GREEN + SMART CITIES
PLANNING FOR A SUSTAINABLE URBAN FUTURE

MODULE “GS”

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By the end of this module you will:

**Understand**
The beneficial nexus of smart and green cities

**Know**
How smart + green synergies work to benefit cities overall & support global sustainable development agendas in the areas of:

i) Sustainable waste management infrastructure & services
ii) Green buildings & infrastructure
iii) Smart green mobility
iv) Climate smart and resilient cities

**Be able to**
Apply that understanding to specific and pressing urban development challenges
GGGI at a Glance

Headquartered in Seoul, GGGI has 32 Members with operations in 33 countries.

GGGI’s mission

To help developing country governments transition towards a model of economic growth that is environmentally sustainable and socially inclusive.
GGGI Services Value Chain

- Sustainable Energy
- Water & Sanitation
- Sustainable landscapes
- Green cities

GGGI Value Chain

Diagnosis
- Development, economic growth and sustainability diagnosis

Green impact assessment
- Sectoral green impact assessment and prioritization
- Macro economic impact assessment

Sector/Sub-sector strategy & planning
- Policy and institutions analysis
- Analysis of costs and investment requirements
- Development of sectoral/sub-sectoral investment plans and selection

Design, financing & implementation
- Design: Project and policy preparation
- Financing: Identification of possible financial structure
- Implementation
GGGI’s Activities

- Strengthening policy/regulatory frameworks
- Integrating with existing government processes
- Setting-up institutional structures and coordination mechanisms to implement NDC
- Building capacity of countries’ climate diplomacy
- Developing and implementing concrete NDC implementation plans
- Connecting-the-dots and integrating between various strategies, plans and commitments that are already in place
- Developing sectoral policies and incentives
- Developing and strengthening MRV systems in the context of their NDCs
- Developing quality control and quality assurance procedure and building MRV capacity of key stakeholders
- Addressing sectoral policies, gaps and regulatory risks
- Advising to correct market failures and policy failures where relevant to enhance investment conditions
- Designing policy relevant instruments such as tariffs, subsidies, power purchase agreements, etc.
- Facilitating mobilization of domestic/international resources
- Establishing/strengthening the National Financial Vehicles
- Supporting the development of bankable projects
- Designing risk-reducing instruments
- Accessing clean technologies
- Providing carbon trading partnership
- Strengthening country capacity through training programs with tools and methodologies
- Providing knowledge sharing platforms, including multi-stakeholders and private sector
Supporting Partner Governments to achieve the SDGs and NDCs

Work with 33 developing country partner governments to achieve their **Nationally Determined Contributions** (NDCs)

GGGI’s 70 projects currently contribute to most of the 17 **Sustainable Development Goals** (SDGs)
For GGGI Green Cities are...

Innovative & Smart
Inclusive & Pro-Poor
Healthy & Liveable
Prosperous & Bankable
Resource-efficient & Low Carbon
Climate Smart & Resilient

“A city/town/city-region which pursues resource efficient, low-carbon, climate resilient and socially inclusive urban development, generating green job opportunities”
GGGI’s priority areas to transform cities

1. Mainstreaming green growth into urban planning, management and finance.
   - Green (secondary) cities strategic planning.
   - Strengthened municipal finances.
   - Increased green public spaces.
   - Climate-resilient urban infrastructure.
   - Green buildings, sustainable low-cost housing.

2. Supporting circular urban systems & economies
   - Improved solid waste management.
   - Waste-to-energy, waste-to-resource.
   - Enhanced local livelihoods, jobs, investment.

3. Sustainable urban infrastructure and transport to support connected & healthy cities
   - Climate resilient and adaptive urban infrastructure.
   - Improved air quality through transport solutions.
   - Sustainable ecosystems and ecosystem services in urban & peri-urban areas.
Reflection:

How do we understand: smart cities; green cities & smart+green cities?
A Smart City is Green &
A Green City is Smart!

A smart green city is well governed, inclusive, manages its eco-resources sustainably and through ICT is able to provide efficient, affordable and effective services to all through smart approaches and systems. It is able to efficiently use finances & generate investment to support its plans.
Applying data smartly

- Increased digitization
- Open source data
- Increased connectivity

**Smart cities**: Value of data is in its use - interpretation towards decision-making

**Functions of digital infrastructure**
Are Smart Cities Green Cities?

• Smart city applications can support innovations in transport; quality of life; economic competitiveness; planning; communications and good governance.

• Most approaches to smart cities have shifted from ICT-centred to include people and quality of life.

