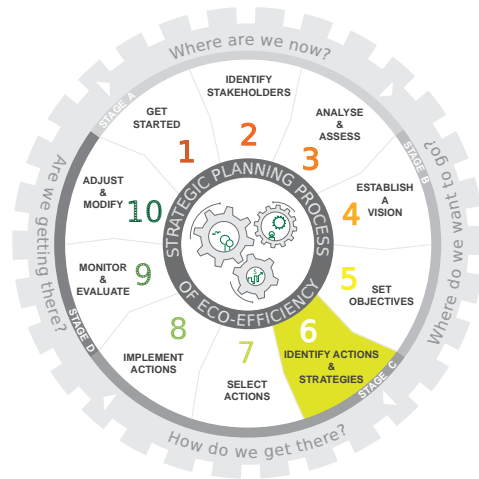
How can you plan and finance the prioritized actions and strategies?

After this stage you will not only have identified and organized eco-efficient actions and strategies but also evaluated and prioritized them according to local objectives and vulnerabilities.

STEP 6: IDENTIFY ACTIONS AND STRATEGIES

What actions can make your objectives a reality?

How can you combine action into effective strategies?



Why separate actions from strategies?

Now that the objectives are set, you can start compiling a list of actions to address them. From this list the most promising in terms of eco-efficiency will be chosen. While compiling this list it must be clear how you define actions and strategies, as these terms are often mixed-up. In this case, we look at actions as separate ideas for achieving objectives while strategies are a group of actions working together to maximize the effectiveness of each action within and throughout sectors.

This step focuses on generating a large list of potential action to achieve the objectives.

These actions will undergo a screening and ranking based on their relevance to achieve the objectives set and on their feasibility. After the ranking, you can start combining these actions into strategies. Actions and strategies will be further refined and prioritized based on their promotion of eco-efficiency in step 7.

The following tasks can help you to identify the best actions and strategies:

Task 6.1: **Generate action ideas to achieve your objectives**

Task 6.2: **Organize, screen and rank actions**

Task 6.3: **Develop strategies**

Task 6.1:

Generate action ideas to achieve your objectives

Once specific objectives and targets are formulated, the following question should be asked: What actions could be undertaken to achieve each specific objective? Action ideas can be identified by taking each specific objective separately and thinking about what actions are needed to achieve it. You can also develop a list of actions around means objectives (information and communication) or by sector (transport, buildings, waste and water).

To generate ideas in an inclusive way, independent thinking techniques, brainstorming and other tools should be used. Breakout groups can be a productive way to develop courses of action per single objective. When the actors involved have similar interests, it is common to brainstorm

for ideas around sectoral issues. Whatever groups you are working with (stakeholder group, technical working group, etc.), participants should be challenged to think big and limitless to generate a wide range of potential actions. No idea should be rejected or ignored during this step. An action that may seem too expensive or non-effective at first glance, in fact, might turn out to have multiple benefits and be very effective in combination with other actions.

Task 6.2:

Organize, screen and rank actions

At this point you should have assembled a long list or multiple lists of potential actions. Now it is time to organize the actions, screen out those that are unworkable in your local context and, if applicable, assemble individual actions into comprehensive strategies.

The challenge is to choose the one action that will have the greatest positive impact on all the objectives, with a focus on the high-priority objective(s). Numerous action ideas will likely be put forward during task 1. These can be sorted first by considering the following:

- Which actions are related?
- Can these actions be restated in a way that summarizes several actions?
- Are some actions identifying a higher degree of detail of other actions? (Think of a logical way to group higher-level and lower-level actions.)

You should sort actions into clearly defined categories. There is no right or wrong way

to organize long lists, and flexibility may be needed to tailor your needs. Some options for organizing your actions into categories and subcategories might include:

- **By sector:** Based on the results of step 3 (analyse and assess), use the sector of interest, such as building, transport, water supply, waste management.

- **By location:** Based on city/community maps, use specific locations of concern, such as areas with low-quality housing, bad transportation, water shortage or vulnerability to flooding.

- **By timing:** Some actions may need to be staged, such as planning a transportation system and flood control structures before modifying zoning or areas (buildings). It is often useful to further organize actions into short term (1–5 years), medium term (5–10 years) and long term (10+ years) categories. This is particularly critical when assessing larger infrastructure projects because the useful life of existing infrastructure should be assessed to determine when modifications for adaptation should be incorporated.

- **By cost:** Some actions may be capital intensive and require national or international funding, while other less-costly actions potentially could be funded locally through current budgets and programme areas or mainstreamed with already-funded initiatives.

Screen and rank

Screening out or screening in is the next level of getting organized. In some cases, certain actions may be impractical. In other cases, some candidate actions are easily implemented, and you will want to highlight them for immediate priority. Some criteria to guide this first screening include:

The screening and ranking process should compare the candidate actions mutually. One way to do this is by weighting the actions. Rankings can be made by identifying which actions perform best in terms of eco-efficiency (multiple benefits) and by analyzing how feasible they are.

Figure 10: Criteria for action selection

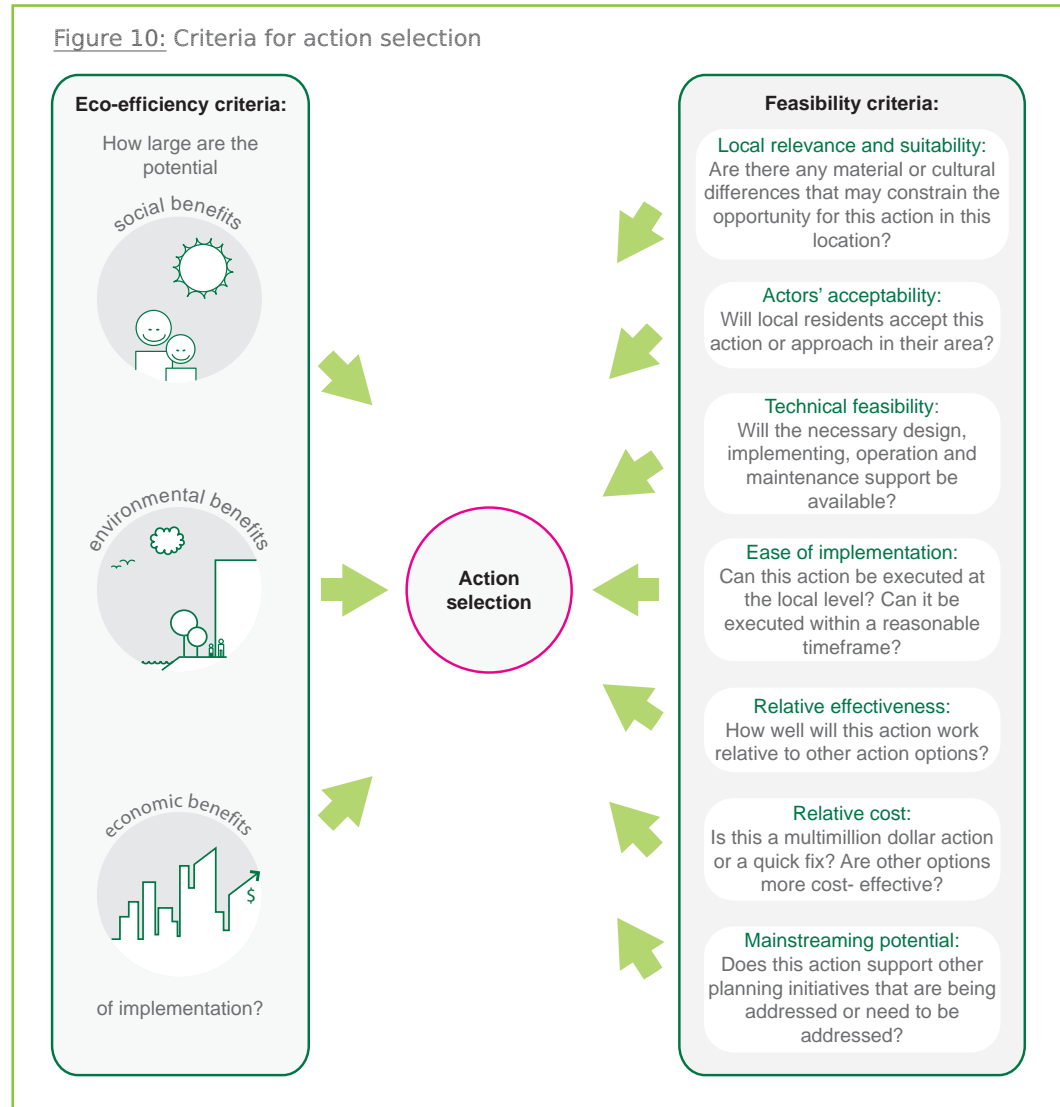


Table 13: EXAMPLE OF POLICY OPTIONS WEIGHTING AND RANKING

POLICY OPTIONS	ECO-EFFICIENCY SCREENING CRITERIA			TOTAL (RANK)	OTHER SCREENING CRITERIA, E.G:			FINAL RANK
	ECONOMIC BENEFITS	SOCIAL BENEFITS	ENVIRONMENTAL BENEFITS		RELATIVE COSTS	ACTORS ACCEPTABILITY	TECHNICAL FEASIBILITY	
Action 1	1	2	3	6 (3)	+++	++	+++	1
Action 2	2	1	1	4 (4)	++	++	++	4
Action 3	4	3	4	11 (1)	+	++	+	2
Action 4	3	4	2	9 (2)	+	+	+	3

To explore how potential strategies can be compiled it can be helpful to consider that strategies usually include five typical categories: common actions, “low-hanging fruit”, low-regret options, win-wins that will be more difficult to achieve and high return policies but with trade-offs.

• **Common actions**

When combining actions or mainstreaming them into existing planning processes or initiatives, some actions may need to be a part of every strategy (such as public outreach and information).

• **“Low-hanging fruit” and visible results**
Some actions might be obvious, simple ones that are easily attainable, commonly agreed upon and can be implemented quickly. These low-hanging fruits do not require more detailed evaluation. These actions are often used for pilot projects or just simple projects

that help to generate trust, motivation and momentum.

• **Low-regret options**

So-called “low-regret” options are actions that contribute directly to large city or community development goals (such as poverty alleviation) and support the objectives developed in stage B (such as enhance access to water, sanitation, energy, housing and transport, etc.). These actions are often already part of an existing strategy.

The following two categories are worth considering in a strategy, because of their high environmental or social benefits, although they may be more difficult to implement or involve some trade-offs.

• **Win-wins that will be more difficult to achieve**

These are initiatives that have the potential to

generate both economic and environmental benefits without requiring profound lifestyle changes, but which are technically, politically, financially or commercially more complex and likely to take longer to implement.

- **High return policies but with trade-offs**
These are the initiatives that offer the highest environmental and/or social benefits (such as land use change) but may conflict with commercial and economic interests in the short or medium terms.

It is important that strategies have a balance of different categories of actions. If we focus only on low-hanging fruits we may miss on more difficult but much more effective options, while if we focus only on difficult actions we may encounter resistance and stakeholders may lose motivation in the process because of lack of results in the short term.

Refer to annex 3 for examples of actions and strategies that promote a competitive and liveable city (eco-efficiency).

Task 6.3:
Develop strategies

In many cases, such as needing a comprehensive plan across multiple sectors or locations, a further task will be required to construct a strategy. A strategy is a logically consistent set of individual actions, combined to create a comprehensive plan or policy response.

Developing eco-efficiency strategies can be as simple as connecting dots: moving from one action to the next in order to complete a picture of a competitive and liveable city. Building upon your organized action lists, creating a strategy involves selecting one or more actions from each category and combining them to create an all-encompassing plan, typically with a recognizable theme or approach.

When designing eco-efficiency outcomes, there is rarely one single “best” action or a quick fix, especially when an urban area is trying to achieve many objectives. The key is to design strategies that target the city’s specific objectives and context and that will bring a wide range of support to ensure its success.

Organizing actions into strategies might be affected by timing, where “x” must happen before “y”. Some strategies might address particular objectives more than others or be limited in their effectiveness by various constraints, such as funding. Strategies can be designed to focus explicitly on one objective or sector or to minimize or avoid impacts among multiple objectives. Creating good strategies is an iterative process, guided by the eco-efficiency objectives and by newly generated information.

If you have dozens of potential actions across several categories, there is a multitude of possible combinations that could form a strategy. However, it is important to make your strategy comprehensive and coherent. For example, many actions may be identified

as priorities but not all of them may logically go together or, alternatively, some may need to be done in concert.

Questions to help guide the development of a coherent strategy include:

- Is there a unifying theme that can guide the selection of actions (related to social, environmental and economic benefits)?
- Which actions will best support the achievement of the objectives set in step 5?
- Do some actions in one category have prerequisites in another category?
- Are there synergies or efficiencies to be generated if you can implement different actions from each category simultaneously?

- Do you have a fixed budget that should be used to constrain the selection of actions (such as a five-year capital plan)?

A strategy illustrated in table 14 is a logical way to visually represent alternative strategies in terms of specific selections made from various categories of actions. Strategy tables can be applied at several levels of organization.

The next step is to evaluate competing strategies in terms of how well they might achieve planning objectives (that improve quality of life and environmental protection at relative cost).

Table 14: EXAMPLE APPLICATION OF A STRATEGY TABLE TO DEVELOP ALTERNATIVES

STRATEGY A	STRATEGY B
Short-term actions: 1. ... 2. ...	Short-term actions: 1. ... 2. ...
Medium-term actions: 1. ... 2. ...	Medium-term actions: 1. ... 2. ...
Long-term actions: 1. ... 2. ...	Long-term actions: 1. ... 2. ...

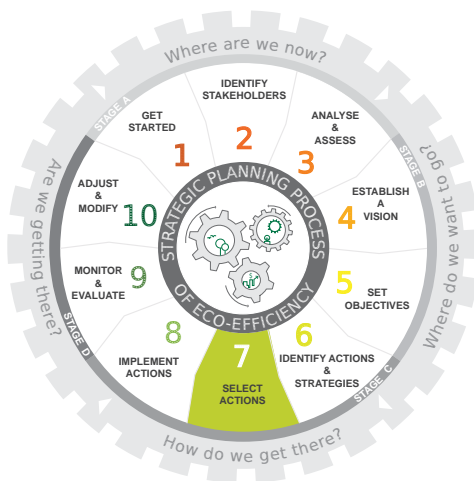
Checklist:

- What actions can make your objectives a reality?
- How can you combine action into effective strategies?
- ✓ A comprehensive list of action ideas has been compiled to achieve your objectives.
- ✓ Actions have been sorted into clearly defined categories.
- ✓ Actions have been ranked based on their promotion of eco-efficiency and feasibility.
- ✓ By combining actions, strategies have been developed compared.

STEP 7: SELECT ACTIONS

How can you prioritize actions and strategies with the biggest impact?

How do you evaluate them?



This step will help you and other actors decide which actions and strategies best meet the identified city or community objectives, addressing social, environmental and economic issues and fit with current urban planning priorities and gaps. This involves further comparing and evaluating the actions and strategies developed in step 6. It is important to consider how a given action will perform in your local context, in terms of political will, integration with other projects (mainstreaming), available capacity and resources.

The following tasks can help you to prioritize and evaluate policies and strategies:

Task 7.1: Assess consequences of actions and strategies

Task 7.2: Prioritize the best actions and strategies

Task 7.3: Assess mainstreaming opportunities and refine actions and strategies

Task 7.1:

Assess consequences of actions and strategies

This task helps to decide which actions and strategies should be used by estimating their consequences. This is done by using available knowledge and tools that predict the impact of certain actions on people, the economy and the environment. The assessment of consequences is an analytical task and does not involve value-based judgements about the relative importance of those consequences or picking a preferred strategy.

The consequence estimation of your actions and strategies can be conducted through a variety of tools and assessment methods. The following are some of the most commonly used and established methods.

Environmental Impact Assessment

The International Association for Impact Assessment defines an environmental impact assessment as “the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made”. In short, an environmental impact assessment is the process of identifying and evaluating the environmental impact of a project prior to making any decisions.

The method is relevant for the prediction of eco-efficiency impacts because it has the potential to deal with social and economic impacts besides environmental impacts on the project scale.

Characteristics of the environmental impact assessment:

- construction/operation
- project level
- micro impact
- environmental scope with sustainability focus
- medium- to short-term time scale
- mainly quantifiable field work and statistical data
- legal restrictions and best practices benchmark.

Strategic environmental assessment

The Strategic Environmental Assessment method can be defined as a systematic and ongoing process of evaluating the environmental quality and consequences of alternative visions and development options incorporated in policy, planning and programmes.

The method is relevant for the prediction of eco-efficiency impacts because it ensures the integration of environmental, economic, social and political considerations.⁹ In other words, it deals with eco-efficiency impacts at the strategic scale. The method can be streamlined with other processes, such as the environmental impact assessment of projects. The process deals with energy, transport, waste and water, urban and regional land use and planning and management.

Characteristics of the strategic environmental assessment:

- strategic/vision concept
- policy, planning level
- macro impact
- sustainability issues
- medium- to long-term time scale
- mainly descriptive but mixed with quantifiable data
- sustainable benchmark (criteria and objectives).

Life cycle analysis

The Life-cycle assessment is a “compilation and evaluation of inputs, outputs and potential environmental impacts of a product and service system throughout its life-cycle”.⁹ The method is “a systematic process for identifying, quantifying and assessing environmental impacts throughout the life cycle of a product, process or activity. It considers energy and material uses and releases to the environment from cradle to grave”.¹⁰

The method is relevant for the prediction of eco-efficiency impacts because it deals with the impacts of infrastructure over its life cycle. Moreover, it can be conducted in parallel with the environmental impact assessment and strategic impact assessment.

Characteristics of the life cycle assessment:

- construction/operation
- product/infrastructure level
- micro impact
- environmental scope with sustainability focus
- medium- to long-term time scale
- mainly quantifiable field work and statistical data

- legal restrictions and best practices benchmark.

Cost-benefit analysis

The cost-benefit analysis is a decision-making approach from the field of economics. It is widely used in government and business to assess whether a proposed project, programme or policy is worth doing, mostly by comparing different alternatives for action. The analysis involves comparing the total expected costs of different option against the total expected benefits. In this way it can be defined whether the benefits outweigh the costs, and to what extent.

The technique is relevant for the prediction of eco-efficiency impacts because it deals with assessing efficiency. Moreover, it uses understandable impact categories and measurement units. However, only those benefits that can be monetized are taken into account. This does not allow considering many of the values associated with sustainable infrastructure.

Cost-effectiveness analysis

A cost-effectiveness analysis has the objective to identify the least cost option of two or more courses of action. The cost-effectiveness analysis doesn't ask if a course of action is justified in terms of social benefits. The cost effectiveness is calculated by dividing the costs over a certain period of time for courses of action by beneficial measures, such as kilometres of river shore restored, tons of emissions reduced or acres of land preserved.

The technique is relevant for the prediction of eco-efficiency impacts because it can

deal with other values than efficiency (as is the case with the cost-benefit analysis). However, inputs need to be monetized and outputs quantified.

Multi-criteria analysis

The multi-criteria analysis technique usually uses a matrix with at least two dimensions: i) the objectives and evaluation criteria and ii) different alternatives for action. Priorities or weights are used to show the relative importance of different criteria. The technique is used in combination with the cost-benefit analysis and is strongly related to the multiple-goal analysis.

The technique is relevant for the prediction of eco-efficiency impacts because it can deal with multiple values (economic, social, and environmental) and efficiency may be a priority or not.

Environmental and economic accounting

Economic assessment techniques, such as the cost-benefit analysis and the environmental accounting, have the possibility to broaden their scope to include social and environmental impacts. Efforts to do so have resulted in a model called environmental and economic accounting, in which economic growth implications have been linked to the use of natural resources.

The technique is relevant for the prediction of eco-efficiency impacts because it is concerned with environmental consequences of economic activities.

Choosing relevant tools

Choosing relevant tools can be done by:

- looking at the level, objective, scope and type of analysis and procedures to conduct an assessment.
- evaluating the capacity to use these tools; if capacity is lacking, attract the needed people to conduct the assessment.

Given that each tool has some limitations in terms of assessing either the economic, social or environmental impacts, a combination of more than one tool is most effective and is recommended.

Depending on the situation, once you have assessed the consequences of actions or strategies, you may have all that you require to set up an action plan. However, if the choice of the best action or strategy is not immediately obvious, you might want to evaluate your options again.



Curitiba, Brazil

Table 15: METHODS THAT COULD BE EXTENDED TO DEAL WITH IMPACTS FROM OTHER DOMAINS

ASSESSMENT METHOD	DESCRIPTION/ GOAL	LEVEL / SCALE	STRENGTH	WEAKNESS	RELEVANCE FOR ECO-EFFICIENCY
Environmental impact assessment (EIA)	Process of identifying and evaluating the environmental impact of a project prior to decision making	Project	Statutory process in which a project is subject to design	Reactive, local and monitoring	Project level
Strategic environmental assessment (SEA)	Ongoing process to ensure that significant environmental effects arising from policies, plans and programmes	Strategic decisions, city policy, planning	Holistic framework for planning and decision making, proactive	Sector procedure Supplementary tool	Holistic, strategic, vision and long-term
Life-cycle analysis (LCA)	Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle	Product	Established, holistic and coexistent with other methods	Complex Until now solely environmental aspects	Input-output and life cycle approach for infrastructure

Table 16: METHODS THAT SOLELY DEAL WITH ENVIRONMENTAL IMPACTS

ASSESSMENT METHOD	DESCRIPTION/ GOAL	LEVEL / SCALE	STRENGTH	WEAKNESS	RELEVANCE FOR ECO-EFFICIENCY
Ecological footprint	Measures resource consumption	Individual and regional	A common unit of environmental pressure	Complex calculation natural resources	Environmental pressure
Ecological rucksack	Calculates the sum of all material input needed during production chain of a service or product	Product and service	Simple, life cycle based	Complex calculation due to a lack of information	Life-cycle based
Green poster	Analyses the value and function of urban green areas	City and local	Visual and transparent	Criteria of indicators is unclear	City level
Eco-accounting	Calculates input and output of individual contribution to overall environmental impact on area (housing)	Small to large scale	Established in housing	Lack of Information or data	Life cycle based

Table 17: METHODS THAT SOLELY DEAL WITH ECONOMIC IMPACT

ASSESSMENT METHOD	DESCRIPTION/ GOAL	LEVEL / SCALE	STRENGTH	WEAKNESS	RELEVANCE FOR ECO-EFFICIENCY
Cost-benefit analysis	Measures positive and negative consequences of a project or policy (single criteria technique)	Project or single criterion	Established, comparable to other possibilities and simple	Short-term focus and low level	Potential to broaden scope
Cost-effectiveness analysis	Identifies the least expensive way of attaining a goal	Project	Established and suitable when targets exist	Doesn't identify socially optimal level	Economic optimum
Multi-criteria decision aid	Decision-making tool that addresses problems where different points of view are considered	Processes	Multi-criteria	Subjectivity	Multi-criteria
Environmental accounting	Links economic activities to negative consequences on environment	Macro	Broad scope	Macro level	Minimizing impact on environment

Table 18: METHODS THAT SOLELY DEAL WITH SOCIAL IMPACTS

ASSESSMENT METHOD	DESCRIPTION/ GOAL	LEVEL / SCALE	STRENGTH	WEAKNESS	RELEVANCE FOR ECO-EFFICIENCY
Social impact assessment	Process of assessing the impact of policy, project, plan or programme on people	Project	Communication and single assessment framework	Relation with other techniques is unclear	Poverty alleviation, job creation
Socio-economic impact assessment	Examines how a development will change the lives of people	Community	Proactive and stakeholder involvement	Community focused	Who benefits and who doesn't

Task 7.2:**Prioritize the best actions and strategies**

You can evaluate actions and strategies by showing to what extent they might achieve each objective. This can be done in a relatively simple manner – by using a table that shows the consequences of each action or strategy. A table like this can be an important tool for ensuring that decisions are made on the basis of a common understanding of the expected outcomes of different alternatives. The information needed to use this table relates to stating actions and strategies in a way that they are comparable. To choose among and between strategies the table should show important uncertainties and trade-offs.

In the case of developing infrastructure in an eco-efficient way, the consequences might be complicated and trade-offs should be minimized (as the aim is to maximize linkages between sectors). Therefore, a more analytical approach to evaluate your strategies is often needed. You can use a consequence table as a launching point for discussion, but you should draw upon additional tools to weight the importance of each performance measure.

The disciple of economics provides tools which can include eco-efficiency criteria in evaluation. One criteria of eco-efficiency is the economic efficiency. Strategies can be evaluated by comparing the costs and benefits of different options. When inputs and output can be monetized, the most commonly used method is the cost-benefit-analysis. However, in the case of win-win policies,

you are not only dealing with the economic value of efficiency but with social and environmental values as well. An alternative tool is the cost-effectiveness analysis, which can be used when values are other than efficiency but inputs need to be monetized and outputs quantified. However, when there are multiple values, and efficiency may be a priority or not, multiple criteria analysis is an appropriate tool to prioritize policies.

Task 7.3:**Assess mainstreaming opportunities and refine options and strategies**

As the evaluation process unfolds, you might need to make adjustment due to new insight and information and, most importantly, adapt the actions and strategies to what matters most in your specific planning context. However, the information so far should enable you to better assess mainstreaming opportunities and to refine your strategies.

Mainstreaming opportunities

Mainstreaming focuses on integrating eco-efficient actions and strategies into pre-existing or emerging plans and programmes. In order to not miss this opportunity to mainstream these actions and strategies you can ask:

- Have any new opportunities emerged to mainstream specific actions into other plans, programmes or policy development initiatives?
- Do any of the actions you've identified to date require coordination with other initiatives in order to maximize the potential for benefit or minimize the potential for working at cross-purposes?

- Can any low-hanging fruit actions be handed over for immediate implementation as part of existing department or programme responsibilities?

At this point you have formally considered the environmental, social and economic impacts, brainstormed actions and evaluated their efficiency. Depending on the answers to the above questions, you may want to begin the process of methodically integrating eco-efficiency actions and strategies into existing plans, programmes or policy development initiatives.

Refining strategies

However, if you still need to tackle some challenges or integrate new ideas after the evaluation so far, you can consider asking the following questions:

New actions and information requirements

- Are there any new actions that have been identified to address weaknesses in your strategies?
- Can any actions be refined to more effectively meet your objectives and enhance eco-efficiency outcomes?
- Have any uncertainties hindered your ability to effectively evaluate actions or strategies? Can long-term data gathering be developed as a specific action?

Planning constraints

- Does the cost of actions identified to date exceed your available budget? Do you need to prioritize the most important actions or seek out other sources of funding that will be required?

- Have you run up against firm planning constraints (such as zoning requirements or building codes) that constrain your ability to carry out an important eco-efficient action? Do you need to coordinate with other levels of government – regional or national – to revise policies or standards?

Capacity

- Has the strategy development and evaluation process uncovered capacity issues – lack of knowledge, skills, etc. – that need to be addressed? Are there specific competency-building actions that need to be developed?

