BMZ Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung

Operationalizing the Urban NEXUS

Towards resource-efficient and integrated cities and metropolitan regions

Published by

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

ICLEI Local Governments for Sustainability

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Foreword

Carmen Vogt
Head of Sector Project
"Sustainable Development of Metropolitan Regions"
GIZ – Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH

Monika Zimmermann
Deputy Secretary General
ICLEI – Local Governments for Sustainability

and

Kathrine Brekke
Urban Research Officer
ICLEI – Local Governments for Sustainability

Today, more than half of the world's population lives in urban areas. In addition to demographic growth, cities and metropolitan regions are centers of economic activity and increased resource consumption. A global "business as usual" scenario will drive up the demand for water, energy and food by 30-50% by the year 2030. Simultaneously, a doubling of the world's urban population is projected to result in a tripling of land consumption. This rapid urbanization requires an integrated perspective on urban planning and management, which is able to foster urgent synergies needed between sectors to limit adverse consequences, mitigate trade-offs and ensure sustainable urban development.

The Bonn 2011 Conference, "The Water-Energy-Food Security Nexus – Solutions for the Green Economy", co-organized by the German Federal Ministry for Economic Cooperation and Development (BMZ) and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) concluded with a major political impulse towards the Rio+20 debate on securing the world's future sustainability. The message is simple however, the task complex: it is time to leave behind the mono-sectoral planning and management practices of the past, in favor of enhanced coordination between sectors; thus resulting in accelerated access to resources and overall resource efficiency. Since, the NEXUS perspective has taken its first steps from the arena of international debate, to projects on the ground.

This study on "Operationalizing the Urban NEXUS: Towards resource-efficient and integrated cities and metropolitan regions", features an essential step ahead in putting the NEXUS into practice for a sustainable urban future by delivering an approach, which encourages new ways of thinking and action in institutions, policy making and society at large.

The Urban NEXUS responds to the urgent need for policies and implementation mechanisms with an approach to counter silo-thinking in vital urban sectors. This approach addresses the crucial metropolitan sectors of Water, Energy and Food, to additionally encompass policy areas such as land-use, social inclusion, waste and transport management, in order to achieve a more efficient and effective use of resource cycles in urban and peri-urban areas. A key factor for the success of the Urban NEXUS approach is its methodology for both vertically and horizontally integrated governance, building upon existing urban development strategies for enhanced coordination. In doing so, the Urban NEXUS offers customized solutions to sustainably govern rural-urban linkages and resource interdependencies through comprehensive spatial perspectives. It thereby provides salient future-oriented solutions in the context of the Habitat III debate as well as for the shaping of a New Urban Agenda.

This study was undertaken by ICLEI – Local Governments for Sustainability in cooperation with and commissioned by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Sector Project "Sustainable Development of Metropolitan Regions" – on behalf of the BMZ. We express our special appreciation and gratitude to Jeb Brugmann, founder of ICLEI, founding partner of The Next Practice and lead-author of this study, for his concept building in elaborating the Urban NEXUS approach. Further, our thanks go to the project team at the ICLEI World Secretariat, ICLEI South Asia and ICLEI Africa, as well as our implementing partners in the two Urban NEXUS pilot project cities Nashik, India, and Kinondoni Municipality in Dar es Salaam, Tanzania.

The aim of this publication is to provide a conceptual foundation and hands-on approach that serves to inspire, identify and implement Urban NEXUS solutions for integrated, resource-efficient development in metropolitan regions. It shall thereby spark exchange, debate, and learning across sectors and scales.

Executive Summary

Operationalizing the Urban NEXUS: towards resource-efficient and integrated cities and metropolitan regions

Cities are where we must address both local and global resource constraints

Policy makers at all levels and practitioners from across the public, private, philanthropic and civil society sectors recognize that human civilization is facing increasingly urgent resource constraints. These will require a dramatic optimization of the way we use resources. Isolated "business as usual" solutions aimed at just one sector miss out on efficiently resolving these resource challenges of the 21st century – a century marked by an increasing demand for urban space and higher quality of life amidst rising costs of lifestyles and urban production, increasing risk and vulnerability, and declining investment and fiscal support for urban development.