• But are the benefits of ‘smart city solutions’ being realized in addressing major urban sustainability challenges?

• Smart city applications can gather data & create information platforms open to all: but how effectively is this used to shape sustainability agendas?
The Limits of Separation

• **Integration of Smart & Green is not automatic** & benefits are not always clear.

• For some a smart city is to foster a green/sustainable city through greater efficiency, cleaner production, decreased GHGs etc.

• **Smart cities also may have environmental costs**: a 'high-tech' city is energy-hungry.

• Energy consumption & e-Waste: the hidden face of our digital world.

• The digital ecological footprint: computer+internet activity now greater than air transport energy emissions; by 2025 the digital energy footprint will be greater than road transport.
Towards Green+Smart Cities

- No ‘models’ or single strategies: smart+green cities range from centralized to decentralized; technology-printed to collaborative; public-oriented to private/crowd-sourced.

- What they share: integration & application of smart approaches & technology in supporting sustainability.

Following slides address Areas of environmental & technological convergence for developed to developing country applications focusing on:

- Waste management (service innovations, value chain analysis, material valorization, circular economy.)
- Buildings, infrastructure and mobility – which represent key lagging areas in collective efforts to curb CO2 emissions.
- Climate smart & resilient cities (mitigation & adaptation)
• Buildings and grey infrastructure consume **substantial energy** through their production and operations.

• As global population grows in numbers and wealth, **demand for new infrastructure** increases.

• In developed countries, **aging infrastructure** and extreme weather events push infrastructure systems to failure. Limited funds for maintenance.
Physical infrastructure enhanced in capacity, efficiency, reliability and resilience.
Some applications of smart technology in urban infrastructure

- Sensors monitoring health of structures
- Public advisory signage, traffic updates
- Car park vacancy guide
- Automated lighting in parks
Share of smart commercial buildings by region

Smart building growth regions

**IRENA HQ — Abu Dhabi, United Arab Emirates**

<table>
<thead>
<tr>
<th>Aim</th>
<th>To construct an office space with minimal environmental impact.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Method</strong></td>
<td>1. Installed 1,000 square-meters of rooftop solar photovoltaic panels and solar thermal water heaters.</td>
</tr>
<tr>
<td></td>
<td>2. Connected with smart energy management systems throughout the building to conserve water and energy.</td>
</tr>
<tr>
<td></td>
<td>3. Sustainability features in the building achieved <strong>four-pearl Estidama rating</strong>, exceeding requirement.</td>
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<tr>
<td></td>
<td>4. Windows and sunshades block off 90% direct solar radiation.</td>
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<td></td>
<td>5. Wide and central stairways to encourage use of stairs rather than lifts.</td>
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</tbody>
</table>

**Benefits**

- Building consumes 40% less energy than global standard, powered by solar panels. Solar thermal water heaters meet 75% of the building’s annual hot water demand.
- Water consumption is reduced by 53%.

**Impact**

The new headquarters for International Renewable Energy Agency’s (IRENA) in Masdar City, Abu Dhabi, exemplifies the “four pillars of sustainability” of the Estidama - social, environmental, economic and cultural.
Smart Affordable Homes

- **Smart lighting** — sensor control, remote control.
- **Security systems** — locks, alarms, CCTV.
- **Heating/Cooling systems** — thermostat-controlled house heating/cooling.
- **Water pipe sensors** — monitoring pipe leakages.
- **Climate smart & adaptive** — homes & materials
Waste: From Crisis to Opportunity

• BAU: Serious resource impacts for local/municipal government
• Estimated 20-50% of municipal budgets
• Relying on conventional way of "Collect & Dump" approaches
• Geographical limits of landfill systems

But with better understanding of waste composition, the potential for development of business models & investment windows grows.

High proportion of organic waste provides economic opportunities through waste management.

Increasing appetite for change.
Transforming waste systems by integrating smart solutions and technology

1. Urgently address **separation at source** while minimizing waste generation; apply digitalized volume-based waste collection systems.

2. Support existing and new economies around recycling and **valorization of recyclables** by creating online platforms to connect waste generators and local recyclable collectors.

3. Establish **economic opportunities around organic waste** by collecting separated organic waste at source through sensor-based organic waste bins.