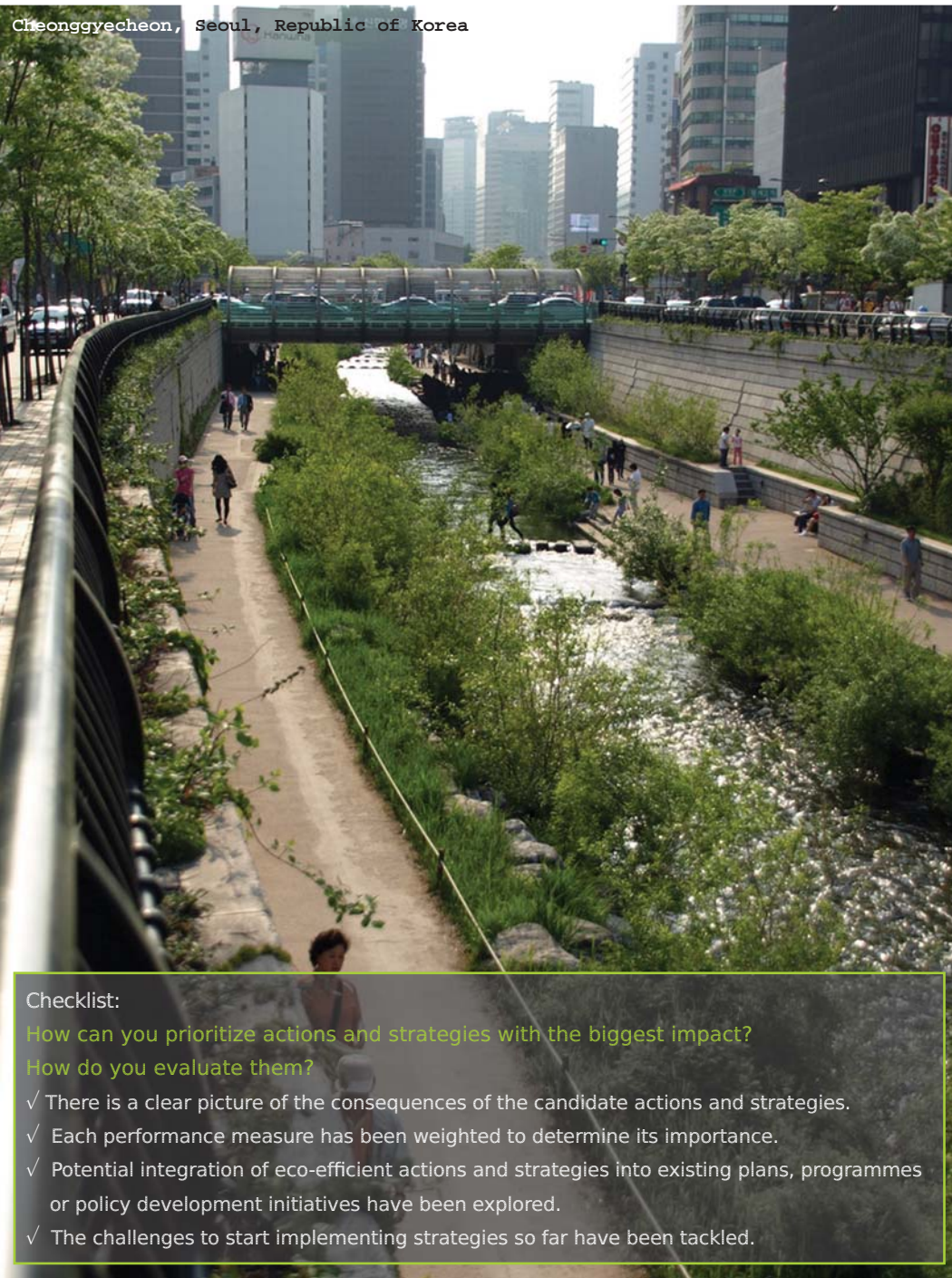
Funding

- Are there any national and/or international sources of funding that could be used for carrying out the plan? Some funding sources may be identified in existing regional or national plans.

Many actions may have long-term time horizons and must have corresponding funds for maintenance and operations and not just the initial start-up costs. Partnership funding, for example, through public-private partnerships, may need to be established. Whatever mechanism is used, it is important for the strategy to have a budget.

At this point you'll need to formally decide upon the best eco-efficient infrastructure development strategy and document them. This should be done together with your stakeholder group and decision makers.

Cheonggyecheon, Seoul, Republic of Korea



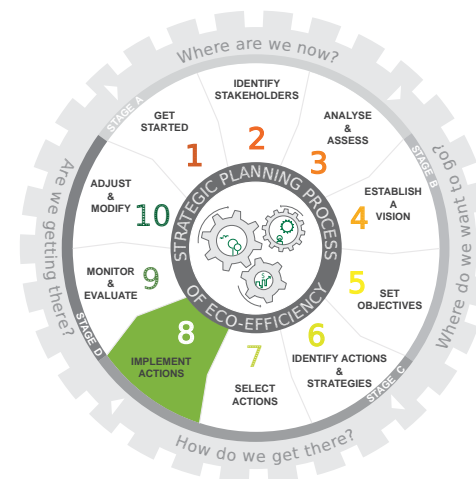
Checklist:

How can you prioritize actions and strategies with the biggest impact?
How do you evaluate them?

- ✓ There is a clear picture of the consequences of the candidate actions and strategies.
- ✓ Each performance measure has been weighted to determine its importance.
- ✓ Potential integration of eco-efficient actions and strategies into existing plans, programmes or policy development initiatives have been explored.
- ✓ The challenges to start implementing strategies so far have been tackled.

**STEP 8:
IMPLEMENT ACTIONS**

How can you plan and finance the prioritized actions and strategies?



This is a step, where you'll move from ideas to real actions, but where planners often tend to lean back. Ideas are often poorly implemented because of:

- a lack of political will to act or changes in organizational or political leadership just prior to implementation
- a lack of cooperation between sectors
- committed resources and funding do not come through
- crisis management takes priority over longer-term (but ultimately more effective) planning.

Considering these issues at an early stage can increase the possibility that ideas actually become actions.

The following tasks can help you to implement policies and strategies:

Task 8.1: Identify and address institutional or governance gaps

Task 8.2: Identify the department or agency that is going to lead the project

Task 8.3: Formally mainstream and link actions and strategies to established plans, programmes or processes

Task 8.4: Develop an action plan

Task 8.1:

Identify and address institutional or governance gaps

Although institutional or governance gaps might have been identified and addressed at the beginning of the planning process, they should be reviewed in case anything has been overlooked or gaps may have arisen during the process so far. To identify and address these gaps, the following questions can help:

- What were the institutional or governance gaps that the project has encountered?
- How were they addressed?
- Have there been any developments in municipal politics or other governance systems that may prove to be gaps?
- How can these gaps be addressed?
- If the gaps cannot be addressed, how can we modify our action or strategy to compensate for the barriers these gaps present?

The core planning team can answer these questions or they can be discussed with the stakeholder group. Once all gaps have been taken care of, project leadership should be directed to one "leading" department or agency.

Task 8.2:

Identify the department or agency which is going to lead the project

The success of many eco-efficiency infrastructure projects can be traced back to

a strong institutional foundation, namely a department or agency that was the primary facilitator, ensuring a holistic view and integrated strategy to bring different views and ideas together. Such a “leading” body is important to drive the process. To identify an appropriate body, consider that they should be able to:

- manage and/or support other departments or agencies involved in a strategy’s execution
- maintain project support and momentum with the project’s broader stakeholder network or group
- ensure political support and/or maintain engagement with elected officials and community leaders.

It may help to review the result of the situation analysis in step 3 (stage A) to see what departments might be able to function as a leading body. By examining current responsibilities of city planning departments and other departments involved in infrastructure development, may give a better understanding of how collaborations between departments could be established and where the crucial development channels (financing, technology, etc.) are situated.

Task 8.3:

Formally mainstream and link actions and strategies to established plans, programmes or processes

To ensure infrastructure will be planned in an eco-efficient way, it is important to formally revisit how and where the actions and strategies resulted from the planning process can be mainstreamed into existing local planning practices, government policies and programmes. Some typical plans, programmes and processes in which eco-efficient infrastructure planning can be included

or formalized cover:

- physical land use plans or city or community plans
- development approval processes, including building codes
- infrastructure plans (sewer, water, road, transit, waste, etc.)
- infrastructure procurement (bidding) processes
- environmental plans, policies and programmes
- community health and social development programmes
- economic development programmes or projects
- city and/or participatory budgeting processes
- corporate plans and strategies.

Once again, ensure that the leading department has established collaborative links with departments and agencies that should be included in eco-efficient infrastructure planning and development and can that can bring together all actors.

Build a stronger business case

By identifying the multiple benefits of the different actions and strategies and by linking these to established plans, programmes and processes, you will be able to build a stronger business case for your projects. If the potential financier is the central government, showing how actions and strategies contribute to the objectives of various line ministries and departments can increase the likelihood of securing funding. Sustainable transport projects, for example, may not only contribute to the objectives of the ministry of transport, but also those of the ministries of health, economic development or environment. If the potential financier is the private sector, the multiple benefits identified need to be “captured” and integrated into the business case, to the extent

possible. This may require complementary policy actions, such as regulation, pricing or special agreements with the private sector.

Task 8.4:

Develop an action plan “Who, what and how”, with time frames, resources, funding and preconditions to go about executing the project or strategy

The final step to the establishment of an action plan is the script for implementing. This is a detailed document that clarifies what exactly will happen, how this will be done (including financing), by whom and when. It is important to be very explicit about the expectations from each actor.

The most logical way to organize an action plan is by time (chronically), making it easy to track the process. It might be useful to break down your project into different phases for which certain actions and strategies are specified. To start, you can set up a chart in which all the activities are described in detail in the left column. Then you can start filling out each specific activity or phase on the right side of the chart. Include at least:

- institutions involved
- project leader (person responsible)
- resources required
- budget (different scenarios to provide

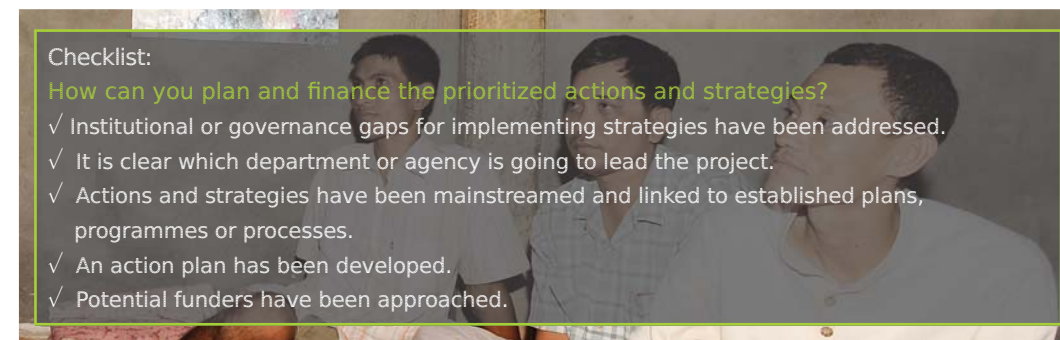
contingency when things change)

- timeframe.

Proposal writing (for financing)

Once all the pieces are in place, you can start to approach funders (banks, government agencies, international donors and funding agencies) to obtain financial resources necessary to implement your project, such as grants or loans. Ensure that you explored funding opportunities for each stage of the project, including for instance technical support. No matter the complexity (size) of the project, it is important to plan ahead to maximize your chances for getting funds. The information needed to actually write your proposal should all be available from your action plan and from all the work already completed during this planning process. Before writing the proposal, you should:

- define your project
- identify the right funding sources and check eligibility criteria
- contact the funders
- acquire proposal guidelines
- know the submission deadline
- determine personnel needs
- update your timeline (this is a good point at which to factor in your schedule time to write multiple drafts and gather materials).



STAGE D: ARE WE GETTING THERE?

Monitoring and evaluation increases the efficiency and effectiveness of a planning process and ensures that plans, strategies and interventions have the desired impacts.

↘ Monitor and evaluate actions and strategies against the multiple values that they may bring to the city and its people.

Corresponds with the strategic principle 4:
Recognize the value of sustainable infrastructure.

↘ Parties involved in the planning process should also be involved in monitoring and evaluation.

Corresponds with the strategic principle 6:
Build the city for people, together with the people.



This stage includes two planning steps and will help you answer these questions:

STEP 9:

Are your plans, actions and strategies working?

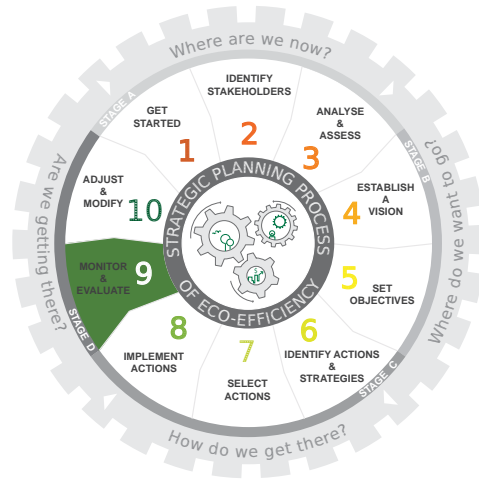
STEP 10:

When and how should you review and update plans, actions and strategies with new information and knowledge?

After this stage you'll know if your plans, actions and strategies have the effect you were aiming for and if adjustments are necessary.

STEP 9: MONITOR AND EVALUATE

Are your plans, actions and strategies working?



What is monitoring and evaluation?

Monitoring and evaluation helps answering the question: “Are you getting there?”. Monitoring is a continuous process of measuring progress and performance of each step in the planning process in order to identify successes or failures as early as possible. An evaluation uses the information from monitoring to determine if changes need to be made. In the implementing phase, an evaluation process is used to determine if interventions are meeting the objectives before it is too late to impose correcting adjustments.

How to monitor and evaluate

The following tasks can help you to monitor and evaluate a planning process:

Task 9.1: Prepare a monitoring and evaluation framework and prepare a work plan

Task 9.2: Decide who will be involved in the monitoring process and what responsibilities they will have

Task 9.3: Decide when and how to document and report

Task 9.4: Evaluate the results of the monitoring programme

Task 9.1:

Prepare a monitoring framework and prepare a work plan

The objectives set and indicators chosen in stage B, step 5, serve as a framework for both monitoring and evaluating and will indicate the degree to which actions and strategies are successful in meeting the objectives and goals set. In other words, this task involves deciding what (objectives and goals) will be monitored and how (required data and collection challenges) this will be done. To do this properly, monitoring should be a systematic process (such as collecting in the same manner) and indicators need to be measurable.

To setup a monitoring plan, the following questions can help:

- Did you use the objectives (step 5) to decide what should be monitored?
- Are there other relevant objectives for monitoring?
- Did you address the main gaps in the monitoring plan?
- Are the indicators clear and measurable?

Task 9.2:

Decide who will be involved in the monitoring process and what their responsibilities will be

Responsibility should be assigned for regular data collection and reporting of results. Actors who are already on board in the planning process often get data collection and reporting responsibilities as well. Responsibilities can differ between:

- direct and substantive roles (contributing funding, ideas, information)
- supportive and technical roles (research, data collection, information analysis)
- promotional role (lobbying, campaigning, advocating).

Task 9.3:

Decide when and how to document and report

Depending on the project, the timing of monitoring can occur from a daily or monthly basis to an annual basis, within or between project phases. A project that involves the monitoring of energy consumption in buildings or traffic calming results, for instance, needs short monitoring periods because indicators are gathered frequently.

Documentation and communication should be harnessed into smooth procedures. To setup a procedure, the following questions can help:

- How will you document and communicate the monitoring process?
- What happens to the data?
- Who gets access to it?
- How will it be communicated?
- How will the results be used and by whom?

Task 9.4:

Evaluate and report the results of the monitoring programme

The tasks for evaluating are the same as those for monitoring. The only differences are that an evaluation occurs at strategic points during the implementing process. To anticipate tasks before the evaluation actually starts, it might be wise to ask the following questions:

- Why is the evaluation being conducted?
- What should the evaluation achieve?
- Who will be involved in the evaluation process?
- When should the evaluation take place?
- How will the evaluation be documented and communicated?
- Who will use the results and how?

An evaluation is usually participatory. This means that core actors should participate in the evaluation process. This can also include local residents. Evaluation questions can be organized according to the following themes: adequacy and effectiveness, efficiency, contextual review and adjustment and recommendations.

Like monitoring, the results of the evaluation should be communicated both to the relevant actors and the community in general.

Checklist:

Are your plans, actions and strategies working?

- ✓ It is clear who will be involved in the monitoring process and what responsibilities they will have.
- ✓ It has been decided when and how to document and report.

STEP 10: ADJUST AND MODIFY

When and how should you review and update plans, actions and strategies with new information and knowledge?

Given the rapidly changing reality of cities, the vision, objectives and plans need to be reviewed and updated regularly. Similarly, new information and knowledge, related to people, the environment and infrastructure needs to be incorporated into the infrastructure development plans. If the monitoring and evaluating process is designed and planned well, planners can determine when and where adjustments might be needed. Long-term plans and strategies should be reviewed and if necessary, adjusted, at least every 5 years.



Khairani Tar, Nepal



Khmer schoolgirls, Cambodia

Checklist:
 When and how should you review and update plans, actions and strategies with new information and knowledge?
 ✓ It is clear when and how plans and strategies will be reviewed so necessary adjustments can be made.



WUF5 Rio de Janeiro, Brazil

4

Case Studies



Who is making the change?

1. Active, Beautiful and Clean waters programme in [Singapore](#) Page 119
Water resource management and ecological conservation
2. Eco-industrial park in [Ulsan, Republic of Korea](#) Page 127
Integrated resource management
3. Taehwa River restoration project in [Ulsan, Republic of Korea](#) Page 137
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Urban service infrastructure – drinking water, lighting and transportation



Active, Beautiful and Clean waters programme in Singapore

Water resource management and ecological conservation



Recognizing the attractive features of water infrastructure beyond its water supply functions adds urban vitality, recreational opportunities and economic growth potential to a city and ultimately helps improve the quality of life for residents.



By shifting the management perspective of water infrastructure system as something that is cost-laden to a view that it offers multiple benefits. Repositioning water infrastructure from an economic and engineering necessity to a life-sustaining element that has social relevance contributes to both economic and ecologic gains for a city.



It takes policy decisions and different management strategies to shift the water infrastructure system in a city from mono-use to multi-functionality, from basic flood control and water conveyance to multiple uses for community participation and enhancing a city's attractiveness.

Singapore – city profile

• population	5.08 million
• administrative area (km ²)	712
• GDP (national) per person (US\$)	48,400
• population density (persons/km ²)	7,126
• climate	tropical

INTRODUCTION

Singapore is a city-state that is fully urbanized. Over the years, the city has been developed to provide an attractive living environment that ensures strict control on air and water pollution, efficient management of solid waste, as well as a comprehensive public transportation system and control of private cars. The city runs a successful free-market economy, depending heavily on exports, particularly in consumer electronics, information technology products, pharmaceuticals and on a growing financial services sector.

Singapore gained self-governance in 1959 and has prioritized urban development and economic growth as critical to the country's success. In the area of water management, the concerns of scarcity of drinking water, waste-water disposal, and discharge of untreated sewage into rivers had prompted the Government to heavily invest in its water infrastructure.

From a water-scarce country that relied on water imports from its neighbouring country, Singapore is now largely self-sufficient, with four major sources of fresh water supply.

In the early years of its development, the Government focused on physical infrastructure to meet the economic needs and to alleviate flooding problems; however, a recent reorientation of policy and thinking shifted its approach to be more holistic, embracing the principles of eco-efficiency and sustainability to deliver economic, social and environmental returns.

The evolution of the Singaporean Government's philosophy in water-resource management is summarized by Prime Minister Lee Hsien Loong in 2007: "...having developed a comprehensive base of water infrastructure, we should now take a new step forward. Our waterways and reservoirs should do more than meet our water needs. They should enhance our living environment and lifestyle. In the past, we protected our resources by keeping people away from them; now, we will bring people closer to water so that they will enjoy and cherish it more."

This outlook led to a landmark initiative to create new value in Singapore's waterways and reservoirs, through a programme known as the Active, Beautiful and Clean (ABC) Waters Programme, with the tagline: **Water for All: Conserve, Value, Enjoy**. The initiative is actually an umbrella programme that embodies the vision of unlocking the hidden potential and opportunities of the waterways and reservoirs. Singapore's water-infrastructure management is no longer limited to the narrow objective of water-supply purposes but has been widened to provide additional value in various forms to the community at large. Because of this initiative, water in Singapore is now regarded as an important basis for urban development; water is integrated as part of the planning and design of the city so that the local community can begin to embrace its waterways as attractive and recreational features in the urban landscape.

Most importantly, the programme has used a comprehensive master planning approach, with detailed guidelines drawn up for all the identified watersheds. These guidelines are responsive to the character of the areas studied, with attention given to functional and design differentiation, the importance of safety and the protection of water quality as well as the integration with natural systems and biodiversity. At the same time, through water-sensitive urban design interventions, the aesthetic qualities of the waterways have been enhanced in tandem with efforts to cleanse the water, using various bio-engineering methods.

WHAT WAS DONE

The ABC acronym encapsulates the fundamental and inherent aspirations of the programme:

Active: Providing new community spaces and bringing people closer to water through recreational activities. With more opportunities for interaction, the idea is that people will connect with the water, developing a sense of ownership and valuing it better.

Beautiful: Developing reservoirs and waterways into vibrant and aesthetically pleasing lifestyle attractions that integrate with parks, estates and even commercial developments.

Clean: Improving water quality by incorporating features such as aquatic plants, retention ponds, fountains and recirculation to help remove pollutants. The aim is also to minimize pollution in the waterways through public education and by building a closer people-water relationship.

Objectives

The programme was conceived to widen the scope of Singapore's water infrastructure management, which is now no longer limited to the objective of water harnessing, water conservation and water-supply purposes. Rather, it serves to also add value to the community and population at large through integrated planning principles. Its main objectives are:

1. To tap ideas, expertise and resources from the people-public-private sectors in developing and managing the catchments and water bodies as new community spaces




while continuing to safeguard the water quality.

2. To develop the water bodies beyond their functional use as resources for water collection, storage and drainage into vibrant, clean and aesthetically pleasing lifestyle attractions where recreational and communal bonding activities can take place.

3. To act as an umbrella programme for integrating and holistically managing all initiatives involving catchments and water bodies.

Strategies for achieving objectives

The ABC Waters Programme integrates “blue, green and human networks”. The following scheme outlines its strategies:

<p>Catch rainwater</p> 	<p>Catch every drop of storm-water on site</p> <ul style="list-style-type: none"> - roofs, car-parks, roads, parks, drains, canals, rivers, reservoirs
<p>Clean and release</p> 	<p>Treat the stormwater on site and slowly release</p> <ul style="list-style-type: none"> - green roofs, porous pavement, swales, infiltration trenches, litter traps, bio-retention systems, rain gardens, wetlands
<p>Beautify</p> 	<p>Enhance the aesthetics by using water as main element</p> <ul style="list-style-type: none"> - soft edges, water features, rock-pools, dams, green cover, canal greening, floating gardens, landscapes, nature side profiles
<p>Activate</p>	<p>Create opportunities and space for activities</p> <ul style="list-style-type: none"> - sports, play, retreat, art, nature, culture, commerce, education

The key to making these strategies effective was an integrated urban planning approach, which embraced engineering, science, landscape design, urban design as well as a commitment to community involvement in a master plan framework.

Implementation

The action plan set out to comprehensively execute projects systematically and progressively. For planning purposes, Singapore was divided into three watersheds, each with its own theme and projects; and for each, a private sector consultant team was appointed to develop the catchment plan in coordination with government planning agencies, such as the Urban Redevelopment Authority, the Housing and Development Board, the JTC Corporation and the National Parks Board. Since the programme was launched in 2006, the ABC Waters Master Plan has identified more than 100 projects for implementing in phases over the next 10-15 years. Under the first phase, more than 20 projects were planned to be implemented by 2012 in various parts of the island.



Floating Island at Sengkang Wetland
Source: PUB, ABC Waters Master Plan 2008

The Sengkang floating wetland is an example of the programme’s river component. The wetland is essentially used to improve water quality while providing a natural habitat for animals. It is linked by footbridges from one bank to the other, which also provide easy access to mangrove swamps that offer an ‘outdoor classroom’ for the study of mangroves, wetlands and biodiversity. It is a place for relaxation, recreation and excursion into nature as well as a venue for different sporting activities.

Policy shift

The ABC Waters Programme can be perceived as a policy shift “from economic-centric to eco-centricity”. It demonstrates how to incorporate eco-efficiency and environment protection into resource management and urban infrastructure planning processes through sector integration and a participatory approach.

Three other major changes in perspective are evident:

1. A shift from a view that water infrastructure is a cost-laden burden to seeing it as source for many benefits and thus a considerable value.
2. A shift from mono-use to multi-functionality, from basic flood control and water conveyance to something that has multiple uses for beautifying the city and engaging communities.
3. A shift from economic necessity to social relevance, progressing from regarding water infrastructure as a needed engineering element that is detached from the community

to respecting it as a source of social life and community well-being.

OUTCOMES AND SUCCESS FACTORS

The ABC Waters Programme is an urban innovation that entails a positive change in society, with overall improvement to the quality of life of Singapore’s residents.

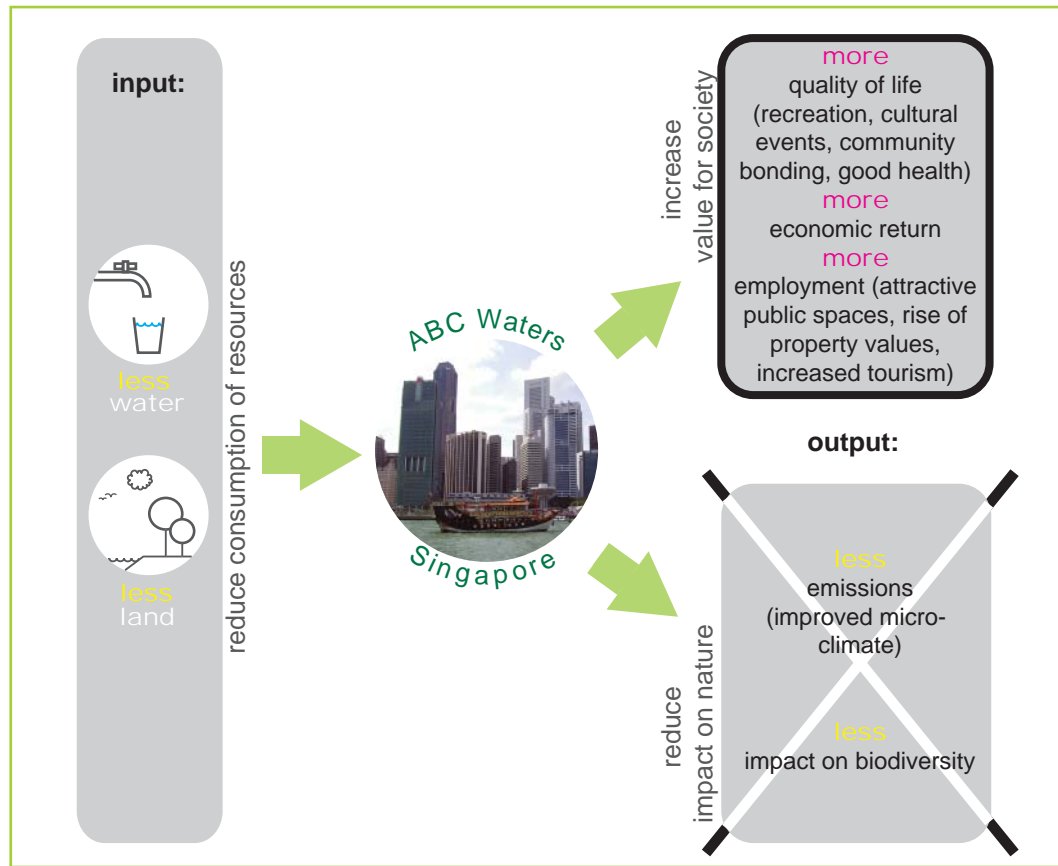
Evaluation of outcomes

To assess the outcomes and results of the completed projects under the ABC Waters Programme at both the macro and micro levels, a methodological framework was developed to qualitatively evaluate its eco-efficiency. The framework was based on four questions:

- Has the project increased product or service value?
- Has the project optimized the use of resources?
- Has the project reduced negative environmental impacts and created positive impacts on nature, land, water and people?
- Has the project made an impact on the community in terms of engaging everyone and influencing the market or community with new ideas?

Specific eco-efficiency outcomes

The programme illustrates that significant change can be made to improve resource efficiency, impacts on nature and the value for society as a whole. The following ‘values’ can be identified, manifested in varying degree, as part and parcel of project development: positive social/community impact (including educational, recreational, cultural/historical,



community bonding, health/well-being), positive environmental impact (including ecological, climatic and potentially planting of food crops), positive urban impact (including aesthetic, amenities, lifestyle and increased tourism) and longer term potential positive economic impact (including property value enhancement, employment creation and improved city competitiveness).

Qualitative evaluation of Singapore's two most critical resources – land and water – illustrated optimum use of both. In the case of water, apart from performing a multitude of functions, the programme has contributed

to closing the water loop, as water quality is improved naturally throughout the system thus optimizing the entire water cycle.

In the case of land, more efficient and optimal use has been secured through multiple land uses, such as parks and scenic areas in and around the water-catchment areas. This avoids the duplication of amenities in other areas, and nature areas have been integrated to preserve their ecological integrity and enhance the ecological links within the island parks.

Success factors

The Government's and planning agencies' understanding of the strategic need to conserve resources while developing the economic, ecological and social potential of urban infrastructure established the programme's principles, which led to its success:

- Integrated planning: creatively transforming existing waterways through landscape planning, watershed planning, water-sensitive urban design and community connections.
- Recognizing the multiple values of natural resources: taking water as a basis for urban development and as a resource that can actually improve quality of life as well as help sustain other resources.
- Establishing a sense of ownership: encouraging the public to embrace the concept by attracting public attention, increasing enjoyment and instilling a sense of stewardship in protecting a city's waterways and respective water as a resource to conserve.

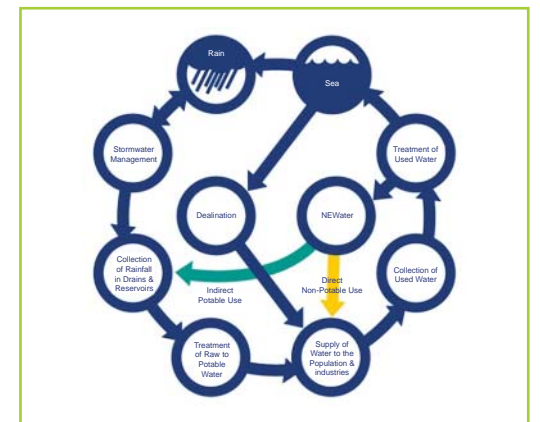
The programme has consistently worked to ensure that negative impacts on the environment are conscientiously minimized while positive impacts are created through detailed urban design guidelines.

Replicability

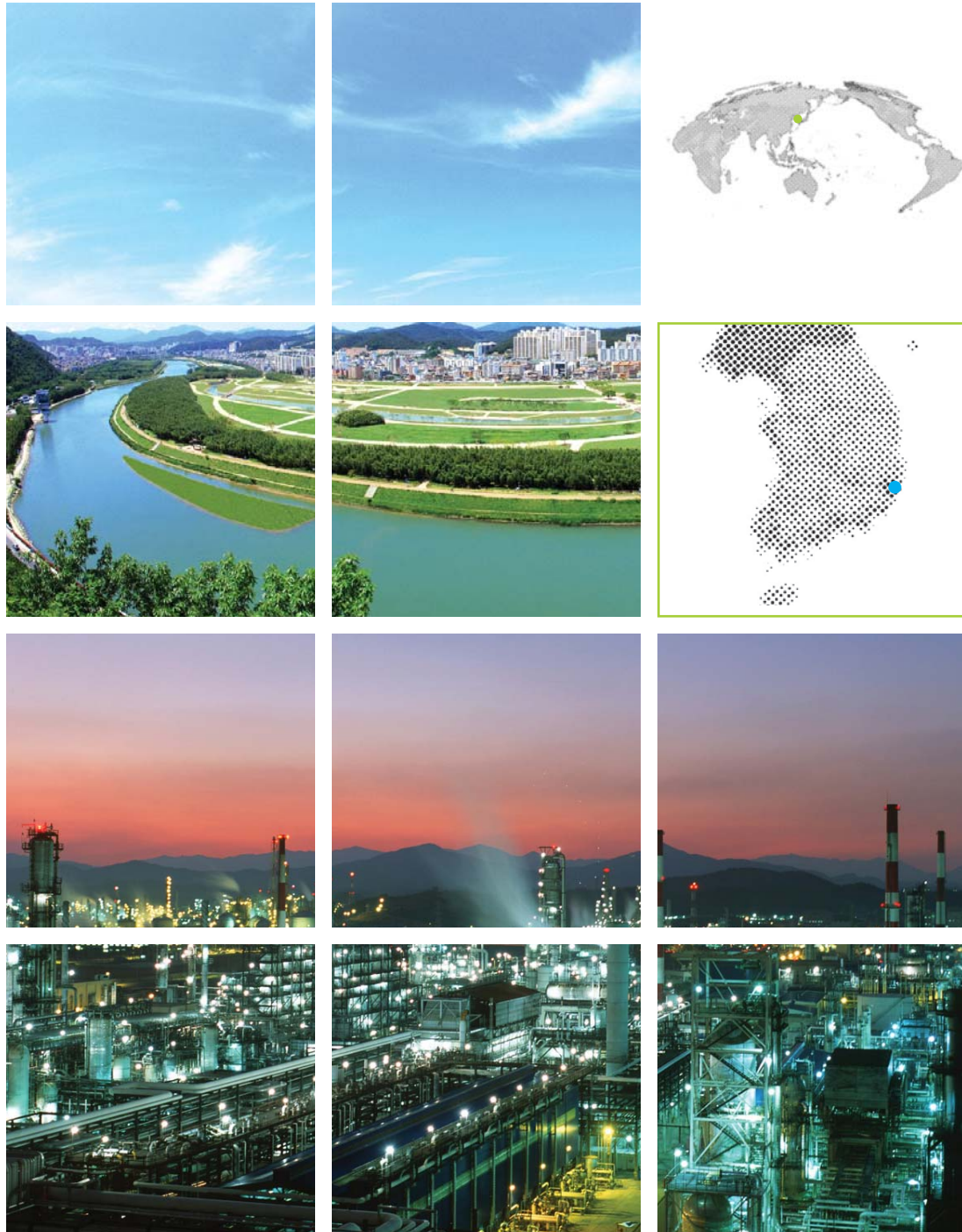
There is considerable potential for adopting Singapore's ABC Waters Programme principles for cities in other developing countries, provided the appropriate financial, institutional and capacity-building support is available. There are areas that require close attention: upholding the core functions of water storage, conveyance and flood

alleviation, influencing the supply chain, taking a life-cycle perspective, and building water-resource stewardship. The main challenge is that the process of stewardship building is not a simple matter that can happen quickly but requires sustained effort for the values to be ingrained into the psyche of the nation; appreciating and conserving water becomes natural to all residents. Education is instrumental and should be pursued.

Cities can emulate the working model after correctly assessing the scope of remodelling, scale and potential of their water infrastructure system. Barriers may include lack of funding availability, organizational or institutional capabilities, technical expertise, local participation and political willingness, given the priorities of other development needs and the perceived longer-term concerns of maintenance and sustainability. Cities need to be flexible in applying strategies, considering their specific objectives and circumstances.



Water loop
Source: PUB, Singapore's National water agency, available from: www.pub.gov.sg



Eco-industrial park in Ulsan, Republic of Korea

Integrated resource management

Resource sharing between businesses within an industrial cluster has tremendous potential for profit and significant environmental and social benefits

↘ Eco-efficiency can be a driver for businesses because it helps them to produce better goods and services while using fewer resources and generating less impact, and thus improve their environmental performance as well as profits.

↘ Local government can help businesses build the business case by setting the necessary conditions: policies and legislation that require efficient use of resources and collaboration among businesses.

Ulsan – city profile

• population	1.1 million
• administrative area (km ²)	1,057
• GDP per capita (US\$)	40,154 (regional)
• population density (person/km ²)	1,052
• climate	subtropical

INTRODUCTION

Ulsan is the seventh-largest metropolis of the Republic of Korea, located in the south-east of the country, next to the Sea of Japan.

Ulsan is the country's industrial powerhouse, hosting more than 1,000 companies that employ more than 100,000 people. These include the world's largest automobile assembly plant, shipyard and refinery. The unprecedented industrial development went hand in hand with a massive population increase (from 85,000 in 1962 to the more than 1 million currently) and made Ulsan the country's richest city (measured in GDP per capita). Over the years, the increase of household income led to a drastic increase of waste generation.

Ulsan was designated a specialized industrial district in 1962 as part of a national plan to encourage the development of heavy industry to spur economic growth. However, over time the focus on heavy industries has had adverse effects on people and the environment: Large amounts of emissions and pollutants have been discharged from the industrial complexes, causing damage to agricultural and marine products. As a direct result of this, seven districts consisting of 7,467 households had to be evacuated,

and industries involved in the polluting were forced to compensate the residents for the damage.

Over the past two decades, the Republic of Korea has experienced a great evolution in its economic policy and thinking. From an industry-based economy, the country has moved to a service-oriented economy, viewing its economy in terms of circular models. In this context, a 15-year, three-phase Eco-Industrial Park Project was initiated in 2005. The Ulsan industrial park was selected as one of five demonstration regions. In line with Ulsan's new vision for the city as of 2004 – for the city – to become a sustainable “ecopolis” and end the heavy polluting associated with industrialization – the municipal government made the realization of an eco-industrial park a top priority.

The project includes initiatives related to cleaner production (at the company level), industrial symbiosis, eco-industrial parks (at the industrial cluster level) and eco-industrial park networks (at the regional level).

Objectives

The Republic of Korea decided to transform its industrial parks into eco-industrial parks primarily because its industrial activity and urbanization had caused considerable damage to its ecosystems and because global competition for resources had become fierce.

This led to the following broad objectives:

- reduce industrial pollution to protect human health and natural ecosystems
- performance of industries on a higher level of resource efficiency.

Benefits

The Korean Government envisioned that the eco-industrial parks around the country would bring great environmental, economic and social benefits, broadly known as the “triple bottom line”. The goal was ecologically sustainable industrial development in line with the country's green-growth strategy. The eco-industrial parks would enable

industries to become more efficient and reduce their pollution through a variety of strategies, such as improved inter-company collaboration within the industrial complex and within the supply chains. Eco-industrial parks can stimulate the reduction of industrial CO₂ emissions, land filling of materials, hazardous waste streams and industrial use of water. Simultaneously, it also can reduce the demand on natural virgin resources and generate cost savings, increased commerce and more jobs and business start-ups.

Eco-efficiency

Eco-efficiency can be the driver for companies to produce better goods and services while using fewer resources and generating less impact, thereby improving both their environmental performance and their triple bottom line.

An eco-industrial park is a community of businesses that cooperate with each other and with the local community through a formalized, systematic and comprehensive process to efficiently share resources (information, materials, water, energy, infrastructure and natural habitat), leading to economic gains, environmental quality improvements and the equitable distribution of jobs.

WHAT WAS DONE

Policy initiative and action plan

Operations, production and delivery in the Korean industrial sector went through extensive change in the 1990s. The industrial environmental policy drastically changed after the Ministry of Knowledge Economy enacted the Act to Promote an Environment-Friendly Industrial Structure in 1995. Accordingly, the first comprehensive master plan for environment-friendly industrial development was created that included streamlining the supporting system, cleaner production transfer and dissemination, promoting environmental industry and stimulating environmental management. The national policy of pursuing a sustainable industrial strategy proved instrumental in renovating the traditional industrial parks in Ulsan by requiring the use of advanced environmental technology and creating opportunities to introduce industrial symbiotic networking into the large-scale industries that also drew in medium and small companies.

The process

The establishment of an efficient eco-industrial park in Ulsan took place in four stages:

1. Eco-Industrial Parks Master Plan for the Republic of Korea

In 2005, the National Cleaner Production Center, with the support of the Ministry of Knowledge Economy, initiated the 15-year, three-phase Eco-Industrial Park (EIP) Project, which included Ulsan as one of the five targeted regions. The Ulsan park consists of two industrial complexes, Mipo and Onsan. Companies located there operate in non-

ferrous metals, steel, metal manufacturing, automobile production, ship building, petrochemicals, refinery, incinerators, etc.

2. The Ulsan initiative

The conversion of conventional industrial complexes into an eco-industrial park had started on a company-to-company basis by the mid 1990s. However, before the launch of the eco-industrial parks initiative in 2005, the focus was still on production chains, resulting in huge amounts of by-products and waste material.

EIP center

The Ulsan EIP center was set up to innovate and renovate the Mipo and Onsan industrial complexes through a systematic linking of companies, or industrial symbiosis. The Ulsan EIP center was mandated with three primary functions:

- **Data collection**

The EIP center collected data on the supply and demand for resources and waste-sharing opportunities from all the companies in the Mipo and Onsan industrial complexes.

- **Symbiosis identification and feasibility study**

Based on the collected data in terms of supply and demand, possible links were identified. The Center for Clean Technology and Resource Recycling at the University of Ulsan and other R&D institutes in Ulsan provided research and development support to evaluate the feasibility of each link between businesses.

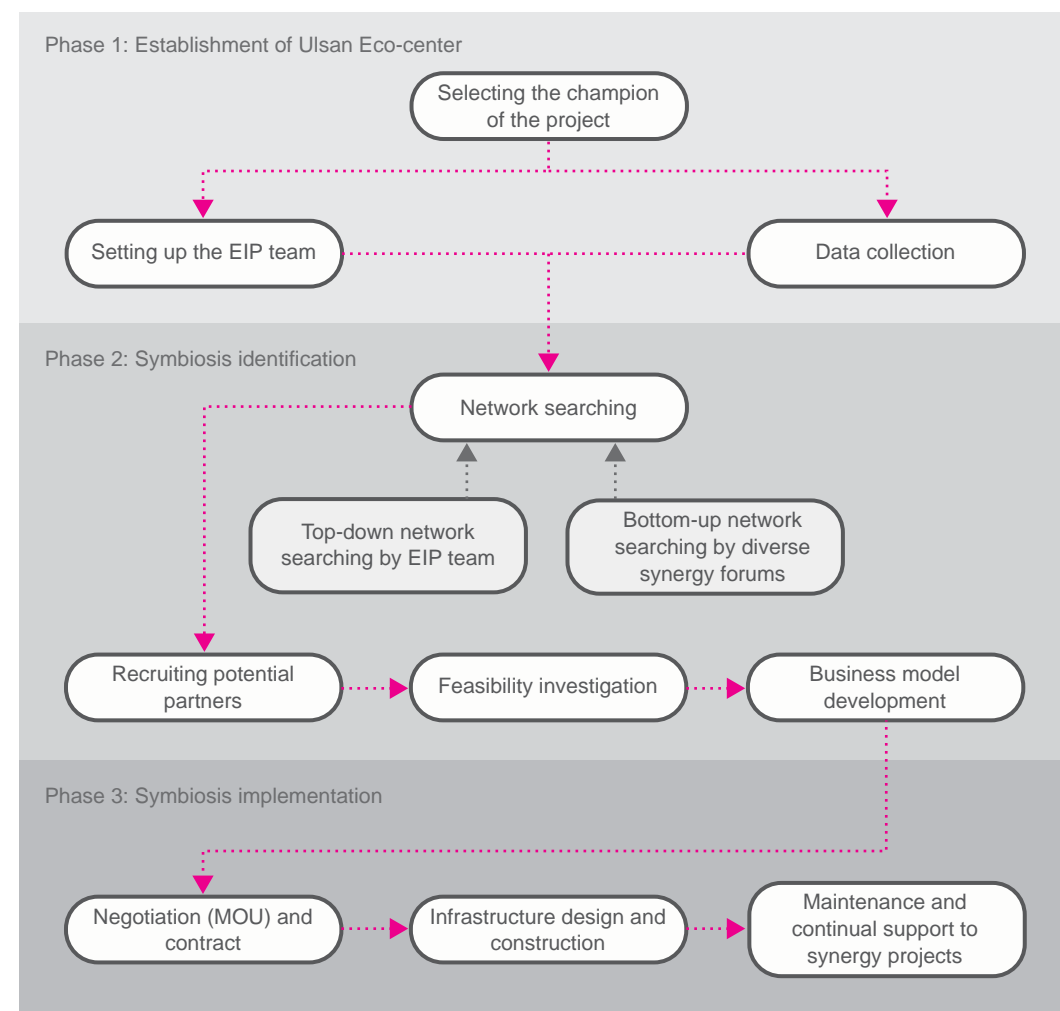
- **Symbiosis implementation**

This involved support to the participating companies to execute their identified links with each other. EIP center staff negotiated with company or agency officials to overcome barriers.

Road map for industrial collaboration (symbiosis) in the Ulsan EIP transition

The EIP center established ten industrial networks within a period of three years (2006–2008). Based on the experiences and lessons learned in setting up the first two networks, i) between Yoosung Company and Hankook Paper and ii) between the Sung-am municipal waste incineration facility and the Hyosung Company, the EIP center developed

its own site-specific road map to transform the existing industrial parks into eco-industrial parks. The road map spelled out the how, where and when.



3. Networking evolution in Ulsan eco-industrial park

The industrial symbiosis networks were established among a diverse group of industries that were either operating or planning to operate in the eco-industrial park in the future.

Involved parties:

- Korea Industrial Complex Corporation (KICOX)
- Ulsan EIP center
- Ulsan metropolitan city government
- companies in the Mipo-Onsan industrial complexes

Financing resources and partners: The investment for setting up each industrial symbiosis network was, and remains, shared by the participating companies, while the Ulsan EIP center supported the research and development fund to examine the feasibility. In the first phase of the eco-industrial park initiative in Ulsan, the EIP center provided US\$6 million as research support. Profits are shared and are based on the proportion of the investment each company contributes to the infrastructure developed.

There are diverse financing resources and mechanisms in the Republic of Korea, both government and private, that have been used to develop the eco-industrial parks. Several government-financed incentive funds, such as the Water Saving Company (WASCO) and the Energy Saving Company (ESCO), can be used for investing in energy and water-saving improvements and waste recycling.

Private investment of course has also been encouraged through various models: build-transfer-operate, build-transfer-lease, build-own-transfer and build-own-operate.

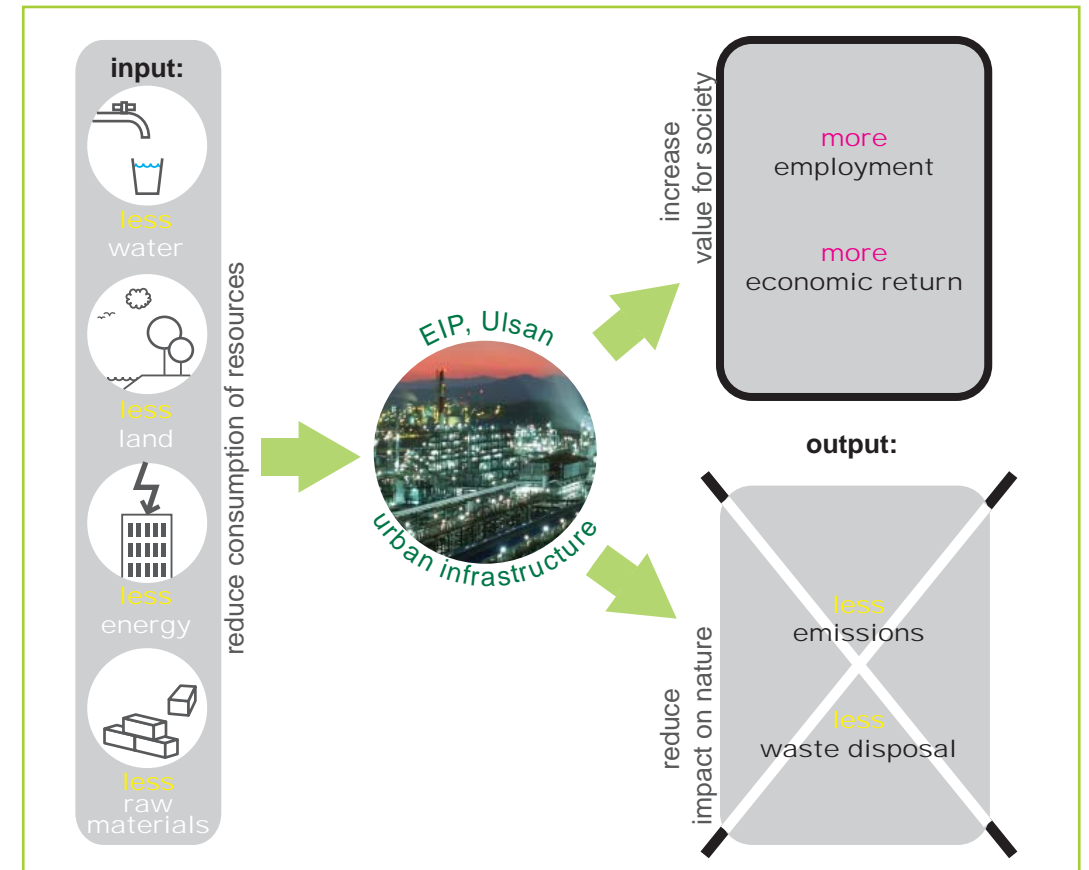
OUTCOMES AND SUCCESS FACTORS

Economic and social benefits

In many cases, the profit shared (per year) by the participating companies was greater than their investment for the infrastructure design and construction. For instance, the Sungam municipal waste incineration facility and Hyosung Company shared US\$6.5 million after investing a total of US\$4.5 million. Similarly, the Yoosung Company and Hankook Paper shared a profit of US\$2.1 million on an investment of US\$0.8 million.

Economic returns can be big due to the relatively small investment needed for the technology adjustments. In the case of Yoosung Company and Hankook Paper, for instance, the investment to exchange steam produced from waste had a payback time of less than half a year. The exchange of nutrients for micro-organisms from industrial wastewater from the Sunkyuonng Watech company to the Te-kwang Industry had a payback time of less than a year.

In addition, social benefits were derived from increased employee and community satisfaction due to job creation and improved environmental performance. For example, the Hyosung Company invested US\$140 million to construct a new production unit



to use its excess steam, which then created employment for 140 people.

The eco-industrial park project demonstrates that with a well-established business model, different parties can be motivated to invest in infrastructure that offers them significant economic gains while simultaneously contributing to a cleaner and greener environment. The first phase of the Ulsan eco-industrial park initiative attracted an investment of US\$50 million from the private sector, based on the potential economic benefit of US\$50 million per year.

Environmental benefits

The eco-industrial parks and industrial symbiosis directly resulted in a reduced need for energy, water and raw materials. The environmental benefits in terms of reduced resource consumption, emissions and waste generation have been significant. Improved practices relate especially to waste reduction and recycling practices, waste-water recycling and reduction in the use of energy. This in turn has led to CO₂ reductions and other pollutants (SO_x, NO_x, TSP, CO and VOC). The benefits gained through the industrial symbiosis network between the Sungam municipal

waste incineration facility and Hyosung Company, for example, was 18,850 m³ per year in energy reduction, 55,500 tons per year in CO₂ reduction and 176.8 tons per year in air pollutant reduction.

Strategies to enhance competitiveness

By becoming eco-industrial parks, industrial complexes enable tenants to become more efficient and to reduce pollution through a variety of strategies. Some of the features that enable greater competitiveness include:

- Improved inter-company collaboration within the industrial complex and within supply chains enables synergy in environmental protection, community benefits and competitive bidding.
- Shared services and facilities lower the costs of individual companies, especially small and medium enterprises (SMEs); affordable access to cleaner production training and consultation is strategically important for SMEs.
- Company-to-company exchanges of material, energy, water and services enhance the efficiency of each unit of input.
- A cluster of resource-recovery companies uses by-products not absorbed through company exchanges.
- A cluster of environmental technology and service companies helps companies in the complex, especially SMEs, in improving product and process design, avoiding waste generation, and gain higher efficiency.
- A management unit provides services for resource management, infrastructure, knowledge management to companies, utilities, the local community and regional networks.

- The management of infrastructure for the complex seeks high-performance technologies and management practices in sewage and rainwater treatment, recycling and recovery technologies, efficient use of fossil fuels, use of renewable energy sources and efficient transportation and food services.

- Jointly managed emergency prevention, preparedness and response systems reduce the risks and costs of major incidents and increase the investment security in the complex.

- The eco-industrial park provides its services and know-how as a centre of excellence in all aspects of resource efficiency, serving industry, commerce and municipalities as a source of innovation on a regional scale.

Success factors

Important factors for the successful development of the Ulsan eco-industrial park relate to:

- Organisational

- a strong vision for Ulsan and the development of the eco-industrial park
- the effort to link companies and identify business cases in the eco-industrial park; securing commitment and ownership from a variety of parties
- a transparent and efficient implementing procedure
- The harmonizing between local policies for the development of the eco-industrial parks with regional development policy.

- Institutional

revising policy and legislation, such as:

- Industrial Clusters and Factory Establishment Law

- Industry Location Law
- Solid Waste Management Law
- Collective Energy Law
- Energy Framework Law.

(The Ulsan EIP center recognized that the current legislation does not enable or encourage industries to implement some of the potential synergies, such as those related to water, and suggested that the municipality needed to change the law.)

- Technological

- developing the capability of practitioners in research and development for high-tech applications in potential industrial symbiosis
- diagnosing processes or products for networking flexibility
- securing quality assurance and risk management
- developing reliable and effective operation and management tools

Additional improvements

There is widespread enthusiasm and commitment shown by the industries operating in the Ulsan eco-industrial park to achieve a greater number of industrial symbiosis networks and, in the long run, to be a world-class example of eco-industrial parks. This commitment is reflected in the disclosure of their baseline input and output data and their willingness to participate in the project. The currently established networks are more diverse and significant, which positions Ulsan well among the leading-edge examples of industrial symbiosis. Nevertheless, many industrial symbiosis opportunities still appear to exist mainly in three broad areas: water, energy and industrial by-products.

Replicability

The potential for adopting the Ulsan eco-industrial park policy framework and principles for projects in other developing countries is good. However, local circumstances, objectives, environment management guidelines and finance mechanisms available need to be taken into account. This means that political objectives and the willingness of different parties to participate and invest must be in place in order to develop fruitful industrial symbiosis. The municipality can assume a crucial leading role in identifying potential synergies and technical options, as shown in Ulsan. The success of such projects essentially depends on the coordination between the vertical structure of governance in a country and the implementing capacity, skills and aspiration in the horizontal sectors at the local level. There is plenty of scope to enhance the eco-efficiency of industrial clusters either by transforming the existing industrial parks to eco-industrial ones or by establishing new eco-industrial parks. This kind of action taken at the local or regional level will have sustaining positive impact economically and ecologically.



Taehwa River Restoration Project in Ulsan, Republic of Korea

Water management with an eco-efficient vision

It takes a strategic approach – a combination of a strong city vision, comprehensive master planning, inclusive planning and vigorous private sector investment – to successfully restore a river. But it is doable.

➤ River restoration projects require consistent and sizeable interventions and investment over a long period of time. For projects to succeed, initiatives and financing modalities need be anchored to long-term city objectives and plans.

➤ The involvement of NGOs as major players can be effective in raising public awareness on the importance of river restoration and in examining the relevance of various policy measures.

Ulsan – city profile

- population 1.1 million
- administrative area (km²) 1,057
- GDP per capita (US\$) 40,154 (regional)
- population density (person/km²) 1,052
- climate subtropical

INTRODUCTION

Ulsan is the seventh-largest metropolis of the Republic of Korea, located in the south-east of the country, next to the Sea of Japan. Ulsan is the country’s industrial powerhouse with more than 1,000 companies (including the world’s largest automobile assembly plant, shipyard and refinery). The heavy industrialization provoked a massive population increase, from 85,000 in 1962 to more than 1 million currently.

Since the 1970s, the negative effects of that massive industrialization, such as polluting discharge and untreated waste from the industrial complexes as well as the tremendous waste generation from households, caused severe damage to the natural environment and ecosystem in the area around the city, leaving the Taehwa River heavily polluted. Inadequate river management, which included poor ecological conservation strategies and reckless rapid urbanization, made the situation of the Taehwa River even worse. This resulted in its nickname, “river of death”.

Nowadays, the Taehwa River can be seen as a role model of urban river restoration in the

Republic of Korea, even though the work is still ongoing. Biological diversity has already returned, an ecological park and recreational facilities were built and property values have risen. Reversing the river degradation took political will and impressive policy changes, bundled into the Taehwa River Master Plan, which was initiated under the umbrella of the Ulsan Ecopolis Plan. The plan builds on a joint declaration by the city government, business owners, residents and NGOs to “build a joyful city where the environment and economy live together and humans coexist with nature by restoring our blessed nature and conserving our precious cultural heritage”.

WHAT WAS DONE

Policy initiative

Water quality deterioration in the Taehwa River was mainly regarded as a consequence of the lack of environmental infrastructure, such as sewage treatment facilities, which was largely caused by the sudden increase in demand due to rapid urbanization. To tackle the negative effects of the deterioration of the Taehwa River, such as unattractive river banks for housing and recreation purposes as well as decreased ecological habitat, the

Ulsan metropolitan government initiated a variety of long-term comprehensive policy measures.

Technical management

The most prominent characteristic of the Taehwa River Restoration Project is that the city government took a precautionary approach on river management. The majority of policy measures are concerned with the treatment of wastewater downstream of local rivers, using local sewage treatment plants in order to prevent the inflow of wastewater into the Taehwa River from households and industry. Given the comprehensive sewage scheme, municipalities at both the metropolitan and district levels have employed multi-year action plans for a sludge-dredging project for building pollutant-treatment and sewage-treatment facilities. In addition, a tele-monitoring system is used to control wastewater from both households and industry that discharge over 200 m² of wastewater per day.