4. Converting local informal dumpsites into material recovery centers with **integrated resource management solutions** (e.g. smart sorting, processing, and information system).
**Volume-based Waste Fee - Seoul, Republic of Korea**

<table>
<thead>
<tr>
<th>Aim</th>
<th>To reduce volume of waste generated, to segregate waste.</th>
</tr>
</thead>
</table>
| **Method** | 1. Households/businesses purchase standard bags for waste disposal.  
2. Standard bags differ in color and size for different types of waste.  
3. The bags for households are purchased at designated places, while sales and distribution of bags for business purposes are commissioned to private companies.  
4. Households pay for disposing of food waste at the food waste machine using special cards. |
| **Benefits** | • **District information on waste generation** and disposal is automatically collected through sales of waste bags.  
• Weight scale food waste machine encourages households to **reduce food waste**.  
• Collected **waste is sorted**, ready for recycling/reuse. |
<p>| <strong>Impact</strong> | The Volume-Based Waste Fee system reduced the amount of waste generation by 16.6% and increased the recycling rate from 15.7% to 43% (between 1994-2001). |</p>
<table>
<thead>
<tr>
<th>Aim</th>
<th>To increase the ease and efficiency of waste collection for recycling.</th>
</tr>
</thead>
</table>
| Method | 1. Households/businesses use a multifunctional recycling WebApp with a comprehensive toolkit on waste recycling and collection to call a waste collector when waste is ready for collection.  
2. Waste is weighed and recorded in the application during collection.  
3. Webapp includes a rewards system which records points from the collected recyclables. Points are redeemable for products made from the collected materials and offers discounts in associated brands. |
| Benefits | • Provides 200 jobs and improved the health and safety conditions for waste collectors. Provides reliable incomes to waste management sector workers.  
• Markets green products through a rewards scheme.  
• Increased diversion of recyclable waste from landfill. |
| Impact | Reduced the landfill by 900kg of plastic, 600kg of metals, and 550kg of paper products during its pilot program alone. |
Sensor-based organic waste boxes - Turin, Italy

<table>
<thead>
<tr>
<th>Aim</th>
<th>To ensure segregation of organic waste in households.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>1. Municipal government distributes organic waste boxes installed with information chips to every household.</td>
</tr>
<tr>
<td></td>
<td>2. Information chip informs collectors if there are bins for collection and tracks bins to prevent losses. It also prevents theft of boxes.</td>
</tr>
<tr>
<td></td>
<td>3. Waste collector is able to report households that do not separate organic waste through the information chip.</td>
</tr>
<tr>
<td>Benefits</td>
<td>• Organic waste is separated from other household waste.</td>
</tr>
<tr>
<td></td>
<td>• Covered bins increase collection rates and prevent wild animals from rummaging through the bins.</td>
</tr>
<tr>
<td>Impact</td>
<td>Reduction of mixed waste volume being sent to landfills.</td>
</tr>
</tbody>
</table>
Smart & Green Mobility
Smart & Green Mobility

- **Planned cities** – Need to plan for public & private transport including NMT. Smart & Green includes accessible & connected cities.

- **Technology** – includes citywide infrastructure (Wi-Fi & adequate energy) to meet demand.
Public & Private Smart and Green Transport

• **Private vehicles**: Use of Wi-fi to connect cars with GPS, manage traffic in real time.

• **Public transport**: Users connect via smartphones to access public transport data, bus schedules updated in real time.

• **Electric cars/buses**: running on battery, Wi-fi-enabled. Question to consider: *is the grid clean? Could be future of smart vehicles be autonomous, are cities ready for this technology?*

• **Challenges**: High infrastructure cost; data privacy; inadequate coordination between departments.
# Integrated Public Transport — Seoul, Korea

## Challenge
Seoul had poor transport infrastructure in 1950s and 1960s. Increasing number of cars led to congestion & calls for public transportation.

## Aim
To provide an adequate mobility option to the public in Seoul.

## Method
1. Introduce features to improve efficiency of bus service. These include bus lanes, smart traffic cards, public transport information system.
2. Establish a control center that collects real-time traffic data, monitors 9,000 buses, vehicle violations (speeding, parking, stopping, etc.) and road accidents.
3. Control center analyzes traffic demand and causes of congestion and provides real-time traffic information. Also carries out unmanned enforcement.

## Benefits
- Provides low-cost, efficient and reliable transport to 7 million passengers daily. Public satisfaction rate **96%**.
- Reduced reliance on private cars to move around the city.

## Impact
Greater use and reliability of public buses.
Reduced congestion on the roads, improved air quality and reduced GHG emissions.
**Challenge**
Medellin has a mountainous topography which led to inaccessibility of transportation and exclusion of communities on the hillsides. The exclusion exacerbated issues of poverty, crime and violence in these communities.