Institutional arrangement for implementing

Recognizing that the river management has been fragmented in the past, the Ulsan metropolitan government took a comprehensive and integrated approach to

the Taehwa River management, making sure that an overview existed of available resources and capacities and that implementing practices were specified. In that way, the Ulsan metropolitan government was able to deal with various policy agendas, including water quality, ecological recovery, urban regeneration and cultural and historical restoration. Practically, this means that in addition to plans for cleaning up the river, there were also plans to develop an ecological park and recreational facilities to enhance its use among the city population.

The Taehwa River Restoration Project has been implemented under a two-tier planning system: the Ulsan Ecopolis Plan and the Taehwa River Master Plan. The Ulsan Eco-polis Plan sets overall ambition and objectives for the Taehwa River Restoration Project as a non-legally binding strategic plan, while the Taehwa River Master Plan proposes specific and sector-based projects. To prevent non-effective cooperation between different city divisions and ensure efficient implementation of the restoration project, a special task force unit for river management was initiated. To ensure environmental issues were not overlooked, concerns of local NGOs were integrated into the Taehwa River Restoration Plan.

Details of the riverfront development of the Taehwa River (unit: m²)

TOTAL	SIZE OF LANDSCAPED AREA					RECRE- ATIONAL FACILI- TIES	PARK- ING LOTS	WALK- ING PATH
	SUB TOTAL	FLOWER GARDEN	GRASS FIELD	SACRED GROVE	ECOLOGI- CAL PARK			
1 052 465	868 364	577 020	136 683	9 052	145 609	119 940	64 161	17.7

Example of division responsibilities for the water-quality improvement projects within the Taehwa River Project Master Plan

PROJECTS	RESPONSIBLE DIVISION
Sludge Dredging Project at Urban Downstream	Construction and Road Division
Building Non-Point Pollutant Treatment Facilities	Environmental Policy Division
Building Livestock Wastewater Treatment at Upstream of Daegok Dam	Environmental Policy Division
Development of Riverbank Filtration Source	Environmental Policy Division
Expansion of Sewage Treatment Facilities	Sewage Management Division
Restoration of Wetland at Taehwa River	Environmental Policy Division
Ecological Restoration of Urban Creek	Environmental Policy Division
Establishment of Water Quality Monitoring System	Environmental Management Division
Expansion of Tele-Monitoring System at Polluting Source	Environmental Management Division
Prevention of Inflows of Wastewater at Taehwa River	Sewage Management Division
Local Water Comprehensive Plan	Environmental Policy Division
Naturally Cleaning Project at Taehwa River	Environmental Management Division

Involved parties

The inclusion of local NGOs in the Taehwa River Restoration Project contributed to the successful sensitizing of the public on the importance of river restoration and in more comprehensively examining the relevance of policy measures for the project. Due to the former central government-driven policies on river management, little local knowledge existed on how to counter deteriorating rivers with the help of local people and their knowledge. The NGOs assisted in improving the policies and promoting local knowledge for revamping the river.



Activities of NGOs in the Taehwa River Restoration Project

LOCAL NGOs REACTING TO TAEHWA RIVER	MAJOR ACTIVITIES
Ulsan Environment Alliance	Conducting field survey on the Taehwa River Organizing Eco-education for youth and adults
Taehwa River Conservation Council	Establishing eco-class for Taehwa River Conducting field survey on the Taehwa River Organizing workshop and seminar on the Taehwa River project Campaign for national trust of the Taehwa River
Citizen Group of Saving Yeochun River	Assisting ecological restoration of the Yeochun River
Dongcheon River Conservation Council	Assisting ecological restoration of the Dongchun River
Volunteers for Bamboo Forest	Conservation of Bamboo Forest near the Taehwa River
Citizen Group for Taehwa River	Cleaning and conservation of the Taehwa River

The private sector also contributed significantly to the project. Contrary to other Korean cities, where the government is often the only player in environmental projects, 73 businesses and industrial companies had participated in the river clean-up project by 2008 as part of the campaign “One Company, One Kilometre” in which each took responsibility for 1 km of the river. The diversity of parties in the project helped to raise business owners’ social responsibility and to mobilize resources for environmental improvement projects. The involvement of NGOs in the river manage-

ment has reduced conflicts and confrontations through inclusive planning and development and helped to generate creative alternative policies that promote sustainable river management.

Financing of major projects for Taehwa River restoration

PROJECT	TOTAL BUDGET (MILLION US\$)			
	TOTAL (%)	GOVERNMENT	CITY	DISTRICT
TOTAL	315 (100%)	128 (40.5%)	173 (55%)	14 (4.5%)

Financing

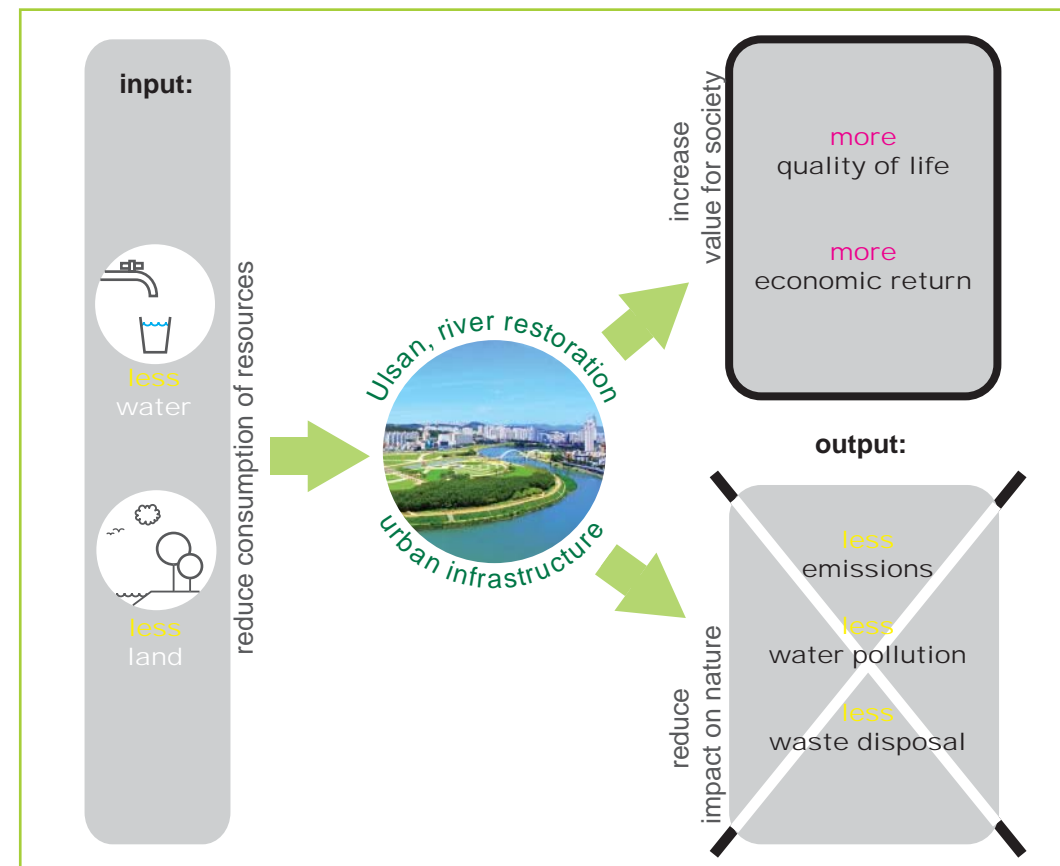
The financial sources for the major projects of the Taehwa River Restoration Project are predominantly channelled through the central and metropolitan governments, and are associated with the division of roles on the river's projects: the central and metropolitan governments took exclusive responsibility for the downstream Taehwa River, while the districts were responsible for local river streams connecting to the river. As a consequence, the share of total budget for the Taehwa River Restoration Project from the central and metropolitan governments together reached 95%, while the districts accounted for less than 5% of the total budget.

The financial modality of the Taehwa River Restoration Project was heavily dependent on subsidies as the major financing source at the early stage. Yet, as demands of social welfare and other urban sectors enhanced, the Ulsan metropolitan government attempted recently to seek a financing alternative, based on public-private partnerships. For example, a newly built sewage facility was constructed through a build-transfer-operate contract with a private company. Additionally, a cost-recovery scheme was initiated, applying pollution charges based on the prin-

ciple that "polluters pay". The metropolitan government impose business-user levy to cover the costs incurred from wastewater treatment.



OUTCOMES AND SUCCESS FACTORS

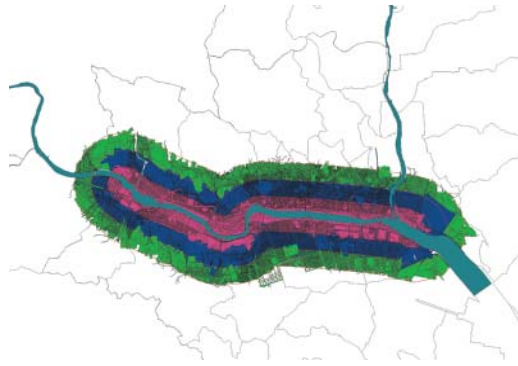


Environmental and social benefits

The most remarkable achievement of the Taehwa River Restoration Project is the rapid improvement of the water quality, which brought about a rating of "very good" by national standards on water quality and aquatic ecosystems. This improvement of water quality has resulted in increased ecological habitat. The necessary improvements in turn have resulted in increased attractiveness and use of the river front for people (ecological parks and recreation).

Economic benefits

The restoration project is not only contributing to reduced environmental load but is generating economic value through urban renovation. Property values in the newly built-up areas (up to 1,500 m radius) along the Taehwa River have increased much more (by 30-40%) than other areas of the city.



The built-up areas at Taehwa River, at 500, 1000 and 1500 metres

Comparison of land prices between riverfront and non-riverfront zones, in 2005 and 2009	
	INCREASE RATE
Riverfront zone (0 – 1,500 m)	40.6%
Non-riverfront zone (outer 1,500 m)	10.1%

Policy implications

Several policy implications can be drawn from this project on how to develop eco-efficient urban infrastructure:

Leadership

The mayor of Ulsan prioritized the improvement of the urban environment in his policy agenda. Political commitment was crucial to execute policy changes and to mobilize resources. An important point was the signing of the Ecopolis Ulsan Declaration in 2004.

Strong vision

Policy responses should be considered from a medium- to long-term perspective because many project activities, such as pollution remediation and the upgrading of sewage treatment facilities, require constant and large investment over a long period of time. A strong vision, such as established in the Vision for Ecopolis Ulsan, is useful because it sets objectives that reach further than those set in one political term.

Comprehensive master plan

A comprehensive master plan is important to give an overview of available resources, capacities and responsibilities.

Participatory approach

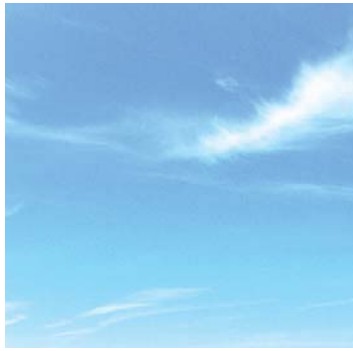
Involving local businesses, NGOs and the public as major actors enhances the availability of resources and capacities. Local environmental issues, such as air pollution, water contamination and waste generation, are difficult to address through conventional approaches in which the local government is the exclusive player.

New financing alternatives

Local governments often face financial deficiencies in meeting demands other than for infrastructure, such as social welfare. Thus, new financing alternatives, such as public-private partnerships should be considered for cities struggling with severe deficiencies in their urban infrastructure.

Overview of the improvement and details related to eco-efficiency assessment of the Taehwa River Restoration Project

SECTOR	TARGET AREA	ASSESSMENT OF ECO-EFFICIENCY	SELECTED INDICATOR	REMARK
Environmental	Water quality		Biological oxygen demand	Improved
Environmental	Water quality	Economic value (benefit)	Willing to pay in money term	Increased
Environmental	Water quality	Environmental and economic	Degree of satisfaction on water quality	Increased
Environmental	Water quality	Economic value (cost)	Cost improvement of biological oxygen demand level	Increased
Ecological	Ecological restoration	Environmental restoration	Number of species and natural habitats (salmon)	Improved
Economical	Urban regeneration	Economic value	Property value	Increased
Technical	Technical management	Environmental and economic	Local river management system	Enhanced
Social	Amenity and accessibility	Environmental and economic	Degree of satisfaction on Taehwa River ecological park	Increased
Social	Social and institutional governance	Environmental and economic	Institutional arrangement	Enhanced
Social	Social and institutional governance	Environmental and economic	Degree of public involvement (NGO activity)	Enhanced
Social	Local response	Environmental and economic	Level of environment improvement of local river	Increased
Financing	Financing	Economic	Financial modality (subsidy, public-private partnerships)	Diversified



Encouraging reduction, reuse and recycling rather than landfilling in Ulsan, Republic of Korea

Eco-efficient solid waste management

Reducing the ecological impact of waste management can reduce costs.

Local governments can reduce ecological impact and costs by prioritizing policies that minimize waste generation from source, involve the private sector for waste collection and promote recycling practices.

Measures should be adapted to local spatial and socio-economic circumstances; high-density areas can prioritize centralized waste treatment policies due to relatively low transportation costs for waste collection, while low density areas can focus on reducing waste from the source and treat the waste locally.

Ulsan – city profile

- population 1.1 million
- administrative area (km²) 1,057
- GDP per capita (US\$) 40,154 (regional)
- population density (person/km²) 1,052
- climate subtropical

INTRODUCTION

Ulsan is the seventh-largest metropolis of the Republic of Korea, located in the south-east of the country, next to the Sea of Japan. Its unprecedented industrial development attracted a massive population increase, from 85,000 in 1962 to more than 1 million currently, which resulted in a drastic increase of household waste generation.

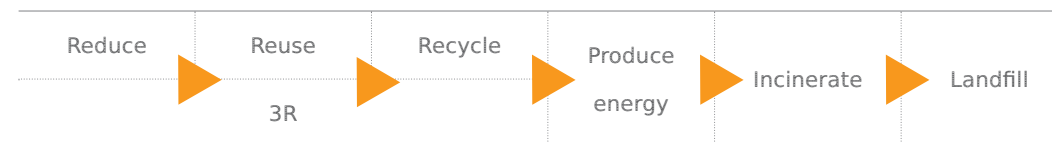
In the Republic of Korea, there is a clear division of roles in waste management between the national and local governments. The national Government is concerned with policy and frameworks, while local governments are responsible for the collection and handling of waste. Waste discharge from industrial companies is handled by those companies.

The residents of Ulsan currently generate a daily average of 10,000 tons of waste. This entails 1,072 tons of municipal waste, 5,151 tons of industrial discharge waste, 3,014 tons of construction waste and 738 tons of designated waste. Korean cities have been predominantly dependent on conventional waste-treatment methods, such as landfill, without fully developing incineration or recycling processes.

WHAT WAS DONE

Project: Ulsan required a radical change in its waste management practices to counter the growing generation of waste and unsustainable treatment methods. “Environmental pollution has become a pending issue that should be addressed without fail in order for Ulsan to achieve sustainable growth, as well as an urgent challenge that will determine the destiny of the city,” the then-mayor, Maeng-woo Park, said.

The vexing issue of environmental pollution led to a shift in policy and thinking in the municipality: from a grow-first approach to an eco-efficient paradigm. In a bid to create a city of resource circulation, the municipality introduced environmental considerations into its municipal waste-management process, and it pursued a broader eco-efficiency agenda for urban infrastructure development. This shift led to the prioritizing of waste-reduction measures and recycling practices to replace the unhealthy use of landfill. By taking into account the specific geographical and socio-economic circumstances around the city, the measures were tailor-made for different neighbourhoods.



Policy initiatives and priorities: To promote a resource-recycling society, two main policy initiatives were prioritized: First, a volume-based waste charging system was introduced to discourage and reduce waste generation from the source. Second, a “3R” (reduce, reuse and recycle) approach was introduced to improve waste treatment in terms of eco-efficiency. To prioritize the 3R policy over incinerating and landfill, the Ulsan government established the above policy prioritizing sequence.

The policy priorities were further streamlined under the objectives of the Ecolopolis Ulsan Plan, which resulted in ten major projects on municipal waste management.

	PROJECT	RESPONSIBLE DIVISION
1	10% Increase of Recycled Household Waste	Environment Resource Division
2	10% Decrease of Household Waste Generation	Environment Resource Division
3	Voluntary Agreement with Local Businesses on Energy-Saving Measures	Economic Policy Division
4	Expansion of Landfill and Incinerators at Sung-am	Environment Resource Division
5	Expansion of Automatic Selection of Recycled Goods	Environment Resource Division
6	Establishing the Second Stage Promotion Plan on Local Environment and Energy Industry	Industrial Promotion Division
7	Reuse of Steam from Incinerators	Environment Resource Division
8	Production of Biogas from Waste	Environment Resource Division
9	Sewage Sludge Incineration Project	Sewage Management Division
10	Eco-Industrial Park Project	Industrial Promotion Division

Specific policies

The municipality developed a set of policies to improve the eco-efficiency of its waste management, emphasizing reductions in resource use and waste disposal and introducing an integrated management approach to ensure the efficiency of the city system. The major interventions included:

- implementing a volume-based waste charging system aimed at reducing the volume of waste generation and disposal by making the generators (residents) pay the waste disposal expenses in accordance with the volume
- introducing regulations on the use of disposable products and thus restraining businesses from providing them for free (such as charging for the use of plastic grocery bags in supermarkets)
- making recycling mandatory by obliging citizens to separate recyclable waste and further sort it into different categories
- introducing innovative waste treatment facilities, allowing for recycling, processing and energy production (such as waste-sorting centres, petrochemical companies and incineration plants)
- adopting an integrated approach of municipal waste management that links the major urban sectors, such as industry, transportation and land use and creates a reliable resource-circulation system.

Implementing mechanisms were set up that involved both local businesses and residents and that discouraged waste production and stimulated recycling and inter-sector resource circulating. The local government

has secured investments for innovative waste-treatment technology that allowed for recycling, produced energy and established a symbiosis with the industrial sector.

The collection method for domestic waste was divided into two modalities: door collecting and spot collecting. Each district in Ulsan has adapted these two municipal waste-collection systems selectively, according to the nature of the service area. The core districts exclusively provide door collecting, while the periphery districts depend mainly on spot collecting. The rationale for this binary approach for different districts is that population density is negatively correlated with garbage-collection costs.

The Ulsan municipal government also constructed several innovative waste-treatment facilities, which now allow for renewable energy production. One of the facilities is a petrochemical company that uses gas from landfill waste. Another facility is an incinerating plant that provides steam from the burning of combustible wastes. The renewable energy from these waste-treatment facilities is further channelled into local industries.

Implementing and financing

The role of the municipality has been instrumental in leading the waste-management process. The generation of municipal waste in Ulsan has steadily decreased since the early 2000s. Yet the budget on municipal waste management has increased by an average annual growth

of 10.5%. There are several contributing factors: the change in policy priority to promote better quality of life for all residents, the increase of costs incurred from waste collecting and treatment, and the investment on the modernizing of the facilities and equipment needed for waste management. Given this situation, the participation of the private sector was encouraged to improve the cost savings on waste collection. The following table illustrates the cost-saving potential through private sector involvement in the Republic of Korea.

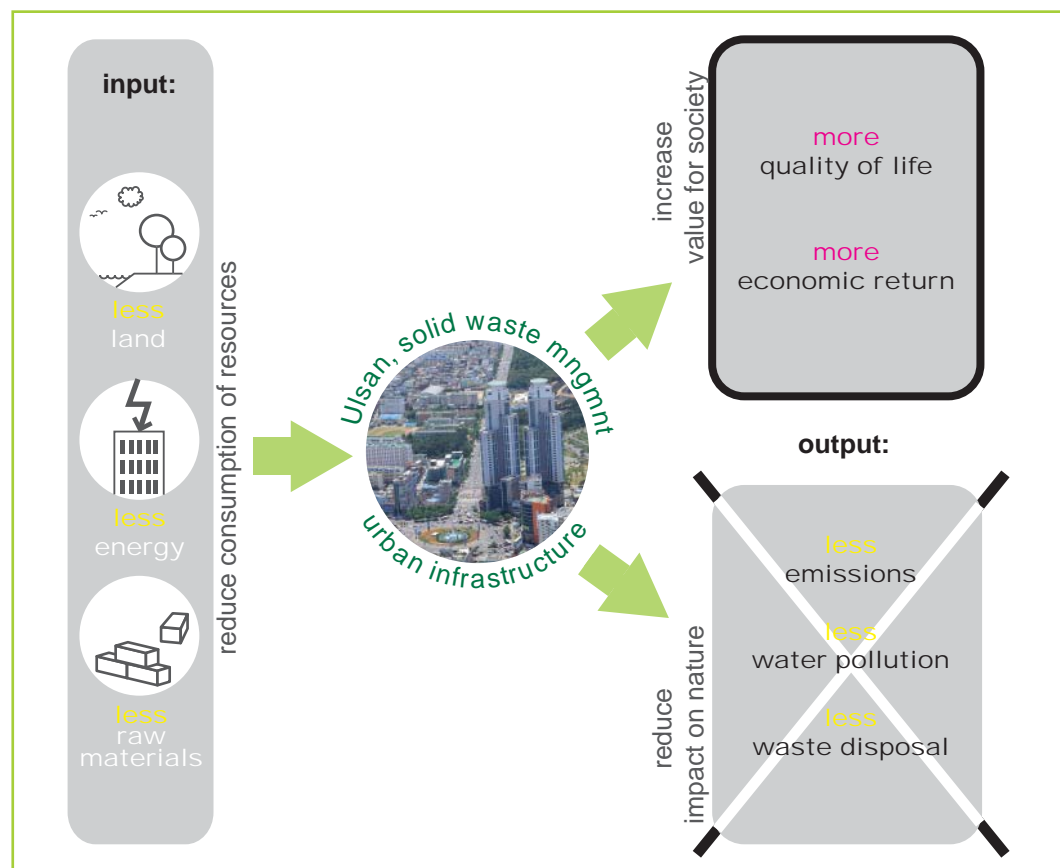


Comparison of waste-collection costs between the public and private sectors in the Republic of Korea

	COLLECTION (TON)	COLLECTION COST (MILLION US\$)	COLLECTION COST PER TON (US\$)
Public sector	1,105,204	97	87
Private sector	8,399,516	348	41
Public- Private Partnership (PPP)	5,203,907	254	48

Source: Ministry of Environment, 2008

OUTCOMES AND SUCCESS FACTORS



The outcomes of the Ulsan metropolitan solid waste management initiative have manifested in several dimensions – environmentally, economically and socially. The share of landfill as the conventional waste-disposal method has decreased considerably while incinerating and recycling have become the primary treatment methods. This has resulted in the reduction of the environmental burden as well as municipal waste-management costs. Additionally, by promoting eco-efficiency,

the initiative introduced positive social change by cultivating a psychological shift and behaviour change towards a resource-recycling society.

By 2006, the share of conventional treatment methods had decreased sharply to 18.5% (from 85.6% in 1994) for landfilling, while recycling practices increased from 23.5% to 58% in 2006 alone. Such an increased share of recycling goods on municipal waste generation is effective in reducing the

environmental burden as well as treatment costs. In addition, requiring the separation of recyclable goods by material is not only effective for increasing what is recycled but is important for reducing combustible/non-combustible wastes. Moreover 64% of the entire steam generated from incinerating is now used for heating systems and power generation by local industries. Such a development and application of waste heat-recycling practices through incineration has become a benchmark case for symbiosis with the industrial sector in terms of eco-efficient use of municipal waste management.

The total generation of municipal waste has decreased with the stringent enforcement of the recycling policy and waste separation. Although the figures indicate consistency in waste production throughout the entire period of analysis between 1994 (1,017.0 tons per day) and 2006 (1,111.8 tons per day), per capita waste generation has also shown a declining tendency (from 1.10 tons per day to 0.99 tons per day) in the same period, indicating that even with the population increasing, reductions continued consistently.

Regarding the collection of municipal waste, there are few changes in terms of the quality of service delivery. Local districts are increasingly using the private sector to collect waste. Although there is no significant change in the number of personnel charging for waste collection in recent years, the quality of services and related facilities in the private sector has improved.

Success factors

This brief overview suggests that the project resulted in positive change in the city's development paradigm. The project help the transformation from a city confronted with environmental pollution and unbalanced growth to a successful benchmarking case in terms of eco-efficient use of municipal waste management. Ulsan is now further strengthening international cooperation in the environmental field to maintain its position as a world-class eco-industrial city. The Ulsan waste management system relies on public-private environmental governance, which involves joint participation of the city government, residents and local businesses. This broad participation of parties ensures that the project is not limited to just the technical execution of eco-efficient measures but that it also allows for positive social change towards a resource-recycling society and thus environmental sustainability.

There are a few factors contributing to the effective management of municipal waste generation in Ulsan. First, as in other Korean cities, Ulsan implemented the volume-based waste charging system in 1995, which contributed to the rapid decrease of household waste (26.5% during the first 2 years). However, the volume-based charging system proved to be effective only in the first few years. Hence the necessary policy priority shift to the 3R approach (reduce, reuse and recycle), which is now regarded by the municipality as the most effective policy response for realizing eco-efficient outcomes.

Another lesson learned is that there should be an integrated approach to municipal waste management. Integration links the major urban sectors, such as industry, transportation and land use, for the purpose of circulating resources at the local level, which ultimately proves cost-effective. In many Asian cities, selecting a location for waste-treatment facilities, such as a landfill site or incinerator, is based on factors such as land costs and expansion capacity. But including factors such as transportation costs and reuse capacity can make another location more appealing in terms of overall costs. It is important for a municipality to consider various issues when selecting treatment sites.

Population density is widely perceived as negatively correlated with waste-collection costs. An empirical study on municipal garbage collection conducted by the Ministry of Environment in 2008 found that less-populated regions are not cost-effective with their waste collection compared with highly populated regions, such as the urban centres. Thus the peripheries of Ulsan now place higher priority on reducing local waste and have constructed small-sized waste treatment facilities. This approach is effective in how it has reduced the number of trips (and distances) to collect local waste, leading to increased economic value (reduced transportation costs) and reduced environmental load (greenhouse gas emission from the transportation process). In Ulsan, a crucial point has been the strong link between the spatial expansion of newly built-

up areas and the generation of household waste. This suggests that the measures need to be based on the changes in local socio-economic and geographical factors.

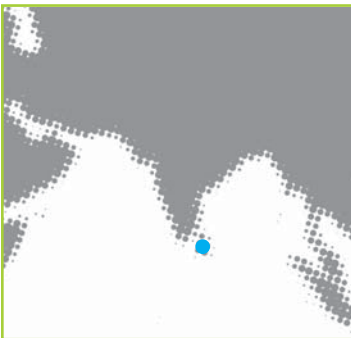
In sum, the case of Ulsan highlights the eco-efficiency of municipal waste-management in terms of policy priority as well as cost saving. From this perspective, municipalities should prioritize measures to reduce waste generation because they significantly reduce environmental impact and costs.





Community-based decentralized solid waste management in Matale, Sri Lanka

Pro-poor and eco-efficient solid waste management



Waste is a resource with which local entrepreneurs and waste pickers earn income and local governments save costs.



About two-thirds of the waste in developing countries is organic and can be used for composting and biogas generation.

Technologies for treating waste need to be adapted to the local context, cheap to operate and suitable for local communities to manage and maintain.

Matale – City profile

• population	36,989
• administrative area (km ²)	8.6
• GDP per person (US\$)	5,026
• population density (persons/km ²)	415.5
• climate	tropical

INTRODUCTION

Matale is a medium-sized urban centre in central Sri Lanka, surrounded by large plantations and famous for its spice gardens. In addition to agriculture, the city's economic activities include tourism and trade. The city generates 21 tons (21,000 kg) of municipal waste per day, of which 17 tons are disposed at an open dumpsite. Although 20% of the Municipal Council's budget is spent on solid waste management, there is no city-wide collection, and households describe the service provided by the municipality as poor. According to the findings from a survey carried out by the NGO Sevanatha, Matale households listed unclean drains, poor waste management practices and sanitation as priority issues. The Municipal Council has thus prioritized creating a more cost-efficient solid waste management system that will also improve service to households.

Fortunately, the composition of the household waste in Matale is ideal for eco-efficient solutions: 70% of the waste is organic and can be used for composting and biogas generation, 10% is recyclable and can be sold after processing, and only 10% of the waste needs to be placed in a landfill. The

city is relatively small, and a decentralized approach that minimizes transportation is suitable, which further increases the eco-efficiency.

Since 2006, the solid waste management situation has improved in one ward of the city through a pilot project that the Matale municipal government, the Sevanatha Urban Resource Centre and ESCAP initiated. The pilot project was based on an approach developed by Waste Concern, an NGO from Bangladesh, to reduce government costs while providing a business opportunity for a local entrepreneur, improving services to households and managing waste in a more eco-efficient manner.

After the success of the pilot project, the Matale Municipal Council decided in 2010 it was a suitable option for treating all waste. With assistance from Waste Concern and ESCAP, the approach is being scaled up to treat 20 tons of waste per day, as part of a regional ESCAP project on pro-poor and sustainable solid waste management. It was initially co-financed by ESCAP, the Matale Municipal Council and the Sevanatha

Urban Resource Centre: ESCAP contributed seed funding and technical assistance, and the local government provided land and labour. The national Government funded the construction of an additional compost plant.

WHAT WAS DONE?

In 2006, the Matale Municipal Council, Sevanatha and ESCAP jointly piloted a Community-Based Decentralized Solid Waste Management Project to improve the service in one ward while reducing costs, producing economic outputs and minimizing the amount of waste that was sent to the landfill.

The partners established an Integrated Resource Recovery Centre (IRRC) in Gongawela ward to treat waste. The IRRC handles 2 tons of organic waste per day; since 2007, it has collected and composted segregated waste from about 600 households and small businesses in the ward, providing work to six waste pickers. The households have repeatedly expressed satisfaction with the service provided; in particular, the collection is now done door to door, daily and at advertised times.

The plant is located within the neighbourhood it serves and opposite the mayor's house. Due to its central location, transportation costs are kept low, and fruit and vegetable vendors operating in the area even bring their waste directly to the plant. The fact that the facility is located in the neighbourhood it serves also reduces the risk of contamination because transport distances are short. The

central location gives both the project and the facility a "centre of importance" image, an important factor in motivating households to separate their waste.

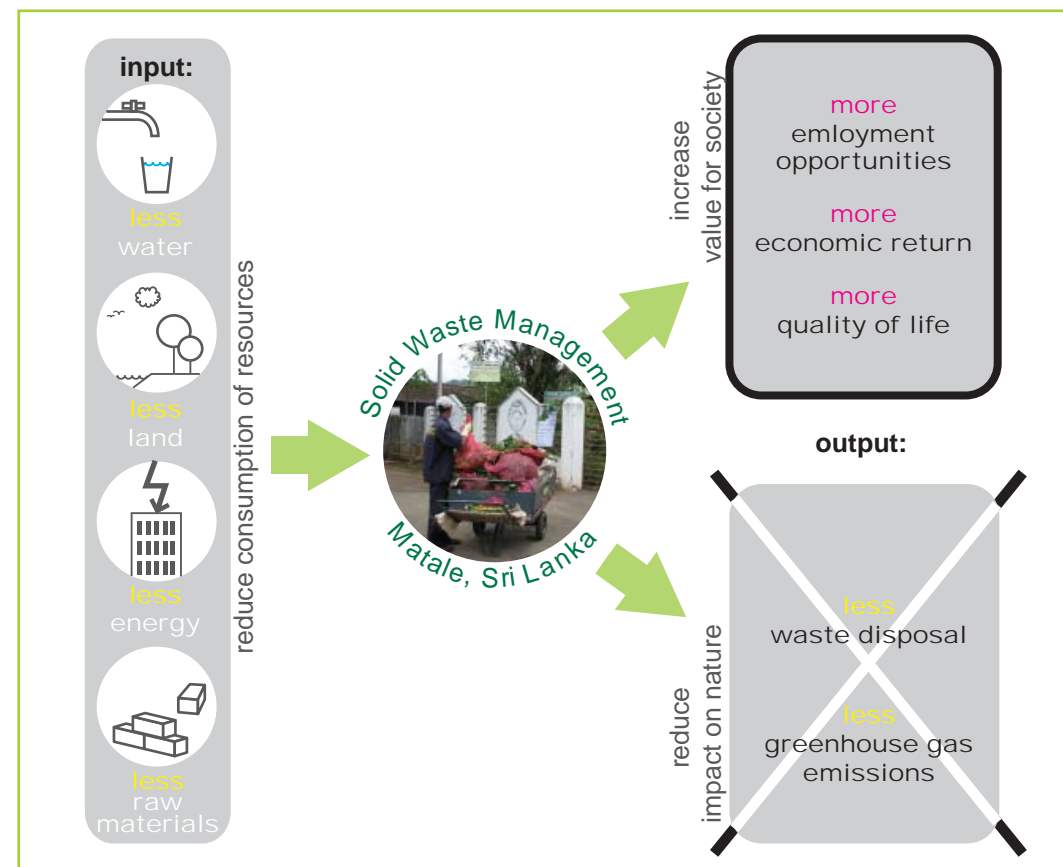
To improve waste separation practices from source, the community was involved; households were trained to separate waste into two bins, organic and inorganic. In addition, as the workers collect the waste from the households, they notice whether the waste is separated properly or not and discuss the situation with the residents. Because it is not possible to reach a 100% waste separation from households, waste is sorted one more time by the workers at the plant into organic waste, recyclables and rejects.

The IRRC produces high-quality compost using the aerated box method. It is comparatively cost-effective, using less land than other methods for composting, such as wind row, and with low construction costs. The technology is simple and non-mechanical, which makes it easy for staff to operate and maintain while keeping operation costs low. In comparison with more advanced technological compost technologies, there are minimal breakdowns and needs for repairs. The production period for compost is on average 90 days. Strict quality control is maintained, and the compost complies with numerous standards for certified organic compost.

To further reduce costs for the municipality by minimizing the rejects that need to be sent to the landfill, the IRRC also stores, processes and sells recyclables. Because the waste is sorted at household level, the recyclables are clean and have not been soiled by other waste, which increases their value. Additionally, by storing the recyclables and selling them in bulk at an appropriate time, the IRRC gets a higher price than if it sold them daily.

A challenge for Matale has been in establishing a market for the produced compost. Chemical fertilizers are subsidized, which distorts the market. However, an increasing interest for organic farming and an understanding among farmers of the added value of compost or organic fertilizers, together with a good reputation for the Matale compost, has helped increase sales. Other compost plants in Sri Lanka have not experienced any difficulties in selling their compost.

OUTCOMES AND SUCCESS FACTORS



The IRRC combines environmental and social benefits with a strong business approach that makes an ideal case in terms of sustainability. The environmental and health benefits from ensuring that waste is collected and treated appropriately are the most obvious advantage, but there are others:

Environmental benefits: reducing waste and green house gas emissions

The approach mitigates climate change by reducing methane emissions. When biodegradable waste is deposited in a landfill, it produces methane. Methane can either be captured or burned to produce energy through aerobic composting. Through source-segregation of waste, followed by reusing and recycling of materials and composting of organic waste, greenhouse gas emissions from the solid waste management sector are significantly reduced.

By minimizing the amount of waste that goes to the landfill, the approach also prolongs the life of the landfill, which saves costs for the municipality. Instead of transporting waste to the landfill site, situated outside the city, the waste is now treated in the community, thus reducing the pollution from transportation and saving transportation costs.

When the approach is scaled up to treat all of Matale's waste, the facilities will also have a biogas digester that treats meat and fish waste, which are difficult to compost. The biogas produced will be used for electricity generation or as cooking gas for nearby households. The IRRC illustrates how an urban problem (waste) can become a rural asset (compost/

fertilizer). Unlike chemical fertilizer, organic fertilizer turns organic matter to the soil, thereby replenishing it and reducing costs, the amount of fertilizer needed and the pollution from excess chemicals in the soil. By using an organic fertilizer, the amount of chemical fertilizer can be reduced yet still increase yields of farmers.

The IRRC is constructed to ensure a resource-efficient production of compost. For example, due to the high moisture content of the waste, a considerable amount of wastewater is generated during composting and the cleaning of the facility. Instead of discharging the wastewater into drains, it is collected in a small, covered storage tank below ground level. This stored wastewater is then reused for new compost piles to maintain the moisture balance, and it is also used to strengthen the decomposition process by mixing the wastewater with fresh water. Using this wastewater saves groundwater resources. The facility is also equipped with a rainwater-harvesting system that can reduce the need for groundwater and saves electricity that is otherwise needed to pump water from the ground.

Economic benefits: making a profit and creating jobs

The IRRC has now operated for three years without any support from ESCAP. In 2009, the local government built a second plant with funds from the central Government, which was recently handed over to Sevanatha to manage. Because the construction costs were low, it was possible for the municipality

to raise funds for a second plant locally.

The IRRC struggled to make a profit in the first years but has since improved its management and is now turning a profit on operational costs. The main challenge for ensuring the profitability was changing the mindset of all parties (municipality officials and operators) to a view that valued treating waste as a resource from which money could be made. The current collection of fees from households and the sales of compost almost cover the IRRC's operational costs.

Although the facility can break even on operational costs, to cover the investment costs when scaling up the approach, ESCAP will help the Municipal Council to access additional funding through a clean development mechanism (a flexible mechanism included in the Kyoto Protocol). Because the IRRC reduces greenhouse gas emissions using an approved methodology, it qualifies as a Clean Development Mechanism project under the Kyoto Protocol that also allows facilities to sell their carbon credits to developed countries for a profit.

Social benefits: employment opportunities and increased quality of life

The IRRC employs 6 workers from the waste-picker community. They are provided with uniforms, gloves, proper equipment and a clean working environment. In addition to their salary, the workers receive a bonus, based on their performance in motivating households to separate waste and increase compost production and sales. The workers have commented that through their job

they have acquired new skills and learned about new technologies. Those skills and their better working conditions have also improved their social status.

Other waste pickers in the city have also benefitted. The IRRC buys recyclables from them at a price that is transparent and often better than the price junk shops pay.

Success factors and lessons learned

The support and leadership of the Municipal Council of Matale in promoting the approach was of paramount importance. The municipality was willing to engage in a public-private partnership with an NGO, a partnership model that was uncommon in Sri Lanka. Further, the municipality supported the IRRC by providing workers, giving it a land concession and by collecting rejects from the plant. Their strong support for the approach also led to the construction of a second plant using the same approach, although with funds from a national solid waste management project.

The IRRC has demonstrated the importance of community participation and proven that it is possible to achieve a high degree of separation of waste at the household level. Sevanatha worked with the community through committee meetings and door-to-door trainings to promote waste separation; residents now obligingly separate. The project has also shown a willingness among residents to pay collection fees in exchange for good service.

Under a regional ESCAP project, the IRRC approach is being replicated and further

improved in ten cities in Asia; some facilities will include a biogas digester to treat meat and fish waste and produce biogas and convert used cooking oil into biodiesel. Depending on the local context, a single facility can process between 2 and 20 tons of waste a day, serving a population of 1,000-50,000 people.

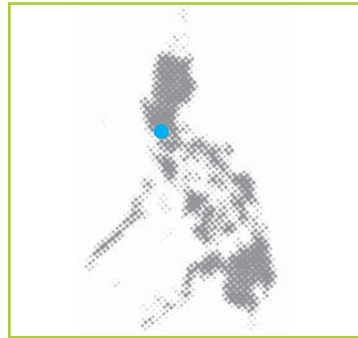
The partnership model will look different in various cities. In some cities, the model will be similar to the one in Matale, with a public-private partnership between the local government and an NGO. In other cities, the management may be with local government but the workers may operate the plant as a cooperative and receive the financial and social benefits.

An important lesson learned from the project in Matale and a similar project in Quy Nhon, Viet Nam, is that it is crucial to include waste pickers as the workers in the centre. In Viet Nam the management of the plant was given to an agricultural cooperative, and although the plant is making a profit and households are satisfied with the service, the amount of rejects is high because the workers, unlike the waste pickers, do not recognize valuable recyclables.

Another critical component for success is access to a market for compost. To maximize profits, a facility needs to sell its compost in bulk to large buyers. Long before a facility begins operating, a market for the compost and possible distribution channels should be established.



Local composting



Options for a pro-poor eco-settlement in Miraculous Hills Resettlement Site in Rodriguez, Philippines

Pro-poor eco-settlement

Poverty reduction and environmental sustainability cannot be treated as separate or even competing development goals; urban poor communities can and want to manage the development of their settlements.

➤ To implement inclusive and eco-efficient solutions at scale, they must be both demand driven and affordable for communities and governments. Holistic solutions should be implemented incrementally, focus on economically viable options that can generate income or lead to cost recovery or minimizing, and apply participatory planning and management arrangements that follow a longer-term shared vision.

➤ Urban poor communities need tailor-made approaches, such as collective management mechanisms and risk distribution, focused capacity development and start-up financing, to empower them to improve their living conditions and resilience. As a range of appropriate approaches with the potential to lift people out of poverty while minimizing negative environmental impact are emerging, urban poor communities should be empowered to implement them holistically to maximize synergies.

➤ Institutionalizing partnerships among local actors, such as governments, urban poor communities, the private sector, development practitioners, professionals and academics, is an effective way to find durable win-win solutions city-wide.

Rodriguez – city profile

• population	223,594
• administrative area (km ²)	313
• GDP per person (US\$)	3,300
• population density (persons/km ²)	714
• climate	tropical

INTRODUCTION

With a population jumping from 80,000 inhabitants in 1997 to 223,594 in 2007, Rodriguez municipality in Metro Manila is urbanizing rapidly, mainly due to various resettlement schemes for people affected by natural disasters. The population of San Isidro, the barangay (village) in which the Miraculous Hills resettlement site is located, is 28,614 persons. The resettlement site is on a small piece of land (0.3 km²) that the Payatas Scavengers Homeowners Association bought in 1998 by pooling community members' savings and taking a bridging loan from Caritas Manila.

The first residents of the resettlement were survivors of a massive trash slide, triggered by a typhoon in 2000, which crashed down upon a cluster of shacks. The survivors were resettled on a priority basis, using a compensation package from the dumpsite operators to partially finance the building of houses. As of 2011, around 280 families own a parcel of the land in the new settlement and are at various stages of repayment for the land and the building of their housing. However, the majority of the families still

live 26 km away, at the squatter settlement next to the Payatas dumpsite. They choose to stay there because of the lack of income opportunities and infrastructure at the resettlement site of Miraculous Hills. Only 50 families actually live in Miraculous Hills. To ensure that other families will move to the resettlement site, it is crucial to find and secure new income opportunities and develop basic services.

ESCAP saw this situation as an opportunity to explore solutions that demonstrate the marrying of development goals and eco-efficiency principles.

WHAT WAS DONE

ESCAP initiated action research to conceptualize and analyse the feasibility and modalities of an integrated approach to a pro-poor eco-settlement in urban and peri-urban areas of Asia. In Rodriguez, the pro-poor eco-settlement principles research merged environmentally sound and affordable options for site development, housing, infrastructure, services, livelihood provision and overall measures to enhance

resilience with participatory, community-led management. While operational at the settlement level, the approach aims to influence legal, institutional and policy frameworks at both the municipal and national levels.

The pro-poor eco-settlement approach takes on the goals of poverty alleviation and environmental sustainability in tandem. This approach starts with the idea that it can be done by identifying and incrementally applying a number of context-appropriate and linked practices that maximize synergies and win-win scenarios at the community and municipal levels. It is a cross-sector, participatory and bottom-up approach.

The pro-poor eco-settlement research was undertaken on two levels: ESCAP first organized normative and analytical research to develop a comprehensive pro-poor eco-settlement concept. Then the Homeless Peoples Federation of the Philippines, the NGO Philippine Action for Community-led Shelter Initiatives, the Payatas Scavengers Homeowners Association and ESCAP worked together to test pro-poor eco-settlement research methods for addressing needs and priorities of urban communities through demand-driven practice in the Miraculous Hills resettlement site.

The Miraculous Hills resettlement site was chosen for the pro-poor eco-settlement action research because of its:

- **Stage of development and “typical” challenges**

Most Payatas Scavengers Homeowners Association members were enduring multiple challenges and barriers to resettling, such as lack of income opportunities near the site, lack of infrastructure and amenities, difficulties in paying for their land and taking on additional housing and infrastructure loans as well as the site’s ongoing risk of landslide.

- **Participatory approach to community development**

The Payatas Scavengers Homeowners Association has a strong and proven community organization and functions as a driving force for the resettlement process at Miraculous Hills.

- **Location**

The local government faces significant challenges in trying to accommodate a rapid population influx. Decisions on how the settlements of the urban poor and wealthier new residents are planned, built, organized and integrated will influence the well-being of communities and the environment in the whole area.

- **Anticipated demonstration and dissemination effects**

The Homeless Peoples Federation of the Philippines has developed a country-wide network of community organizations engaged in people-led development over the past two decades. They are supported by the Philippine Action for Community-led Shelter Initiatives that facilitates communities’ interaction with professionals and other development partners and leverages funds. Both organizations have close links to other national and regional networks of urban poor

communities and the urban development community. Such links indicate the group can be instrumental in spreading pro-poor eco-settlement principles, approaches and practices throughout the Philippines and across the region.

- **Principles of the pro-poor eco-settlement approach**

The pro-poor eco-settlement approach is demand-driven, taking the needs and priorities of urban poor communities as the starting point. After an initial scoping of challenges and needs with the community, the approach raises a community’s awareness and knowledge of causes and impacts of environmental degradation and starts to develop sets of tailor-made “synergetic solutions” or “virtuous circles” that would enable the community to meet its priority needs using environmentally sound and appropriate technologies, designs and practices.

Many priority needs, such as site development, water and sanitation, energy provision, reduction of indoor and outdoor pollution, housing and certain livelihoods, are directly linked to environmental issues. Other needs, such as additional, diversified or more secure income generation, can be taken care of by applying environmentally sound practices as part of the synergetic scenarios. Community members (facilitated by professionals, such as engineers, architects, social and business researchers, NGO staff and local government officers) are encouraged to analyse the status quo of their communities and to research linked solutions.

As community members’ understanding of the linked poverty and environment-related challenges and opportunities increase throughout the research, they are encouraged to develop a vision for the incremental but holistic development of their settlement. They then create a strategic plan that focuses on implementing the most needed and most easily achievable good practices by first connecting them within “synergetic systems” over time.

The beauty of the approach is to empower communities to sustainably manage these systems either by themselves or in partnership with local government and other local business and civil society entities and to catalyse a dynamic that encourages them to continue to search for and experiment with new practices to improve their lives and settlements.

The pro-poor eco-settlement action research was divided into four parts, which:

1. Described and analysed the status quo of the resettlement site, focusing on physical and technical aspects of site development, housing, infrastructure, economic issues, livelihood aspects, environmental risk assessment, health concerns, organizational and institutional aspects and on the wider municipal context.
2. Researched and analysed various relevant pro-poor and eco-efficient options for housing, infrastructure, services, livelihood provision, environmental risk reduction and other resilience measures, taking into account technical feasibility, legal and

regulatory issues, local markets, financing options, management modalities and skills requirements.

3. Proposed “synergetic development scenarios”, which are combinations and adaptations of the feasible options researched under point 2 and which, through their integration, maximize synergies and win-win solutions.

4. Developed an overall vision, implementing strategy and community action plan, based on the research recommendations from points 1-3.

The research modalities for the first part included quantitative and qualitative data collection and analysis through onsite observations, onsite rapid participatory appraisals, technical measurements, a socio-economic census of the Payatas Scavengers Homeowners Association members, including questionnaires (to determine people’s awareness, attitudes and behaviour related to environmental and health aspects), food diaries, focus group and workshop discussions and individual interviews.

Research modalities for the second part involved desk research and field visits undertaken by the subcommittees of a research consortium (see explanation in the next section) and the Payatas Scavengers Homeowners Association members to learn of good practices elsewhere.

The synergetic scenarios were then written up within the research consortium by grouping issues and feasible solutions that

had been identified for priority interventions. Three main synergetic scenarios were created (page 173). The primary functions of the scenarios is to articulate and discuss possible synergies, to disseminate the idea of integrated solutions to the wider community and to initiate discussion about how to implement the different parts of the overall vision for Miraculous Hills as a pro-poor eco-settlement. The first activities included planting shrubs and trees as a guard against erosion and setting up a rainwater-harvesting system for the community centre.

The fourth part of the research took place in stages, starting with a general assembly (September 2010) and ending (for this phase of the action research) with a “visioning” workshop for the Payatas Scavengers Homeowners Association leaders (May 2011). Concepts, good practices and their feasibility were discussed with members when undertaking the community survey, in separate focus groups for men, women and children. An agreement was established on a five-year strategy to turn Miraculous Hills into a pro-poor eco-settlement by implementing the feasible parts of the synergetic development scenarios and by integrating pro-poor eco-settlement principles in all their other development activities – including the building of housing.

How and by whom

To motivate people to drive their own development, they need to be able to identify their status quo, challenges and opportunities, decide on priority needs and research options on how to meet those needs holistically. To facilitate and maximize such awareness raising and skills and enable the community to take ownership of their pro-poor eco-settlement development, the action research followed four principles:

1. Participatory and people-centred

All the activities promoted learning by doing and offered demand-driven training. Decision making on the types and pace of interventions was left in the hands of community members. This was achieved by establishing a research consortium consisting of around 40 persons in 6 subcommittees, including partners and consultants. The entire community and representatives from the local government were kept informed throughout the research and participated by providing information and ideas.

2. Trans-disciplinary

Although the research was divided among the subcommittees, consortium meetings were organized every two weeks for research planning, problem analysis and scenario development for maximizing the cross-pollinating of ideas and solutions across sectors and dimensions.

3. Gender sensitive

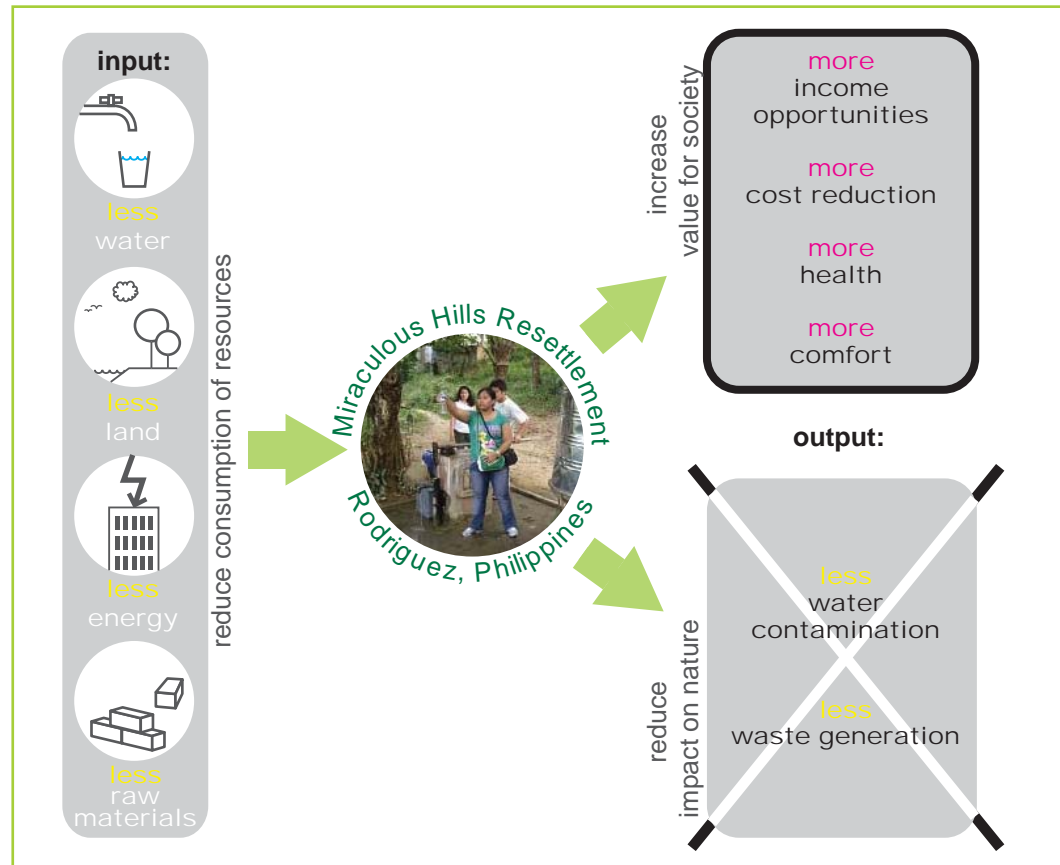
The researchers collected sex-disaggregated data and analysed gender-specific opportunities, challenges and vulnerabilities. As a result, development options were recommended that provided equitable opportunities for men and women, girls and boys, such as those that focus on supporting female-headed households and that further strengthen women’s roles in the community.

4. Merge aspects of poverty reduction and eco-efficiency

The research focused on solutions that, at the minimum, were affordable to community members but ideally also a tool for income generation – while minimizing the strain on the environment and improving the living conditions and resilience of the community.



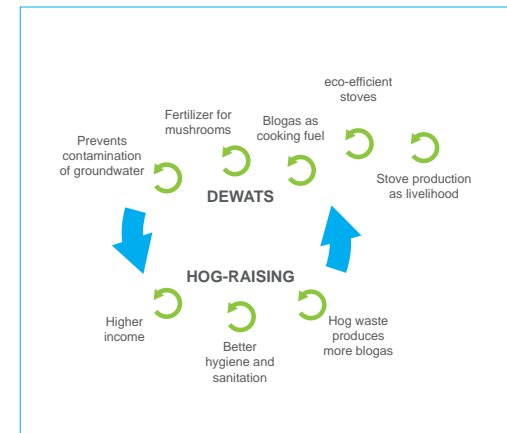
OUTCOMES AND SUCCESS FACTORS



The action research developed a series of custom-made and still evolving synergetic scenarios that each links a number of solutions to several challenges the community is facing - creating co-benefits and value-added outcomes for poverty reduction and environmental sustainability. Through these scenarios, the community has started to share a common vision of what they want their settlement to look like and what kind of activities and possibilities

they want within their settlement. In a final visioning workshop, the Payatas Scavengers Homeowners Association leaders decided that they would like to become a pioneering community as a fully settled pro-poor eco-settlement within the next five years.

The following are the three synergetic development scenarios the research and consortium members produced:

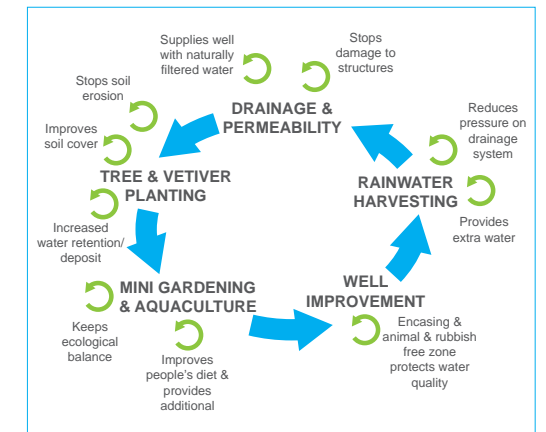


Scenario 1

The research found that water from the community well was not fit for drinking, likely due to inadequate sanitation (pit latrines with waste seeping directly into the ground) and the raising of pigs in and near people's housing without adequate waste management. Community members also used either wood (cutting down trees in the vicinity, thus increasing the danger of landslides and flooding) or rubbish (high indoor pollution) as cooking fuel because they could not afford alternatives.

The consortium members agreed a decentralized sanitation system would address the challenges. This system will include a biogas digester, with the biogas used as cooking fuel. Because the cooking gas will not be enough for everyone and difficult to deliver to all households, the community proposed to set up a public kitchen. The area for that public kitchen will also serve as a multipurpose green space for cooking and looking after children. They proposed to introduce composting to the

community and co-compost the slurry from the biogas digester to fertilize mushrooms that the community plans to grow. Originally they proposed to shift all pigs into one pig sty next to the biogas digester and direct all pig waste into it to produce more biogas. However, subsequent analysis suggested that the identified location for the pigsty would endanger the water supply further; after rethinking possibilities, they proposed to consider a second biogas digester linked to the pigsty on the other side of the settlement later on.