**Aim**
To connect poor hillside communities to city services and opportunities.

**Method**
1. Introduce integrated mobility network designed for the city, promoting transit-oriented development.
2. Network consists of multi-modal options: metro, cable car, BRT, bus services, public bicycle-sharing and tram.
3. Also implemented infrastructure projects highlighting inclusiveness and connectivity. Public spaces and outdoor escalators promote access and social interactions.
4. Integrated payment system uses single card across systems.

**Benefits**
- Travel time to the city reduced from 90 to 30 minutes.
- About 90% of poor hillside communities perceive improvement in quality of life.

**Impact**
Decreased crime rates and reduced traffic congestion in the hillside communities.
Increased walking and cycling in public spaces, increased access to the city.

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Inclusive Ecomobility Network
Medellin, Colombia

Transport in Medellín

[Images of transport in Medellin]
<table>
<thead>
<tr>
<th>Challenge</th>
<th>Bus fares in Kigali used to be paid in cash, collected by conductors. This was inefficient and often resulted in loss of revenue for operators and overpaying for passengers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aim</td>
<td>To improve the efficiency and safety of fee collection in buses.</td>
</tr>
</tbody>
</table>
| Method          | 1. The Tap & Go smart payment solution launched in 2015, was developed by a local start up. The initiative is a joint venture between a Rwanda technology company, the government and city bus operators.  
                  2. The system also monitors the location of the bus, its speed and information about passengers onboard.  
                  3. Commuters can charge smart cards through their mobile money account or Tap & Go agents. |
| Benefits        | • Improved revenue collection rates for bus operators and reduced operational costs.  
                  • Commuters are able to use the payment card for other services.                                                                 |
| Impact          | Demand to export the payment solution to other cities and countries.                                                                                                                                 |

**Bus Smart Card System — Kigali, Rwanda**
Climate Smart & Resilient Cities

On the frontline: Cities represent concentrated vulnerabilities (of assets, infrastructure and people).

- What does it take to be a climate smart green city?
- Co-advancement of resilience, mitigation, adaption

‘Climate Smart’ cities: integrated systems which avoid cascading failure.

- Smart city applications support adaptation/shift away from sector approaches & fragmented planning & investment responses (role of artificial intelligence).
- Smart climate resilient cities also invest in resilience of their communities – especially the most vulnerable.
Singapore Marina Barrage

- Tidal and flood control barrier.
- Inland freshwater reservoir.
- Urban recreational space.
- Sensors continually monitoring pressure on structure.

Climate resilient smart infrastructure
GROUP DISCUSSION

Please select the topics relevant to the group and discuss (20 mins).

City Planning — How could your city use smart technology to plan for “green and inclusive growth”? What is needed to improve the resilience of your city and how can smart technologies support it?

Waste Management — How can smart technology be applied to improve waste management in your city?

Green building & built environment — What are the opportunities in promoting green building and green public spaces with smart technology? What policy options would you suggest to tackle the impediments?

Sustainable transportation & mobility — How can you use big data to improve mobility and connectivity in your city? How else can technology enhance mobility?
THREE KEY TAKEAWAYS

Co-dependency
Green and Smart Cities are co-dependent on each other in sustainable city planning and implementation.

Observation through evidence-based data
Smart cities are not always high-technology based but it is more about using the data and information to design cities to be more climate resilient, inclusive, low-carbon, and resource efficient.

Transformation
Transform the way we plan, manage resources, design urban infrastructure, communicate with urban dwellers, invest urban finance to make our cities greener and smarter.
Towards Green + Smart Cities:
Key Transformations

<table>
<thead>
<tr>
<th>The way we plan</th>
<th>To achieve smart, green &amp; sustainable cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>The way buildings are designed &amp; operated</td>
<td>For a resource efficient &amp; low carbon built environment</td>
</tr>
<tr>
<td>The energy produced &amp; consumed</td>
<td>Access to renewable energy &amp; efficiency</td>
</tr>
<tr>
<td>Waste to resources</td>
<td>Close the waste/resource loop</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water resource management</th>
<th>Access to clean water and sanitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The way people move and connect</td>
<td>Connected &amp; walkable/less motorized cities</td>
</tr>
<tr>
<td>Balancing expansion, growth &amp; opportunity</td>
<td>Pro-poor and inclusive cities</td>
</tr>
<tr>
<td>Enhance investment prospects for ‘green finance’</td>
<td>Address how cities manage and account for their assets</td>
</tr>
</tbody>
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