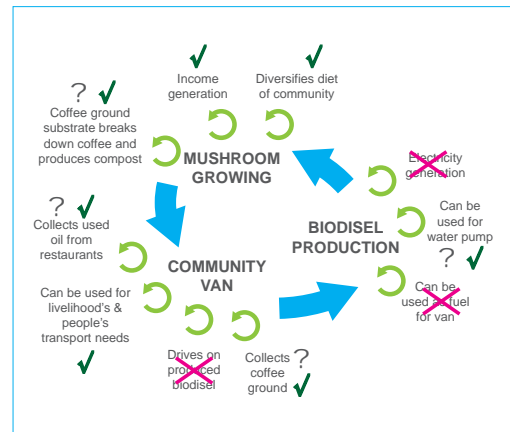


Scenario 2

The resettlement site is located on steep slopes and the community has experienced land erosion and strong water run-offs during and after storms, with temporary flooding of lower parts of the settlement. Most of the settlement does not have drainage, and the existing drainage does not follow the natural inclination of the land and is partially choked up. Needing cooking fuel and not aware of how it exacerbated problems, households have been cutting down trees.

At the same time, the community does not have enough water during the dry season or even throughout the year and has to collect water from wells with manually operated pumps. The research also pointed out that people endure significant food insecurity and unhealthy diets throughout the year.

The options proposed and linked in Scenario 2 mainly diminish the risk of stormwater flooding and land erosion. The drainage channels will be covered with slats that have holes to maximize the rain and stormwater catchment, while walkways (where safe) will be made from permeable materials to let water seep through (and be naturally filtered before entering the well). Planting trees and vetiver grass will decrease risk of land erosion, while the tree foliage will also absorb much of the rain. The trees will be fruit bearing, serving to improve nutrition and as an additional income source. Near the housing, the tree shade will also cool down indoor temperature. The rainwater harvesting will mean less stormwater runs into the drains and that households will have a more ready water supply. Part of it will be directed into the kitchens or collected just outside the house, while another part will be collected at the bottom of the hill and then pumped up to the community centre, where it will be stored in tanks to be distributed to households. It will also serve as emergency water storage in case of a disaster. The water pumped to the houses, in turn, will be used to water vertical and barrel gardens on house walls and in the spaces just outside people's doors.



Scenario 3

One of the main resettlement challenges for the community members is the lack of income opportunities at the new location and lack of schools, markets and social support networks. Transportation from and to Rodriguez is very costly, given that many community members earn around US\$4-\$5 a day or less.

Taking a good practice from California, where mushrooms are grown with used coffee grounds and then sold to gourmet restaurants, as the starting point, Scenario 3 proposes collecting used cooking oil from restaurants when delivering mushrooms; then that oil will be converted into biodiesel in the community. The initial plan was to use the biodiesel to fuel a community van as well as other appliances (mainly slow engines), such as a water pump for the now manually operated well or, in emergency cases, provide electricity via a generator. However, further research showed that used cooking oil was not a free waste product but is sold to the urban poor for cooking even though

it is carcinogenic; additionally, biodiesel can harm a van engine. Also, the community found the process of making biodiesel too complicated and worried about their safety.

The community identified mushroom growing as a very appropriate additional livelihood opportunity with low initial capital investment; several members have already been trained on mushroom growing. The proposed community van is regarded as a wonderful opportunity for multiple uses.

Another part of the action research focused on alternative building materials and technologies for the community's housing but also as potential livelihood sources. Several materials were identified that are currently being analysed for their green and pro-poor credential through a life-cycle method; the possible employment opportunities for community members in their production, distribution and construction processes are also being explored. Among the identified materials are panels produced from coconut husk (a waste product) and pressed roofing made from bamboo. The community plans to build the mushroom shed out of such renewable materials to demonstrate their appropriateness and to overcome the scepticism of some community members.

Success factors and way forward

Challenges mainly relate to the cooperation between actors with different time frames, backgrounds, knowledge and attitudes as well as based in different locations. To ensure good cooperation, understanding

and progress, it proved to be important that concepts were popularized using everyday language, posters, pictures and videos and discussing different concepts at length. Field visits and hands-on demonstrations and training were important tools that helped people find concrete ideas and examples that were inspiring.

The Homeless Peoples Federation of the Philippines has started to introduce the pro-poor eco-settlement principles not only in Miraculous Hills but also in other new developments. The federation members now pay much more attention to: i) establishing green and open spaces for environmental risk reduction and improved liveability in their communities, ii) the types of materials, designs and approaches they consider for their housing and settlement infrastructure, iii) income-generating opportunities and iv) building people's resilience through such measures as community-initiated micro-insurance.

In the words of Ruby Papeleras, Luzon coordinator of the Homeless Peoples Federation of the Philippines: "We started out with wanting to build houses for us and other communities, but now we see that we need to build places where people can live and work, and this includes much more than houses... It means balanced site planning that can make all aspects of poor people's lives sustainable, including houses but also green spaces and places where people can meet. And it means planning it all in a way that the community is safe from disasters."



Eco-efficient urban freight transport and public wholesale markets in Nagoya, Japan

Urban freight and logistics



Urban freight is often overlooked but holds significant potential for improving the eco-efficiency of an urban transport system.

Urban freight is necessary to deliver goods and services – it should be orchestrated as efficient as possible.

Many interventions to improve the eco-efficiency of urban freight transport are easy to implement.

Nagoya – City profile

• population	2,258,804
• administrative area (km ²)	326
• GDP per capita (US\$)	41000
• population density (person/km ²)	6,919
• climate	continental

INTRODUCTION

The demand for urban freight transport arises because of the need to move items from sources of production to areas of consumption. However, the volume of transport required has created a moving target of tension between economic and environmental objectives. Some countries have been experimenting with alternatives to reduce the tension and deliver goods to consumers in ways that reduce the level of freight transport but do not increase the costs of production. What is clear is that local governments can influence private sector behaviour. This approach begins with changing policies on urban freight transport.

WHAT WAS DONE

In Nagoya, Japan, the city government set up a transport service within each of its three wholesale food markets to reduce the number of vehicles and trips.

Facilities

In Nagoya, there are three wholesale markets for the food industry. One is located in central Nagoya and is the oldest facility, dating to 1949. Another one, situated in the northern part of the city, was previously a

market and due to increased demand moved to its current location and has served as a wholesale market for fresh food since 1985. The third is located in the southern part of Nagoya. Similarly, it was previously a market and moved to its current location in 2007 in response to an increased demand for meat products. In 1949, a central wholesale market was formally opened in Nagoya. During its operation, many buildings and facilities were sequentially established; the law and regulations were revised to ensure proper operations of the markets.

The Nagoya central wholesale market has an area of approximately 170,000 m². The market is located at the city centre and accessible by road, rail and subway and is equipped with warehouses, refrigerated rooms and parking. The main goods traded are fresh (fish, fruits, vegetables, meats) and processed foods. The market has two types of wholesalers: 6 companies are first-level wholesalers and 134 companies are second-level wholesalers.

The Nagoya north wholesale market has an area of approximately 130,000 m². The market is located 6 km from the city centre, close to the domestic airport and accessible by main roads. It is equipped with warehouses, refrigerated rooms and parking. The main goods traded are fresh food (fish, fruits and vegetables). The market has two types of wholesalers: three companies are first-level wholesalers and 96 companies are second-level wholesalers.

The Nagoya south wholesale market has an area of approximately 61,000 m². The market is located 4 km from the city centre and is accessible by main roads. It is equipped with warehouses, refrigerated rooms and parking. Only meat products are sold here. The market is operated by only one wholesaler of meat products.

Operation

The city government oversees the running of all three markets. In each of the three wholesale markets, two to three large wholesalers acquire fresh products from the local area, the rest of Japan and overseas. The products are transferred to the market early every morning and these large wholesalers start bidding to sell their products to the smaller wholesalers – the second-level wholesalers. The products are then transferred to the second-level wholesalers who deliver the products to their customers (who can be other fresh food markets, supermarkets or local shops). The deliveries are done by the wholesalers or by a transport operator located also in each market.

The Nagoya Central Wholesale Market Operation Council and the Nagoya Central Wholesale Market Trade Committee oversee the operations of the markets. The operation council members consist of city government officials, university experts, consumer association representatives and representatives from the wholesale market associations of the three markets. This council conducts investigations related to market operations and reports to the city mayor. The trade committee members (similar as the operation council with local government officials, university experts, small and medium enterprise experts, consumer association representatives and representatives from several enterprise associations, such as the Nagoya Association of Wholesalers of Fruits and Vegetables). That committee provides a guideline for trade and exchanges and also advises the city mayor.

Financing and organization

The facilities are public-private partnerships because they are subsidized and organizing by the local government. The wholesale markets are directly run by the local government through management and business management sections in each location. These sections guide the everyday activities, including transactions and price setting, as well as inspecting the goods sold and maintaining statistics.

Outcome

The Nagoya Central Wholesale Market Operation Council has successfully reduced the number of truck trips and operating

vehicles because the links between suppliers (whether they are from the local area, national or overseas operators) and the large wholesalers are also located in the market. In addition, there is no need for transport vehicles between the large wholesalers and the second-level wholesalers located within the same wholesale market. This kind of freight centre is very promising if the public sector focuses sufficiently on the competitiveness of the transport operators active in the market.

Based on a survey of the delivery situation in the Nagoya central wholesale market, about 40% of companies still use their own trucks for delivery. Those companies prefer having their own trucks and use the transport service when they have a shortage of workers or trucks. Expensive fees for delivery services are one of the main reasons why companies prefer to have their own trucks. There is a need to address competitiveness of transport operators. When there is only a single transport operator for everyone in the market, this clearly reduces the competitiveness of the transportation offered and leads to a situation in which the companies prefer to run their own trucks rather than to use the provided transport operator.

Tackling the urban freight burden

The main challenge to reducing the impact of the heavy volume of transporting goods is to prioritize the “right” policies. If we want to promote eco-efficiency outcomes, we need to promote its broad objectives: i) reduce the consumption of resources and ii) the impact

on nature and iii) increase the value for society. Local governments can take these broad eco-efficiency objectives as a basis to ensure that socio-economic development and environmental sustainability are represented in their own city objectives. By doing so, they open up a considerable scope for win-win policies. Practical criteria, related to local conditions, such as budget, time, capacity and local support need to be considered as well.

Policy instruments

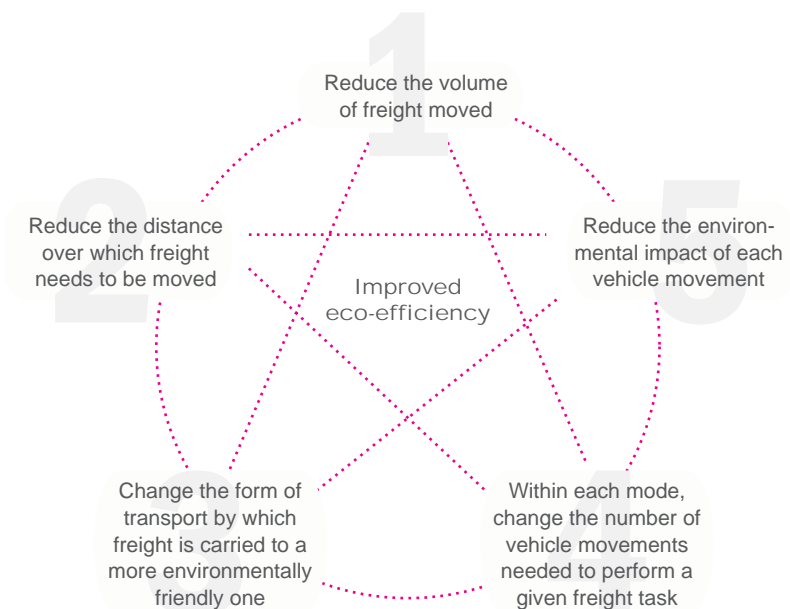
To select effective urban freight policies, it is important to understand how local governments can influence private sector behaviour. There are a number of ways in which the range of policy instruments available to governments can be classified. Important categories include at least i) regulations, which include physical norms and standards (vehicle standards and limitations on access), and ii) economic or fiscal instruments, which include governmental expenditure (including subsidies, grants, loans) and taxation (including pricing, fees). Local governments can also softly persuade the private sector and general public through public awareness campaigns, education and information dissemination or facilitate innovative technologies (cleaner technologies, end-of-pipe control devices, cleaner production). Planning tools, including zoning and design, can be used to influence transport distances. Planning tools overlap with regulations (planning laws).

Available instruments

PLANNING INSTRUMENTS	REGULATORY INSTRUMENTS	ECONOMIC INSTRUMENTS	INFORMATION INSTRUMENTS	TECHNOLOGICAL INSTRUMENTS
Land use planning (including zoning and design)	Physical norms and standards (rules and restrictions)	Government expenditure (including subsidies, grants, loans) and taxation (including pricing and fees)	Public awareness campaigns, education and information dissemination	Cleaner technologies, end-of-pipe control devices, cleaner production

Responses to the challenge

The concept of “attack points” is used as a way of structuring possible responses to the challenge of accommodating a rapidly increasing freight task in a socially and environmentally acceptable way.



Attack point 1: REDUCING THE VOLUME OF FREIGHT MOVED

POLICY DIRECTION	SUPPORTING MEASURES
Decouple economic growth from material consumption	Attitudinal change programmes Industry policy Differential taxation of goods and services
Reduce “consequential” freight movements (inefficiency, with a truck not full or empty when it returns)	Mandating responsibility for reverse logistics Regulation of packaging practice
Increase life of products	Attitude-change campaigns Levies of waste disposal

Attack point 2: REDUCING TRANSPORT DISTANCES

POLICY DIRECTION	SUPPORTING MEASURES
Allocate production and distribution activities	Integrate transport, logistics and production activities Urban planning and zoning Release of public land Tax incentives for specific-location decisions
Local purchasing policies	Awareness campaigns (“food miles” or the impact of imported food) Government purchasing rules “Buy local” campaigns
Increase urban densities	Land-use planning policies Public transport development

Attack point 3: CHANGING TRANSPORT MODE

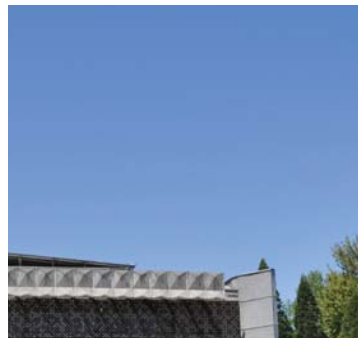
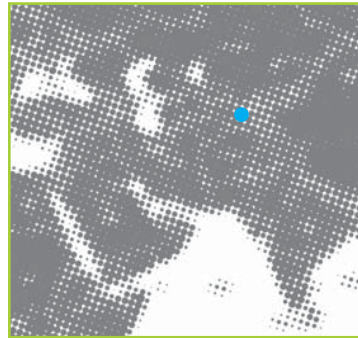
POLICY DIRECTION	SUPPORTING MEASURES
Greater use of rail	Improved rail infrastructure Intermodal terminal development Increase competition in rail operations Road pricing
Increasing use of water transport	Improve land transport access to ports Reduce cargo handling costs Increase cargo security Provide dedicated port facilities for barges and coastal shipping

Attack point 4: REDUCING THE NUMBER OF TRIPS

POLICY DIRECTION	SUPPORTING MEASURES
Increase load-carrying capacity of individual vehicles	Improve road and rail infrastructure Less-restrictive mass limits on designated freight routes Performance-based standards
Improve load to capacity ratios	Road pricing Access privileges Improve information flows
Change logistics systems that generate excessive vehicle movements	Road pricing Fuel taxes Foster information flows Encourage industry consolidation

Attack point 5: REDUCING THE IMPACT OF EACH TRIP

POLICY DIRECTION	SUPPORTING MEASURES
Switch to more environmental-friendly energy sources	Research and development support Differential levels of fuel taxation Access privileges Subsidies or tax concessions for electric or hybrid vehicles Public sector purchasing policies
Pursue fuel efficiencies and reduce emissions through improved vehicle design and maintenance	Design rules and registration requirements Differential road pricing Access privileges Stricter enforcement of emissions standards
Improve driving practices	Information dissemination Real-time performance monitoring technologies Driver-training programmes
Create better operating conditions	Infrastructure investment Intelligent transport systems Traffic segregation Time-of-day pricing



Green Building Initiative in Dushanbe, Tajikistan

Promoting energy-efficiency in public buildings through “retrofitting and design”

A broad compendium of small to major changes in new and existing buildings can generate considerable savings of money and energy.

- ↘ National energy-reduction policies can be driven by social and economic objectives.
- ↘ Energy-efficiency measures in buildings prove to be cost-effective while generating large socio-economic benefits.

Dushanbe – City profile

• population	722,594
• administrative area (km ²)	115
• GDP per capita (US\$)	2,189
• population density (person/km ²)	6,284
• climate	continental

INTRODUCTION

Dushanbe is the capital city of Tajikistan, a central Asian country that gained independence during the break-up of the Soviet Union in 1991. Economic conditions are fragile in this landlocked country, where mountain ranges occupy 93% of the surface. The country has great hydropower potential and is home to the hydroelectric power station Nurek, with the world's highest dam. The country is also endowed with oil, gas and coal resources, although limited.

However, since its independence, the country has struggled with energy-supply problems almost eight months of the year. Despite its great hydropower potential, projects aren't taking off due to high initial investment costs and long payback times. Currently, the energy-related problems have been compounded by abnormally cold and long winters.

Dushanbe is also Tajikistan's largest city and is thus the biggest consumer of energy, mainly due to heating and lighting demands in buildings. Around 16% of electricity is produced by thermal power plants. But growing demands for energy, due to the

cold winters and fast urbanization (internal immigration), often resulting in overloaded substations and grid failures that leave consumers without electricity. Along with production deficiencies, Tajikistan experiences enormous energy losses due to inefficient heating systems in buildings. These energy problems have a direct negative effect on the country's economic development, basic service delivery and environmental sustainability. Thus it has been of particular importance that Tajikistan finds a way to supply energy to buildings in an efficient and reliable way.

While the country's contribution to global climate change is insignificant, the government recognizes the negative consequences and the importance of the problem and is taking an active part in international efforts to address the issue. The government has identified two main targets for improvement in the energy sector: first, the domestic energy sector, including reform of pricing policies and financial discipline as well as welfare reform and institutional reform; second, its export market. Buildings are crucial in energy-saving targets because

they consume a large part of the produced energy.

The main objectives of Tajikistan's energy-related policies are:

- Reliability and quality of the energy supply must meet the growing needs of all residents and businesses and the energy resources must improve the energy security of the country.
- Protect the environment and population from harmful impacts of activities in the energy sector.
- Create the necessary conditions for a consistent transition of the energy sector to a market economy, attracting domestic and foreign investment, establishing economic independence of energy enterprises and ensuring their development through market competition.
- Improve the efficiency of the fuel and energy sector through the introduction of advanced technologies, energy efficiency and reduced cost per unit of energy in the production of the gross national product.

The necessity of solving problems in Dushanbe was determined by several factors:

- 90% of the buildings did not meet modern requirements for thermal protection
- lack of energy resources
- lack of liquid and gaseous fuels
- low awareness of energy consumers
- low tariff for electricity
- power supply infrastructure did not meet the conditions of market relations.

WHAT WAS DONE

Energy efficiency as a priority

Building regulations are the most effective tool to encourage energy efficiency of buildings, providing increased comfort to residents and reducing energy costs. Currently, Tajikistan is in the process of creating a regulatory framework for the design of buildings for different functional purposes. These construction codes specify requirements for thermal protection of buildings to save energy while ensuring sanitary and optimal parameters of indoor climate and the durability of the envelopes of buildings and other structures.

Energy efficiency policies can contribute to achieving the main objectives by meeting growing demands for energy and reducing impacts on the environment and energy independence.

A set of priority measures were identified to improve energy efficiency in the construction sector, including:

- introduction of energy-efficiency standards in building regulations, which set minimum standards for all new buildings
- introduction of energy certification of buildings in the design phase
- construction of buildings with high energy efficiency or with the use of a very small or zero share of useful energy
- retrofitting of existing buildings to save energy loss, such as insulating wall structures, sealing inter-panel seams, insulating attics, basements, insulating heating pipes and the hot water supply, and the reconstruction and

glazing of entranceways

- energy-efficient appliances for lighting that:
 - increase the use of sunlight
 - optimize the lighting design levels
 - use automated intelligent lighting-control systems
 - use more efficient lighting equipment.

WHAT MORE COULD BE DONE

Tajikistan (specifically Dushanbe) can solve many problems through energy-efficiency measures that will secure the supply of energy and make the city's growth more sustainable. In the process Tajikistan can achieve significant results in achieving energy independence.

Various methodologies could be used to enhance the energy-efficiency performance of buildings in Dushanbe. Public and residential buildings have shown a high level of energy loss due to the poor thermal insulation walling and heating systems. Estimates indicate that reductions of energy losses in electrical networks could be increased by up to 30%, while energy consumption in public and private buildings can be brought down by 50%. This can be achieved through intensive energy-saving measures and technologies, such as thermal insulation, building materials with reflective coating and multiple glazing, passive use of solar energy, high-performance artificial lighting, energy-saving household appliances, ventilating and cooling systems with a high level of efficiency and solar water heaters.

The energy-saving measures stipulate a transition from a situation in which the target of energy-supplying entities was to sell as much energy as possible to a situation in which the target becomes the provision of energy services to customers.

How to implement

In terms of structural and spatial design, technical state and functional performance, the existing housing stock in Dushanbe is very diverse. Due to this heterogeneity and cold climate conditions, specific techniques and tools are appropriate to improve the microclimate and thermal protection and to:

- create projects and construction of energy-efficient buildings
- develop and introduce energy-efficient systems for utility services provision
- develop and implement measures to upgrade the thermal insulation of buildings and facilities
- use alternative and renewable sources of energy
- improve the regulatory and legislative frameworks
- inform and train people on how to save energy
- create incentives for the population to ensure large-scale implementation of energy-saving measures.

Usually techniques and tools focus on energy-efficiency targets in the design and construction phase of buildings, while 95% of non-productive losses in heating occur during the operation phase of buildings. Hence, energy-saving measures should focus

on the existing building stock because this is where most of the targets can be met.

Energy conservation in buildings: To achieve energy efficiency targets, the main activities should be directed to:

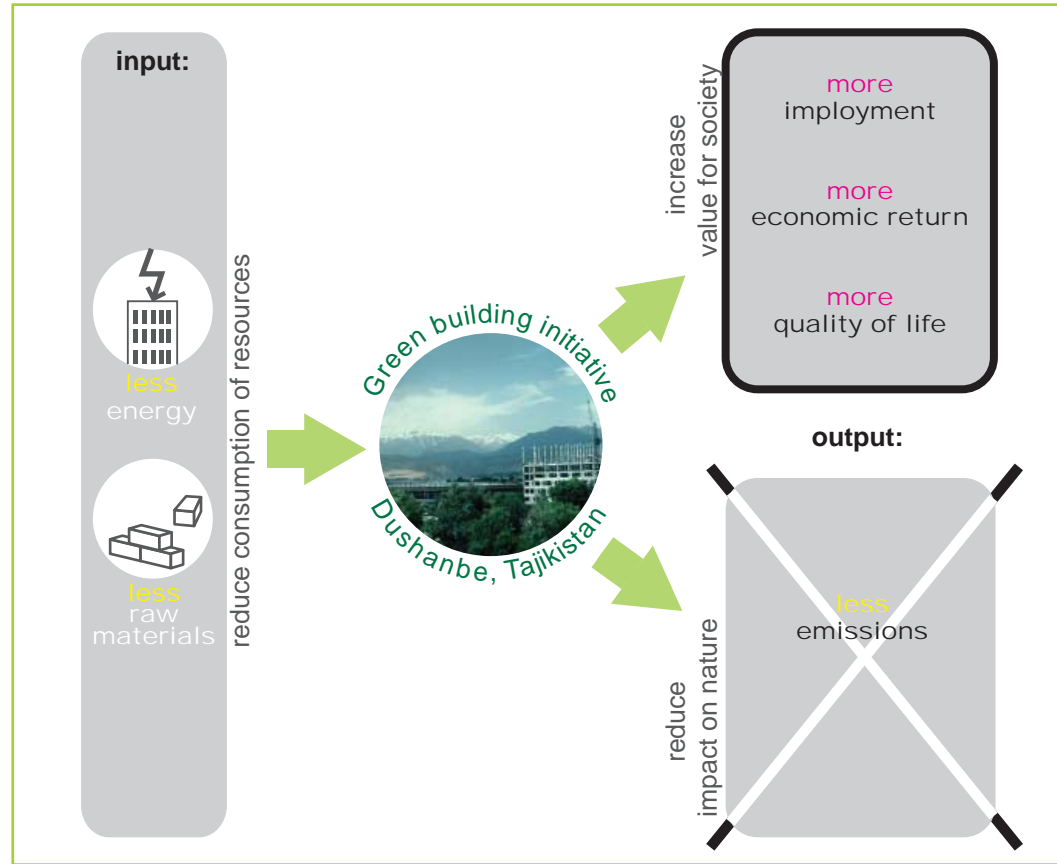
- establishing a state energy conservation entity to address the issue of reducing the consumption of energy resources and achieve better economic feasibility
- adopting sector programmes directed at reducing specific consumption of fuel and energy resources and establishing effective controls to ensure their implementation and effectiveness of energy conservation
- expanding the use of instruments and automatic systems of accounting, control and regulation of thermal systems, fuel and energy

- rationalizing space-planning and design decisions of buildings and their correct orientation to avoid excessive heat gain or loss; developing and implementing energy-efficient walls by using high-quality thermal insulation materials; and providing a high level of thermal protection in buildings
- adding insulation to external walls with effective thermal insulation materials, with a preliminary determination of economic feasibility, based on the energy certification of housing, regardless of the ownership
- improving the regulatory and legal frameworks of the energy supply
- providing information and training on energy efficiency in the operation of buildings
- creating incentives to ensure the implementing of energy saving measures.



Dushanbe, Tajikistan

PROJECTED OUTCOMES AND WAY FORWARD



As part of the case study, a methodological framework was developed to qualitatively evaluate the eco-efficiency of the proposed programme. Economic, social and environmental impacts of energy-saving measures were assessed, using a RET screen software program. The software was used to evaluate energy production and conservation, costs over the life of equipment, finance and various kinds of risks in the use of energy-efficient technologies and technologies for renewable energy sources.

Business case

This study on energy-saving measures in nine-storey buildings (360 units) in Dushanbe reveals a clear business case for green buildings. These buildings can provide savings of up to 44.7 million kWh of energy per year, which is equivalent to saving US\$900,000. The payback time of thermal insulation for wall structures is four years while its lifetime is more than 20 years, making such an investment a clear business opportunity.

The potential for energy saving in Dushanbe is estimated to be 30-50 of the total energy consumption, or 480-800 million kWh of energy per year. Improving the thermal insulation of building envelopes in Dushanbe alone can reduce power consumption from 2,300 kWh per person per year to 1,610 kWh.

Socio-economic and environmental improvements

The large-scale introduction of energy efficiency improvement measures for residential buildings not only reduces energy consumption but also helps to improve the socio-economic situation of homeowners through the reduction of costs and health improvements. Moreover, energy efficiency reduces the impact on the environment in terms of emissions and is a big step towards energy independence.

Measures and results for reducing energy consumption in the buildings of Dushanbe

MEASURES	ENERGY SAVING [%]
Make clear to people the idea of necessity to use energy economically, improve the energy-supply system of buildings, improve the quality of construction	6-8
Rehabilitate existing buildings and heating systems	10-15
Use of non-traditional sources of energy for heating, such as heat of solar radiation	14-17
Improve heating and ventilation systems efficiency	
a) use automatic system for heat supply regulation, on the base of И-BT	20-30
b) use ventilated air heat	10-12
c) use thermostatic regulation of heat supply	10-15
Develop windows, walls and covers with higher thermal protection factors	8-12
Improve lighting-system construction and use the artificial and natural light for heating	6-8
Improve industrialized construction of apartment modules	8-10
Upgrade standards, theoretical bases and calculation methods	6-8



Improving planning processes in La Serena - Coquimbo, Chile

Eco-efficient urban transport system

Governments can reduce infrastructure investment, operation costs and emissions-to-air by improving the planning processes for their transport systems.

- Infrastructure design and performance can be improved through a planning simulation exercise that estimates and measures demand.
- Using simulation exercises, costs and emissions can be predicted for different infrastructure systems, including modes of transport.

Coquimbo – City profile

• population	417, 351
• administrative area (km ²)	107.41
• GDP per capita (US\$)	14,700
• population density (person/km ²)	3,900
• climate	temperate

INTRODUCTION

La Serena-Coquimbo is a fast-growing urban cluster located in Elqui province in Chile's Coquimbo region. The cities of La Serena and Coquimbo each followed different geographic development patterns through their histories, until the mid 1990s when they merged into one conurbation (metropolis). La Serena developed itself as a commercial centre, focused on tourism, while Coquimbo's main activities have involved port activities, with a more recent emphasis on tourism. Both cities have an important role in the collection and distribution of agricultural products because of their strategic position and port accessibility. Their primary environmental challenges relate to poor sewage management in the port areas and poor solid waste management.

The recent merge of the two cities, together with their rapidly growing population, opens opportunities to expand and improve their transport links, which offers the potential to promote an eco-efficiency agenda as part of new policies for urban development. The Ministry of Public Works and the Ministry of Transport jointly developed a mobility and transport plan for the two cities that spans a

time period of 15 years and forms the basis for public and private investments in the transport sector. ECLAC chose the merger of the two cities as an opportunity to launch a project to demonstrate the barriers and opportunities for eco-efficiency practices in the transport sector's master plan.

WHAT WAS DONE

ECLAC conducted its demonstration project to show how a transportation planning process could be improved. The project included a simulation exercise for La Serena-Coquimbo. The simulation exercise was used to incorporate eco-efficiency criteria and principles into the development and operation of a newly designed urban transport system, based on the following objectives:

- achieve higher efficiency in the transport system's performance in terms of emissions control
- reduce emissions on a scale required to counteract increases from operating the new urban transport system.

Simulation mechanism

To achieve the objectives, the master plan was analysed with the simulation's guidelines, using performance indicators to measure the proportion of abatement of various types of emissions and economic indicators to measure change in transport operations. New projections were made by employing the planning process of an existing and proven urban transport system, taking different types of transport and participation needs as variables for change. By looking at the interaction between the different modes of transport in the city, it was possible to estimate the change (costs and environmental impact) that may occur when the mode of transport changes, combined with the total operational balance. Thus, it was possible to calculate the costs for different parties involved (modes of transport).

This method is different from a conventional approach that only estimates the costs or benefits of an environmental innovation in a plan or project. In other words, this approach is an integrated analysis of transport and emissions to determine the net effect of the whole transport system in terms emissions and economic costs and benefits.

This type of planning process is an open planning process that encourages residents to voice their needs and concerns.

Simulation mechanism applied to La Serena-Coquimbo

The planning process was based on a series of studies and participatory activities, coordinated between the local, regional and national levels of government. The process started with an analysis of the travel origins and destinations through a survey and concluded with the preparation and evaluation of an implementing plan. Three tools were used to obtain results:

- A tool designed for modelling the plan and projecting future applications of new plans. Scenarios were built to measure the impact for different policies and strategies in a cost-benefit analysis.
- A tool to structure and update an enormous amount of socio-economic data related to transport and travel needs. The Ministry of Transport developed an instrument to measure different policy options. This model has been applied to different medium-sized cities in Chile.
- An investment plan aimed at resolving the identified problems. The use of models allows for testing the impacts of an investment plan as well as adjusting and finalizing it in a way that considers all the environmental, economic and social gains.

To present an integrated and balanced operational overview of the various modes of transport, it is possible to distinguish peak and off-peak operation per mode of transport, which in turn, can be linked to consumption and emission patterns. A detailed estimate of the impacts associated with interventions

as a metro train, new road connections, extensions of existing infrastructure, can be made, and any action or regulation that changes the system's operating costs significantly can be assessed. To make this estimate, there should be sufficient data on socio-economic indicators, the number of people travelling and the investment and operating costs of the projects.

SECTRA, an organization that has analyzed transportation master plans for 29 cities in Chile, developed a simulation model called MODEM. This model, which has been applied to 4 conurbations and 13 medium-sized cities, can be used to estimate the environmental impact (emissions) of an investment plan or action, distinguishing local emissions from overall effects. The model considers fuel and emission savings by vehicle type over a certain period of operation. Another SECTRA model, MODEC, estimates economic effects due to change in emissions.

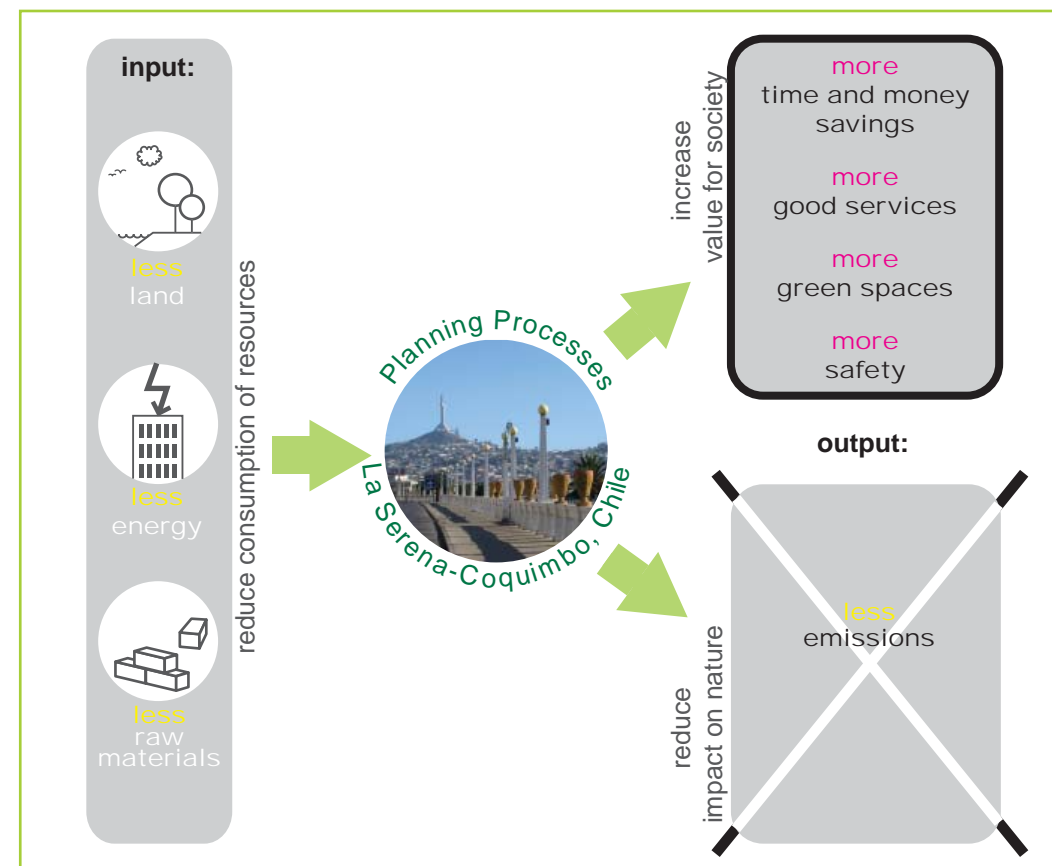
Improving the planning process

To improve their transport planning process, local governments should review the planning methodologies, tools and processes that they use to determine or measure the impact of investment plans in terms of emissions.

ECLAC took the following steps to improve the transport planning process in La Serena-Coquimbo:

1. Reviewed all data available in Chile to identify which organizations use technical and economic indicators to analyse investment plans. SECTRA emerged as having the most relevant data for La Serena-Coquimbo.
2. Reviewed and analysed the plans and projects available in the La Serena-Coquimbo to identify methodologies that consider alternative paths for investment, based on greater efficiency in resource use and climate change impacts.
3. Evaluated the quality and (social, economic and environmental) effects of the urban transport master plan for La Serena-Coquimbo, together with various stakeholders.
4. Discussed with the relevant parties how the evaluation criteria and policies can be changed so that project plans favour actions with the greatest potential carbon reduction and then generated a list of projects that include a new green assessment method.
5. Based on the new plan, evaluated the selected actions in terms of emission-reductions, based on indicators for a period of five years and relevant for a set of cities with a similar size of La Serena-Coquimbo.
6. Identified the institutions, processes and actors that are interested in an eco-efficiency approach and introduced criteria for green investment schemes for developing the urban transport infrastructure.

PROJECTED OUTCOMES AND WAY FORWARD



The main outcome of the improved planning process relates to the relationship between ecological and economic efficiency, in which the modelling and the networks of transportation created as well as the process of designing and evaluating the optimum of economic, social and environmental benefits in the plan led to cost reductions. Additionally, cost reductions in terms of trip time and fuels savings have been the direct result of including eco-efficiency criteria in

investments plans. The micro simulation model that was used allowed for maximizing savings in the energy and physical resources used (space) and a reduction in emissions.

Guidelines for transport system

The participatory simulation exercise for the design of a low-carbon transportation plan in La Serena-Coquimbo generated the following guidelines:

- Promote the use of public transport and provide the necessary conditions of management and infrastructure to bus services so that they have a good standard of operation.
- Build “calm” areas in the centres of La Serena and Coquimbo, such as pedestrian areas, attractive public spaces, safe and well-lit facilities, and all accessible by public transport through dedicated infrastructure.
- Improve the management of traffic streams from the centre to the seaside so no problems will occur in the busy summer months.
- Evaluate different forms of restrictions on movements, especially private car use and public transport.

Specific actions:

These guidelines were then translated into a plan of seven projects:

1. Build a network of bike paths.
2. Build pedestrian areas in the centres, accessible by public transport that operates from the peripheral rings.
3. Develop the waterfront of the river as a major facet of La Serena.
4. Avoid the parking of vehicles on public roads.
5. Develop facilities to improve the operation of public buses with exclusive lanes.
6. Explore the incorporation of new technologies that reduce emissions in public transport.

7. Complete planned routes and streets and improve railroad crossings.

The emissions baseline scenario

Due to an increase in transportation activities in La Serena-Coquimbo, emissions increased by 62% between 2000 and 2005. To estimate the potential net reduction of emissions, this growth figure has to be taken into account.

Reducing emissions

It is too soon to determine the emission reductions as a result of the changes in transport modes or fuel. However, available data from other regions in Chile can be used as proxy estimation, such as the conurbation of Temuco-Padre Las Casas and the city of Calama.

The Temuco-Padre Las Casas case illustrates how restricting transport modes can reduce emissions. After analysing the data, it is clear that the emission reductions were of such magnitude that they produced a net reduction, even though transportation intensity increased.

Pollution reduction versus production trend in Temuco-Padre Las Casas, 2005 and 2010

	EMISSION SAVINGS (TONS/YEAR)	EMISSION PRODUCTION 2005 (TONS/YEAR)	EMISSION PRODUCTION 2010 (TONS/YEAR)
PM10	10,4	45,9	43.8
CO/10	62.4	550.1	580.1
HC	65.9	-	-
NO _x	201.4	1104.0	1 133.7
SO ₂	30.0	175.8	231.1
CO/100	239	-	-

Source: ECLAC, based on SECTRA

The table above reflects the decrease in emission levels produced in the transport system as a result of restricting vehicles, comparing annual production trends in 2005 and 2010. The savings are very significant and show that the mechanism can be a very effective measure.

The table below shows that unlike the vehicle restrictions in Temuco-Padre Las Casas, the reductions are less relevant to total emissions in the urban transport system. Data from Calama illustrates the impact of a change in fuel quality, from a diesel fuel with a sulphur content of 500 ppm to 50 ppm in the same year (ppm = particles per million).

Pollution reduction versus production trend; change of fuel quality in Calama (within one year)

SCENARIOS	PM10 (TONS/YEAR)	CO (TONS/YEAR)	NO _x (TON/SYEAR)	HC (TON/SYEAR)
Base situation 2005	20,06	6253,20	917,23	502,90
With project situation	18,17	6248,82	922,13	501,59
Changes %	-9,4%	-0,1%	0,5%	-0,3%

Source: ECLAC, based on SECTRA

Adjustments to the plan

This project demonstrated the potential for emission reductions, considering the increase in transport activities for La Serena-Coquimbo. On the basis of the results, the urban transport plan should incorporate measures for vehicular restrictions for all modes of transport that generate high emissions. A potential change of fuel could be included under the measures; the incorporation of new technologies that can reduce emissions in public transport should be explored.

The way forward

Local governments can use simulation tools to incorporate eco-efficiency criteria into their planning processes. However, to incorporate criteria efficiently, planners need to consider several challenges.

Challenges:

- Show that emissions can be reduced by improving plans, investment strategies and implementing measures for an urban transport system through the illustration of documented cases.
- Make sure that the documented cases and the processes used to develop criteria and recommendations for an urban transport system can be systematically applied to other systems in the region. This can provide useful information for decision makers elsewhere to encourage the practice of eco-efficiency.
- Ensure that the analysis of good practices for transportation planning in Chile follows the complete process from generating ideas

to structuring a plan.

- While the transport sector in Chile is fragmented and formal institutions might act weakly, the integration of different visions and objectives is important.
- In Chile, funding of public or private infrastructure projects is subject to the outcome of a social assessment standard (specified in the National Investment System). This implies that eco-efficiency projects must compete on equal terms (with conventional projects) for public or private resources. In addition to the challenges, some opportunities are evident.

Opportunities:

- The Chilean experience with the urban transport system analysis methodology appears applicable to many medium-sized cities.
- Public entities (such as the Ministry of Planning and SECTRA) are a rich source of information for developing methodologies for analysing urban transport systems.
- Chile builds on consolidated planning practices. The simulation exercise and impact assessment methodology could be easily shared with other parties through these planning practices.
- The methodologies used in the Urban Transport System Master Plan prepared by SECTRA can be a valuable tool for planners as it includes the analysis of emission impacts for implementing plans and investment projects.
- Some policies and regulations influence the objectives and directions of a plan or project by promoting unsustainable trends. To

maximize eco-efficiency outcomes, perverse subsidies should be removed. For instance, a tax could be lowered for fuels that generate less emissions.

- A strategy that aims at internalizing eco-efficiency criteria throughout the process of infrastructure development and decision making extends not only to the stage of construction but also to the operation and maintenance. This can be done by aligning eco-efficiency objectives and principles with contract regulations, bidding documents, operating contracts, design manuals and manuals for evaluation, among others.

Institutional framework

One of the most important assets in the institutional framework that affects the transport sector in La Serena is the Land Use Committee. The Land Use Committee is composed of the different regional secretaries of government ministries. These regional secretaries represent an important distinguishing factor in the institutional framework of Chile and of La Serena, with the ability to implement national policies successfully at the regional level. The inclusion of the regional secretaries into a Land Use Committee is an important strategy because it allows for both national and local agendas to be taken into account, mostly in the implementing stage, where the Coordination Unit of Urban Roads, which operates through the Ministry of Planning, manages the allocation of investment resources and monitors progress. This institutional framework was developed under the leadership of SECTRA, and although no

formal legal framework exists, its impact on the development and implementing of urban transport plans has been extremely positive. Using the regional secretaries and the Land Use Committee as carriers for an eco-efficient agenda in the transportation sector has the potential to be very successful.

SECTRA's technical leadership as an independent entity is widely respected and its institutional framework has been developed over many years. The advantage of the planning process derives not only from the technical tools but that it fundamentally seeks more involvement of all parties with responsibility in developing the urban transport system who then define the planning scenarios and develop the investment plans.

In sum

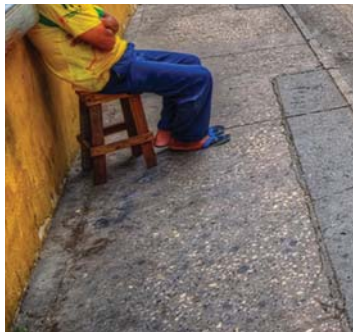
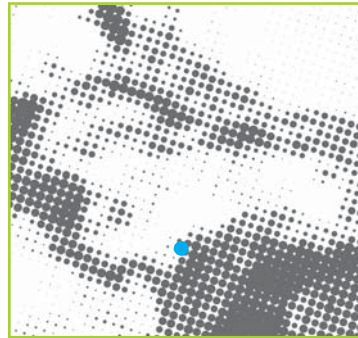
To develop implementing plans based on eco-efficiency objectives for different cities, it is important to:

- identify the impact of low-carbon plans in terms of costs, cost-effectiveness and social impacts
- generalize the findings and move to tailor-made approaches.



Eco-efficient and inclusive urban infrastructure in the Caribbean Corridor of Santa Marta - Barranquilla - Cartagena, Colombia

Urban service infrastructure – drinking water, lighting and transportation



Leaders, planners and designers in cities need to understand the characteristics that make infrastructure projects inefficient, in order to comprehend the nature of the kind of changes they must make.

When creating urban corridors and sub-regional connections, integrated sector planning is absolutely necessary to reach inclusive growth and development. Such integrated planning has the potential to become an important component in the restructuring of urban infrastructure development in the long term.

Eco-efficiency can be achieved in business and services by equating the initial costs incurred to the long-term economic gains and returns.

INTRODUCTION

More than 40 years ago the Latin American country of Colombia embraced good environmental practices in urban infrastructure, owing first to its National Code of Natural Resources (legislated in the 1970s) and later to a modernized national environmental management system in the early 1990s. Although Colombia has historically been at the forefront of environmental practices, it falls short in terms of what it expects from specific infrastructure projects, which remain inefficient. Colombia's framework of environmental consciousness has yet to be applied to its urban infrastructure systems.

Santa Marta, Barranquilla and Cartagena are three of Colombia's most developed urban zones, with more than 95% of their populations living in the respective urban centers. The Colombian Caribbean Corridor, which connects the three zones, accounts for around 60% of the country's national trade. The region is promoting greater international and regional cooperation in trade and commerce, which includes developing relationships to stimulate economic growth, industrial and social development. That vision requires creating an eco-efficient infrastructure corridor to connect resource-rich regions with integrated development that will boost potential investor confidence.

This case analysis focuses on the three urban zones that comprise the Colombian Caribbean Corridor. The unique environmental characteristics and the geographical location

of the area make it one of the country's most valuable social and economic assets. The Colombian Caribbean Corridor presents a promising opportunity for Colombia to urbanize a developing region with efficient, sustainable and inclusive infrastructure. The analysis underlines existing problems in current infrastructure projects and explores distinct barriers keeping the Colombian Caribbean Corridor from creating standards of eco-efficiency and sustainability as a way of illustrating common situations confronting other cities.

The three urban zones within the corridor each encompass a specific set of infrastructure systems and were chosen as exemplary of the lack of communication and awareness of the importance of sustainability. The infrastructure selected to highlight can still be restructured with relatively low initial impact in order to forever change their development and functioning: i) the supply of bottled water provided by the Department (similar to a province) of Magdalena in the city of Santa Marta, ii) the public lighting system in the city of Barranquilla and iii) the mass transport system (Sistema de Transporte Masivo, or SITM) in the city of Cartagena. These projects have the potential to raise the quality of life in each urban centre, provided business-as-usual procedures are considerably altered to include eco-efficient guidelines.

Santa Marta – city profile

• population	447,857
• administrative area (km ²)	2,393
• GDP (national) per person (US\$)	9,445
• climate	temperate

INEFFICIENCIES IN THE DRINKING WATER-SUPPLY SYSTEM IN SANTA MARTA

The problem

Colombia has a large quantity of water resources, with a national average of freshwater supply of 59 litres per second per km². The Department of Magdalena is located in the north of the country, bordered by the Caribbean Sea to its north, to the east by the Departments of La Guajira and Cesar and on the south and west by the Magdalena River, which separates it from the Departments of Bolívar and Atlantic. The area is politically divided into 30 municipalities and 178 townships, with numerous villages and populated rural areas.

The Department of Magdalena has considerable environmental importance due to its ecological, ethnic and cultural reserves and an enormous variety of terrestrial and aquatic ecosystems, including four natural parks and a world biosphere reserve. Magdalena has one of the largest networks of internal rivers in the world, providing an abundance of fresh water. And yet, Magdalena suffers a deficiency of drinkable water. This is mainly due to a lack of sustainable practice in the filtration and distribution processes of the water supply system.

The amount of CO₂ emissions in the aqueduct system

AQUEDUCT	MONTHLY AVERAGE [kWh]	ANNUAL AVERAGE CONSUMPTION [kWh]	EMISSION FACTOR [kgCO ₂ /KWh] *	ANNUAL EMISSION OF CO ₂ [KILOTONS]
Municipality of Ariguaní	160 158	1 921 896	0 2849	547
Municipality of Fundación	169 427	2 033 124	0 2849	579
Municipality of Ciénaga	15 840	190 080	0 2849	54
Santa Marta	1 030 072	12 360 864	0 2849	3 521
TOTAL	1 375 497	16 505 964	0 2849	4 702

Source: Consultoría Proyecto, 2010.

The processes involved in the supply of drinking water are considered inefficient because of the lack of communication among the different divisions in the purification and transportation processes. There is also a territorial issue linked to wealthy landowners who force the water-supply system around their property and thus away from the most efficient routes. Without correlation and integration, infrastructure systems do not run optimally; inefficient systems enable high CO₂ emissions, as shown in the table.

Two private firms supply Magdalena's potable water – Metroagua processes the water supply for the capital city of Santa Marta and Aguas del Magdalena provides the water for the rest of the department. Water-supply companies in Santa Marta, the capital of Magdalena, also collect water from deep wells abundant in the area. The water drawn from those wells need to be treated to make them consumable. The treatment process is expensive, given the enormous distance between municipalities and to the water sources.

Compounding the expensive treatment issue are conflicts of interests between the public and private water-supply systems. Some zones through which the water is transported belong to wealthy landowners who want the water to irrigate their unproductive land but do not want to sacrifice their private property to create an irrigation system. Most of the land in the province is used for cultivating palm that is processed into biodiesel, and the landowners are not interested in efficient

water transportation infrastructure.

The water systems are not properly maintained. Many of them do not have metres and are supplied by old pumping stations. The functioning aqueducts are severely affected due to power cuts. The net results are expensive and inefficient systems, reflecting poor planning, lack of commitment towards supervision and maintenance and ignorance of eco-efficiency criteria.

Because of its limited supply of drinking water, Magdalena was selected for a flagship programme for water and sanitation under the national Government's water and sanitation scheme. The main objective was to transform the industry, providing better aqueduct services:

- making the hydraulic resources sustainable
- rehabilitating the water bodies affected by harmful activities
- establishing a harmonious relationship between the supply and demand of goods and services.

The national water and sanitation scheme is developing projects to reduce the temporary shortages in drinking water and putting in place engineering projects to ensure the sustainability of the resource. By the end of 2010, the Department of Water recorded a 52% increase in aqueduct efficiency and a 34% increase in sewage system projects. The national water and sanitation scheme is a government attempt to replace vested private interests with public institutional goals in water-supply infrastructure. The

Colombian Government recently made water management a priority in local and national infrastructure projects. The Government restored the Ciénaga Grande de Santa Marta, one of Colombia's largest wetlands.

What is needed

Although such projects represent an improvement of infrastructure inefficiencies, the processes only represent the beginning of what needs to be a long and intense restructuring of relationships between the public and the private sector while holding

values of sustainability and inclusiveness in the processes.

In Santa Marta, an energy audit of the aqueducts was conducted in 2009-2010; the findings indicated that to achieve optimum performance in eco-efficiency, the obsolete and low-capacity pumping stations must be replaced, leaks in storage tanks should be fixed, the lighting system needs to change and pumps of varying speeds should be installed.

Findings of the energy audit of the aqueducts in Santa Marta, 2009 – 2010

MEASURE	TOTAL COST OF IMPLEMENTING WITHOUT FINANCING [US\$]	MONTHLY SAVINGS GENERATED [US\$]	TOTAL INVESTMENT COST WITH FINANCING TO TWO YEARS [US\$]	COST WITH FINANCING FOR TWO YEARS [US\$]	PAY-BACK PERIOD OF INVESTMENT [YEARS]
Replacement of pumping units	\$403 million	\$35 million	\$489 million	\$446 million	1.05
Installing variable speed shaft to Ciudadela	\$15 million	\$353 195		\$17 million	3.92
Tank leakage	\$15 million	\$1.2 million		\$17 million	1.11
Changing lighting system in administrative offices	\$8 million	\$189 408		\$9 million	4.05
TOTAL	\$442 million	\$37 million	-	\$489 million	-

Source: Auditoria energética en acueductos – Andesco y Metroagua, Santa Marta 2009-2010

Each municipality should revive its purification and distribution systems, replacing them with a technology that can provide 24-hour continuous services, with low energy requirement. Municipalities also need to create a management system that can facilitate the smooth operation and maintenance of the water-supply system.

In the water-supply infrastructure system, there are conflicting interests, and high costs and energy waste are not given the required priority. Infrastructural changes are required in Magdalena, and for this the local government needs to create an institutional structure that will not allow private players

to manipulate water infrastructure. Regions with water reserves and the regions to where water is supplied have to be networked, and conservation projects to manage the natural resources must be undertaken. The present system should strive for low-energy consumption through technological upgrading. For clear environmental policies incorporating concepts of eco-efficiency, authorities need to clearly specify responsibilities of each actor involved in the water-supply infrastructure system. It is also important to ensure public awareness about the social benefits and long-term sustainability in infrastructural projects.

Barranquilla – city profile

• population	1,146,359
• administrative area (km ²)	154
• GDP (national) per person (US\$)	9,445
• climate	temperate

REDUCTION OF GREEN HOUSE GAS EMISSIONS IN PUBLIC LIGHTING IN BARRANQUILLA

The problem

Barranquilla is located on the north-east point of the Magdalena River, 75 km from the Caribbean Sea. The city serves as the principle centre providing services for the Colombian Caribbean region and is an important trade centre in Colombia because of the direct connection to the Caribbean Sea. Barranquilla's industrial and commercial history, along with its port infrastructure

and location, makes it a crucial zone in the Caribbean Regional Urban Corridor.

But Barranquilla's environmental management system is not very efficient. Owing to the industrial growth in the twentieth century, Barranquilla is now home to highly polluting industries, all located on the banks of the Magdalena River.

The generation, distribution and commercialization of energy have been controversial issues in Colombia. In 1992, the National Government restructured the Ministry of Mines and Energy, dissolving the National Commission of Energy, thereby creating three administrative units: the Commission for Regulation of Energy, which was converted in 1994 into the Commission for Regulation of Energy and Gas, the Mining and Energy Information Unit and the Mining and Energy Planning Commission. These agencies manage Colombia's energy services. Since the 1980s, there has been a dialogue about the energy scenario in the country, but the discussions have focused mainly on the provision of domestic lighting.

Energy efficiency in Barranquilla's public lighting

Street lighting in Barranquilla is operated under a contract signed between the District of Barranquilla and the Concession of Public Lighting Services (Retilap). Public lighting in Barranquilla must comply with certain basic requisites that guarantee the level and quality of the lighting required, consumer protection and conservation of the environment. All requirements must be met with minimum risk in the installation and use of lighting systems. But these general guidelines remain subject to subsequent municipal planning guidelines, which have yet to be implemented. An agreement between the administration of Barranquilla and operators of the public lighting services necessitates the use of high-pressure sodium bulbs or a source with similar or better efficiency.

Public lighting is currently not efficient in Barranquilla due to the institutional inabilities, particularly the lack of clarity in delegating institutional responsibilities related to the service, which makes it more difficult to shift the lighting service to more eco-efficiency.

The district administration tried to optimize energy use by offering bulbs of optimum performance and emissions, but this strategy did not achieve the desired success. That experience suggests that strategies in public lighting need to be redefined to be more comprehensive and should also include safety, quality of life and eco-efficiency as part of the criteria to create a more eco-efficient infrastructure system.

The public lighting service uses largely high-pressure sodium bulbs; the lamps are positioned horizontally with very little inclination and were once considered beneficial in terms of consumption and efficiency. Over time, the district administration replaced some of the light fixtures with mercury lamps, which offer high-power lighting as a result of LED technology. In some areas of the city, there has been limited success in the use of solar panels. It is not yet considered viable to use the panels in bulk, possibly because their initial cost is high and the risk of damage by vandalism would result in a huge loss.

The annual CO₂ emission from the public lighting in Barranquilla is around 9.286 gigatons per year, based on a calculation

using the 0.289 emission factor (kg CO₂ per kWh), which follows the rule that the Ministry of Mines and Energy issued in 2010.

There were difficulties to replace all the street lights with the high-pressure sodium bulbs using the LED technology. Although the lifespan of those lamps, which is around 100,000 hours and 17 times more than the lifespan of typical bulbs (which do not exceed 6,000 hours), the cost for changing all the lamps would have been substantial. This is mainly because the private company that currently provides the lighting services is more interested in an immediate commercial gain. The sector needs to review the performance, environmental benefits and costs of the existing service provider and bring in a new supplier of more eco-efficient bulbs.

What is needed

The future of eco-efficient public lighting relates to the requirements and measurements established by the Technical Regulation of Public Lighting. The requirements and measurements for lighting systems in domestic and street lighting call for compliance in visual activity, energy supply security, consumer protection and conservation of the environment. What is especially needed now are efforts to enforce these standards. Barranquilla has no tools to ensure the compliance, and the existing loopholes further weaken the system.

It is important to explore the possibility of introducing solar lighting technology. It is also important to keep the initial cost factor from influencing policy decisions to make the changes needed. A better understanding of all the eco-efficient options should be considered in the restructuring of public lighting infrastructure.

A government-commissioned technical study to determine the light intensity, durability, efficiency, performance, cost-effectiveness and maintenance factors of different technologies available would be highly useful. It would also be essential to review the institutional framework that regulates the public lighting service, finding ways to establish strong criteria that will guide the implementing of the service. This should integrate performance and benefits, considering the costs in both the short and long terms. Such a scenario would include projections that take into account initial costs involved in changing the public lighting infrastructure as part of a long-term plan to eventually reduce costs by making public lighting more sustainable.

Cartagena – city profile

• population	892,545
• administrative area (km ²)	1,091
• GDP (national) per person (US\$)	9,445
• climate	temperate

ECO-EFFICIENCY MISSING IN THE MASS TRANSPORT SYSTEM IN CARTAGENA

The problem

Until 2001 there was no effective system of mass transport in Cartagena. With rapid urbanization, the lack of a transport system caused great congestion and impaired mobility for many of the city's residents.

In 2001 the Transcaribe S.A. was set up as a firm to manage an integrated system of mass transport (SITM) in Cartagena as part of the Land Use Plan of that same year. Technical and financial support are provided through the National Policy of Urban and Mass Transport, which was issued in late 2003 to create the institutional guidelines for mass transport systems in Colombia's largest cities regarding the planning and managing of traffic and transportation in urban development, which Transcaribe oversees.

The district of Cartagena, in accordance with the guidelines put forward by the national policies, created a plan and another set of guidelines for structuring and implementing its mass transit system. The SITM of Cartagena is composed of the infrastructure

itself, the buses, the fee collection equipment and the fleet control centre. Transcaribe is in charge of the construction and maintenance of both the infrastructure and the operation of the control centre. Cartagena's mass transport system consists of a "trunk", or central corridor, with segregated lanes and preferentiality intended exclusively for the operation of buses with high and medium capacities. This backbone network is then integrated with a complementing road system. The data-recording system is used to monitor information provided by buses and stations to make the operational changes, such as changes in quantity and frequency of buses, needed in the system.

The mass transport system is financed by a loan granted by the International Bank for Reconstruction and Development, which requires compliance with safeguards, such as resettlement plans, environmental management plans and traffic management plans. This specific financial relationship has allowed Cartagena to create co-financing agreements and advance the rehabilitation

and construction of complementary or feeder routes, such as the construction of piers to create more efficient water routes.

The actors involved in the construction and development of the mass transport system of Cartagena are those responsible for the network of public transport services and the construction and infrastructure of the SITM and a multilateral bank. To mitigate and compensate for impacts caused by the purchase of land and relocation of occupants of public space, Transcribe created a resettlement plan that included a programme for relocating occupants of public space within the areas directly affected by work on the SITM. Of all the directly affected occupants of public space on Avenida Venezuela, 263 spaces were relocated, 124 spaces converted and 135 received microcredit.

In the newly created operational proposal, projects should have 100% coverage by means of integrating the operational costs into the taxation system, which would include the fare paid by nearly 475,000 passengers daily. This would guaranty sustainability of the system and provide better service to the consumers. The new proposal holds SITM accountable for 79% of the transport demand, and the public system of feeder or complementary routes can cover the resulting 21% of demands.

What is needed

Possibilities for eco-efficiency in the SITM system: As the system is not yet functioning,

it is difficult to determine the quantity of emissions. There are areas though that clearly will have an effect on resulting CO₂ emissions of the SITM system.

1. Decisions as to what type of fuel will be used are not yet final. The project planners are still to decide exactly how many old vehicles with higher CO₂ emissions will be scrapped and which fuel will be chosen. As of now, the three options are natural gas vehicle, natural gas and biodiesel. While fuel choice has a great potential to lower CO₂ emissions, unfortunately eco-efficient criteria are not being taken into account currently in the planning of the project, therefore fuel choice will not be based on its eco-efficiency.

2. The Andean Development Corporation, which has worked with Barranquilla to create a contract with the goals of lowering emissions through a selection of measures and fuels that follow eco-efficient criteria, is interested in working with Transcribe in Cartagena. The creation of such a project would be an important development for the development of the city.

3. The construction of the project has created heavy traffic and large quantities of pollution. Thus open dialogue in an attempt to streamline the construction process will be important.

The most important factors for reducing pollution levels in the transport sector will be to:

- facilitate the process of scrapping public transport vehicles that are old and more polluting
- put in place a social awareness programme that teaches citizens about the potential for increased quality of life with the decrease of existing pollution and explaining how the SITM can be a central actor in this process.

CONCLUSIONS AND RECOMMENDATIONS

Within each of the three city infrastructure situations analysed, it is clear that projects do not adhere to eco-efficient guidelines. In fact, in all three infrastructure projects explored, eco-efficiency is not considered an important factor in the decision making involved in the development process. The most important factor in creating more sustainable infrastructure should come from a broad and substantive commitment within the public sector to reduce emissions of infrastructure projects through eco-efficient practices. Sustainability within infrastructure development needs to become part of Colombia's common interest, and connections between public and private actors need to be strengthened in order to stimulate eco-efficient goals as part of the country's social and economic development. This would require that all sectors begin to monitor and make public their CO₂ emissions and initiate dialogues on how to build policies and initiatives that can lower each sector's emissions.

It is important that regional leaders are trained to understand eco-efficiency and sustainability measures as a process with productive value and social and environmental importance. This relationship between economic productivity and social and environmental issues must be made clear to all levels of regional governments and private actors to be applicable in the larger process of urban infrastructure development. Such training would allow the norms and strategies of eco-efficiency that currently exist in the national policies to be better implemented in local infrastructure projects.



Annex 1: Actors

Overview of key actors and their potential contribution to the eco-efficiency of infrastructure development projects through their involvement.

PUBLIC (GOVERNMENT AND OTHER AUTHORITIES)	
ACTORS	POTENTIAL CONTRIBUTION
Elected representatives: national, regional and local governments	Leadership, vision and political support, policy and programme expertise, implementation support through existing planning policies, programmes, initiatives and measures
Local government departments or boards (finance, urban planning, road and building transport, housing, waste management, water, electricity, environment): bureaucrats, planners, professional staff	Technical expertise, appraising local conditions, policy and programme expertise; staff, administrative and logistical resources; implementation support through existing planning programmes, policies, initiatives; monitoring and evaluation
Project managers	Technical expertise and management skill, implementation and operation
Technical consultants	Technical expertise and professional skills, planning, design, implementation
Educational and research institutions	Staff and student support, knowledge, information/data on sustainable urban infrastructure, technical expertise, facilities, outreach and communications, critical implementation support (policy development, execution and enforcement), monitoring and evaluation

BUSINESS OWNERS, ASSOCIATIONS AND SPECIALISTS	
ACTORS	POTENTIAL CONTRIBUTION
Business associations: national, regional and local	Funding, facilities and materials, outreach and communications, implementation support, monitoring and evaluation support, local knowledge, political and community support
Chamber of commerce	Funding, outreach and communications, administrative support
Financial institutions and private financiers	Funding, facilities and materials, outreach and communications
Infrastructure planners and consultants	Technical expertise and professional experience, project knowledge, outreach and communications
Infrastructure developers	Project knowledge, professional experience, management skill, funding, outreach and communication
Infrastructure operators and maintainers Utility service providers	Professional experience, management and operation skill
Engineers and contractors	Technical expertise, project knowledge, professional experience
News media	Outreach, communications, public education, awareness raising

COMMUNITIES AND LOCAL AREA GROUPS

ACTORS	POTENTIAL CONTRIBUTION
Local area leaders	Community credibility and support, local knowledge, outreach and communications, project assessment input, implementation support, monitoring and evaluation
Informal economy groups and local associations	Funding, outreach and communications, local knowledge, implementation support, monitoring and evaluation
Neighbourhood groups	Outreach and communications, local knowledge, implementation support, monitoring and evaluation
Environmental interest group	Environmental impact and assessment knowledge, local knowledge, outreach and communications, technical expertise, funding channel, implementation support, monitoring and evaluation
Cultural or historical heritage interest group	Cultural impact and assessment knowledge, local building conditions knowledge, outreach and communications, technical expertise, implementation support, monitoring and evaluation
Disabled interest group	Accessibility planning and design knowledge/ input, local knowledge, outreach and communications
Underrepresented groups (women's and minority interest groups)	Outreach and communications, vulnerability and risk assessment input, implementation support
Landowners	Implementation support, local knowledge, land acquisition support, monitoring and evaluation
Residents and other urban population	Participatory planning inputs, implementation support, monitoring and evaluation, local knowledge, outreach and communications

Annex 2: Indicators

Example of indicators that could be considered for measuring the eco-efficiency of urban infrastructure.

GENERIC CRITERIA	EXAMPLE INDICATORS	MEASUREMENT
Productivity	City product	City product per capita (US\$/person)
		Real disposable household income per capita
	City revenue and expenditures	City revenue per capita less city expenditure per capita
	Investments in infrastructure	Annual total investment in infrastructure
	Unemployment rate	Average of unemployed men and women during the year (% per year)
	Informal employment	Population employed in informal sector (% per year)
Access to services	Travel time	Travel time per work trip (minutes)
	Tenure types	Formal ownership
		Tenancy
		Squatters
		Others
	Water	Households with access to safe water within 200 m (% per year, total numbers)
	Sanitation	Proportion of population using improved sanitation facilities, urban
	Electricity	Households connected to electricity (% per year, total numbers)
Sewage	Households connected to sewage (% per year, total numbers)	
Public transport	Persons who access public transportation within 500 m (%)	
	Public transport seats per 1,000 population (number of seats/1,000 people)	
	Transport modes to work: Private motorized Train and tram Bus and minibus Bicycle, walking and other	
Affordability	Housing	Home price to income ratio
		Home rent to income ratio
	Water	Median price of water per m ³ (US\$/m ³)
	Electricity	Average cost of electricity (US\$/kWh)
	Sewage	
Transport		

GENERIC CRITERIA	EXAMPLE INDICATORS	MEASUREMENT
RESOURCE INTENSITY		
Energy intensity	Energy consumption	Electricity use per capita (GWh/person/year)
	Energy consumption per sector	Transport Public buildings Commercial buildings Residential Total
	Fuel consumption and vehicle kilometres travelled	Annual litres of fuel per capita (litres/person/year) Annual kilometres per capita (km/person/year)
Water intensity	Water consumption	Average consumption of water (litres/person/day)
	Annual withdrawals of ground water	Total gross volume of ground and surface water extracted for water uses (% of total available freshwater)
Material intensity	Total material requirement	
Land use intensity	Land usage	Residential Commercial Transport Total area
	Sustainable land use	Newly incorporated land (km ²) Data on newly incorporated land: non-urban land that has been reclassified as urban land during the last year.
	Floor area per person	Ratio of total living space to number of inhabitants (m ² /inhabitants)

GENERIC CRITERIA	EXAMPLE INDICATORS	MEASUREMENT
POLLUTION INTENSITY		
Greenhouse gas intensity	Emissions of greenhouse gases	CO ₂ , CH ₄ and N ₂ O total emission in tons (tons) Global climate equivalent (Gceq) of total greenhouse gases (CO ₂ , CH ₄ , N ₂ O and CFCs) (Gceq) Emissions per capita (tons/person) Other sectors (tons) Residential sector (tons) Transport sector (tons) Total (tons)
Waste intensity	Waste production	Total solid waste produced (tons/person/year) Total solid wastes produced (m ³ /person/year)
	Solid waste disposal	% of disposal type Sanitary landfill Incinerated Open dump Recycled Burned openly Other Total
Emissions -to-air intensity	Air emissions	Total emissions in tones per capita per annum of: SO ₂ , NO _x and CO ₂ . CO ₂ (tons/person/year) NO _x (tons/person/year) SO ₂ (tons/person/year)
	Emissions of ozone-depleting substances	Emissions of ozone-depleting substances (in ODP) The emissions should be measured in ODP tons, such as metric tons x ozone depletion potential. The indicator should be measured annually. (NO ₂)
Emissions -to-water intensity	Water quality	The quality of rivers and streams (BODmgO ₂ /l)
Biodiversity	Green areas	Percentage of parks, green spaces, open areas and playgrounds in a built-up area
	Quality of urban wildlife	Number of bird species (number)

Source:
Compiled from various sources, including: Agenda 21 indicators, Cities Environment Reports on the Internet (CEROI), UN-HABITAT, Asian Development Bank, World Bank.

Annex 3: Eco-efficient actions and strategies

Specific Objective	Measure	Attractive city, better life			Sector	Complemented with measure:
		Increase value for people and society	Reduce consumption of resources	Minimize impact on nature		
Increase density/ reduce trip lengths	Increase density through efficient use of land and space (regulate/zoning), incl. building orientation, height, floor space ratio and property taxes	++	+++	++	Design, Planning	Encourage mass transit use
	Reduce trip distances through mixed land-use (work, housing, shopping, recreation/green-blue areas)	+++	+++	++	Design, planning	Discourage personal vehicle use Encourage bike use and foot travel
	Reduce waste collection trip distances by considering the use of local waste treatment facilities in non-dense areas	+	+	+	Design, planning, transport	Increase share of renewable and captured energy generation
Encourage mass transit/ discourage personal vehicle use	Expand mass transit service Reduce space for private car use Create transit-oriented development zones (links with other modes of travel) Create dedicated lanes for mass transit	+++	++	+++	Design, planning	Enforce driving and parking restrictions in certain zones and during certain times Encourage bike use and foot travel
	Tax-incentives to developers near mass transit	+	+	+	Design, planning	Increase mass transit use
	Improved quality, frequency and affordability of mass transit (subsidize)	+++	+	+	Transport	Discourage personal vehicle use Restrict number of license plates or tax vehicle registration

Specific Objective	Measure	Attractive city, better life			Sector	Complemented with measure:
		Increase value for people and society	Reduce consumption of resources	Minimize impact on nature		
Discourage personal vehicle use	Driving and parking restrictions in certain zones and during certain times	+	+	+	Transport	Improved quality, frequency and affordability of mass transit
Encourage bike use and foot travel	Traffic calming and increasing bike lanes and walkable areas Link bike lanes and walkable areas to mass transit	+++	+	+	Transport	Discourage personal vehicle use Increase public spaces (green/blue)
Increase vehicle efficiency and alternative fuels use	Special privileges (parking, tax) for alternative fuel or hybrid vehicles	+	+	+	Transport	Enforce driving and parking restrictions in certain zones Enforce emission standards
	Purchase of fuel efficient, hybrid, or alternative fuel vehicles for municipal fleet	+	+	+	Transport	Inform about the good example
Increase building efficiency (energy, water, material, waste)	Increase energy-efficiency by promoting multi-family and connected residential housing through zoning	+	+	+	Design, planning	Increase attractiveness of higher density developments (comfort, green areas, access to mass transit) Increase efficiency waste collection (distances)
	Efficiency/performance requirements in building codes, incl for operation and maintenance (appliance standards, procurement regulations, efficiency quotas, labelling)	++	+++	+	Building	Coordination of public-private retrofitting programmes Strict enforcement Offer subsidies and loans for measures such as insulation
	Coordination of public-private retrofitting programs	+	+	+	Building	Efficiency requirements in building codes

Specific Objective	Measure	Attractive city, better life			Sector	Complemented with measure:
		Increase value for people and society	Reduce consumption of resources	Minimize impact on nature		
Increase share of renewable and captured energy generation	Adjust building codes to require a minimum share of renewable energy; Promote renewable energy generation	+	++	+	Building	Provide technical support, loans and subsidies for renewable energy generation; Impose feed-in tariff; guarantee two-way access to the grid
	Initiate district heating and cooling projects	+	+	+	Planning, design	End requiring connection to district heating/cooling system
	Initiate waste-to-energy programmes	+	+	++	Waste	Regulate incinerator emissions Regulate waste generation (e.g. volume-based charging) Encourage waste reduction from source Impose mandatory landfill standards

Specific Objective	Measure	Attractive city, better life			Sector	Complemented with measure:
		Increase value for people and society	Reduce consumption of resources	Minimize impact on nature		
Increase comfort and affordability of living/ reduce urban heat-island effects	Park and water-way development	+++	+	+	Planning, design	Design in a way that parks and waterways increase attractiveness of dense areas and function as buffer for flooding
	Increase water use efficiency and access (gradual charging; standards; flexible water storage) Increase quality and recycling of waste water (pollution control regulations)	++	++	+	Water	Increase building efficiency
	Building codes requiring design materials that are long-lasting, environmental friendly and/or reduce heat-island effects	++	++	++	Building	Energy efficiency requirements in building codes
	Building codes requiring 'green roofs' with vegetation or white surfaces	+	+	+	Building	Energy efficiency requirements in building codes

Source:
Compiled from various sources, including: ESCAP, OECD, World Bank.

Annex 4: The importance of urban design

Public space as blue-green infrastructure

The introduction of physical design and planning at an early stage of project development is as critical for achieving high-quality results as is the policy planning itself. Urban designers and master planners need to be part of the process from the very conception. Best practices and case studies provide excellent guidance, although in order to achieve concrete results, projects need to be tailor-made according to the specific genius loci, taking into consideration the local climate, socio-economic structure, cultural heritage, the governance establishment, and political context, to name just a few basic considerations. Coordination of all three: political guidance, solid economical foundation, and concrete design proposal is the key to enabling successful outcomes of the planning processes related to urban growth.

The symbiotic relationship between public space and infrastructure is more than evident in our urban environment. Urban design needs to operate on multiple spatial and temporal scales simultaneously to provide meaningful results. It is probably most appropriate to take the scale of the neighbourhood, including all of its public spaces, as the point of departure. Next, the discipline of urban design expands into the macro scale of the city or a metropolitan region, keeping an eye

on the reach of the complete infrastructure network. Simultaneously, focus needs to be directed inwards into the micro scale of the building itself, exploring strategies for use of natural elements in providing sustainable building designs. The neighbourhood scale establishes the necessary dialogue with walkability and provision of services. It is considered a good practice to look into the ¼ or ½ mile radius which translates into 5 or 10 minutes walking distance. These considerations are also critical when setting up a public transport network. The potential for good urban design lays in this overlap of public space and infrastructure.

It is important to define what urban public spaces can do in order to determine their role in the urban ecosystem. Elements of our built environment should not just “be there”. The role of urban designers is not only to make those spaces appealing according to aesthetic criteria, but to make them work functionally. We know that buildings can contribute to energy and water collection. Building-integrated photo-voltaic panels can collect energy while protecting interiors from unwanted heat and glare; roofs can collect rainwater; green roofs can participate in the reduction of heat island effect; an appropriate treatment of ground floor can establish natural ventilation. By working

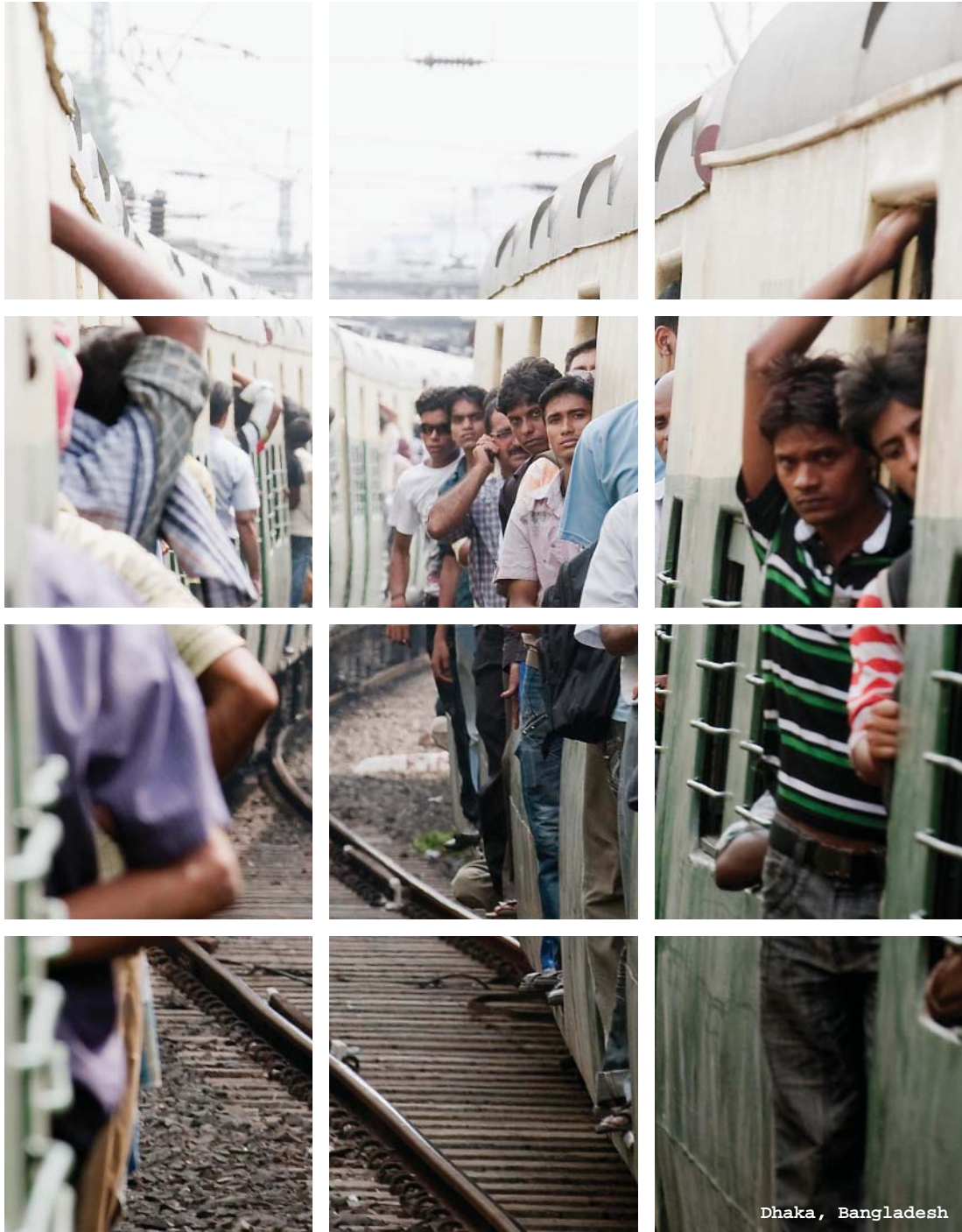
with the natural elements, namely sun, rain and wind, real achievements can also be made within the realm of public space design. Examples of resilient design include stormwater filtration and collection, flood mitigation calibrated with spatial qualities related to relaxation or socializing in public spaces. There is also a large recreational and air quality improvement component connecting good urban design directly to the health of citizens. The real-estate value of properties neighbouring well-designed public spaces and parks is another relevant benefit, and is elaborated extensively in these guidelines. Public safety is another crucial advocate of attentively-designed public space. Urban identity brings us back to the dialogue between architecture and urban design.

Another relevant facet of the overlap of infrastructure and public space worthy of consideration is the fact that infrastructure can have its own “after-life”. When no longer used for their original function, these spaces can be successfully repurposed into spaces of public interest and benefit. This includes the potential for triggering urban regeneration. An excellent example is New York’s High-Line, a disused elevated freight rail viaduct that was redesigned into a public park, establishing an important public space addition to the identity of the neighbourhood. Another example of reuse of a linear stretch of transportation infrastructure to the benefit of public space is the Cheonggyecheon corridor in Seoul, which is well referenced in this publication. One more example is the

Rose Kennedy Greenway in Boston, a part of the “Big Dig”. In this project the Highway 93, which was splitting urban fabric, was “submerged” underground while creating space for a wide stretch of a public park above. This resulted in urban inversion: what used to be a barrier became a connector and fostered adjacent real-estate development across the Channel. These are the examples of urban regeneration projects that have converted infrastructure into public space, and thereby established a new local identity while improving the quality of life.

The temporal scales of design, including planning, phasing, and scheduling, should also be considered. Just as stacking of uses is critical for the proper function of mixed-use buildings, so is the scheduling of programs critical for the polyvalent function of public spaces.

All urban environments depend on the efficiency of the infrastructural systems that service them. In order to establish and maintain healthy and liveable urban setting, it is necessary to look into the design and organization of infrastructural systems in an integrated manner. To achieve healthy urban environments, these systems need to be designed to work in concert, not unlike the systems of a human body that support each other to comprise a healthy living organism. The special position of public space and its role as blue-green infrastructure is based on the fact that it can and must collaborate with other infrastructural systems in the creation of liveable cities.



Dhaka, Bangladesh



Khmer woman, Cambodia

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Acronyms and abbreviations

ABC	Active, Beautiful and Clean
ADB	Asian Development Bank
CEROI	Cities Environment Reports on the Internet
CFCs	chlorofluorocarbons
CH ₄	methane
CO ₂	carbon dioxide
ECLAC	Economic Commission for Latin America and the Caribbean
EIA	environmental impact assessment
EIP	eco-industrial park
ESCAP	Economic and Social Commission for Asia and the Pacific
ESD	ecologically sustainable development
EU	European Union
Gceq	global climate equivalent
GDP	gross domestic product
IRRC	Integrated Resource Recovery Centre
kWh	kilowatt hour
m ²	square meter
MDG	Millennium Development Goal
NGO	non-government organization
NO _x	nitrogen oxide
N ₂ O	nitrous oxide
OECD	Organisation for Economic Co-operation and Development
ODP	ocean depletion
PPP	public-private partnership
PUB	Public Utilities Board
R&D	research and development
SEA	strategic environmental assessment
SMEs	small and medium enterprises
SO ₂	sulphur dioxide
UDL	Urban Design Lab
UDL EI CU	Urban Design Lab of the Earth Institute, Columbia University
UN	United Nations
UNEP	United Nations Environment Programme
UNFPA	United Nations Population Fund
UN-HABITAT	United Nations Human Settlements Programme
WBCSD	World Business Council for Sustainable Development

Glossary

Carbon footprint is a measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation, etc. It is a measurement of all greenhouse gases we individually produce and has units of tons (or kg) of carbon dioxide equivalent.

To calculate your carbon footprint, go to: www.carbonfootprint.com/calculator.aspx
Source: Carbon Footprint™. Available from: www.carbonfootprint.com (both visited 4-11-2010)

Carrying capacity can be defined as the maximal population size of a given species that an area can support without reducing its ability to support the same species in the future. Specifically, it is a measure of the amount of renewable resources in the environment in units of the number of organisms these resources can support.

Source: Roughgarden (1979)

Eco-efficiency is defined as the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the Earth's estimated carrying capacity.

Source: WBCSD (2000)

Ecological footprint is a measure of how much biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates using prevailing technology and resource management practices. Today, humanity uses the equivalent of 1.5 planets to provide the resources we use and absorb our waste. If everyone lived the lifestyle of the average American, we would need 5 planets. Turning resources into waste faster than waste can be turned back into resources puts us in global ecological overshoot, depleting the very resources on which human life and biodiversity depend.

Source: Global Footprint Network. Available from: www.footprintnetwork.org (visited 4-11-2010)

Eco-industrial park (EIP) is a community of businesses that cooperate with each other and with the local community to efficiently share resources (information, materials, water, energy, infrastructure and natural habitat), leading to economic gains, gains in environmental quality, and equitable enhancement of human resources for the business and local community.

Source: Chertow: Uncovering Industrial Symbiosis (2007)

Life cycle analysis and thinking implies that everyone in the whole chain of a product's life cycle, from cradle to grave, has a responsibility and a role to play, taking into account all relevant external effects. From the extraction of the raw material through refining, manufacturing, use or consumption to its reuse, recycling or disposal, individuals must be aware of the impact that this product has on the environment and try to reduce it as much as possible. The impacts of all life cycle stages need to be considered when making informed decisions on the production and consumption patterns, policies and management strategies.

Source: UNEP (2003)

Sustainable development

The Brundtland Report of the World Commission on Environment and Development defines sustainable development as follows: "Humanity has the ability to make development sustainable - to ensure that it meets the needs of the present without compromising the ability of future generations to meet their needs."

Source: United Nations (1987)

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Further reading

Links to publications, good practices and information sources

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UDL, Climate Change Adaptation, Urban Securities and Climate Change

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