Today, more than half of the world's population lives in urban areas, with seven out of ten of the 9.6 billion people on the planet projected to live in cities by 2050 (WHO, 2013). In addition to demographic growth, cities and metropolitan regions are dynamic centers of economic activity and vast resource flows. As such, cities and metropolitan regions comprise the world's most complex "nexus" of social, political, economic and ecological systems.

The extent of rapid urbanization trends is translating into a growing and urgent demand for new or improved infrastructures, services and institutions capable of meeting the three-fold challenge of: 1) providing larger urban populations with access to basic services and vital resources, 2) sustaining continuous economic development, and 3) managing resources within our planetary limitations while addressing the challenges of climate change adaptation and mitigation.

Attempts to satisfy the resource demands of growing urban areas and lifestyles has meant looking ever further afield for supplies – from metropolitan and rural hinterlands, and increasingly at the regional and global level. Meanwhile, prevailing urban governance and management practices in which resources are managed in isolation by their respective sectoral departments (e.g. water, energy, agriculture), have resulted in wasteful trade-offs and increasing fragmentation of infrastructure, land-use and governance mechanisms at the city and metropolitan level. To sustainably govern these rural-urban linkages and resource inter-dependencies, it is now more recognized than ever that the way forward must be an integrated approach to development and resource management, both across sectors and across scales.

A growing number of cities from across the globe, such as Curitiba, Brazil, to Durban, South Africa, have boldly put this notion to practice by turning away from dis-integrated "silo" planning, to dramatically optimize synergies between sectors and manage trade-offs through innovative integrated and cost-effective planning, as well as collaborative decision-making and implementation.

The study "Operationalizing the Urban NEXUS" is founded on these pioneering experiences from cities all over the world that have recognized the crucial inter-linkages between sectors such as water, energy and food – now commonly understood as the "Water-Energy-Food security NEXUS" . Going beyond the Water-Energy-Food NEXUS, the examples in this study integrate a variety

of strategic urban resource sectors and services ranging from combining sustainable urban transportation with inclusive housing and employment schemes, to coupling waste management with energy production, and sanitation solutions with social inclusion and biodiversity conservation.

Such innovative solutions have broken the barriers between sectors and stakeholders, and between the institutions and levels of government involved in their conception and implementation.

Given the wealth of global examples to learn from, this study developed a transferrable and action-oriented methodology to operationalize such practices of organizational and resource optimization in urban and metropolitan regions. The study defines the "Urban NEXUS Approach" and a project development cycle (the Urban NEXUS Development Cycle) founded on successful real-world experiences, and it offers city makers a "how-to" framework for implementing integrated Urban NEXUS solutions.

Introducing the Urban NEXUS: a way to break "silos" and collaboratively optimize urban resources

What is the Urban NEXUS?

The Urban NEXUS is an approach to the design of sustainable urban development solutions. The approach guides stakeholders to identify and pursue possible synergies between sectors, jurisdictions, and technical domains, so as to increase institutional performance, optimize resource management, and service quality.

It counters traditional sectoral thinking, trade-offs, and divided responsibilities that often result in poorly coordinated investments, increased costs, and underutilized infrastructures and facilities. The ultimate goal of the Urban NEXUS approach is to accelerate access to services, and to increase service quality and the quality of life within our planetary boundaries.

GIZ and ICLEI, 2014

The Urban NEXUS seeks out opportunities for integration in cities and metropolitan regions at the different scales of the built environment and its infrastructures; integration of the region's supply chains and resource cycles; and of the policies and operations of local, regional, sub-national and national jurisdictions. For that purpose, an Urban NEXUS solution integrates two or more systems, services, policy or operational "silos", jurisdictions or social behaviors, in order to achieve multiple urban policy objectives and to deliver greater benefits with equal or less resources. Urban NEXUS solutions typically involve a set of coordinated measures that range the areas of technology, policy, planning, finance, business models, institutional design, and communications - amounting to a "solution set".

An **Urban NEXUS solution** integrates two or more systems, services, policy or operational "silos", jurisdictions or social behaviors.

Although the process for identifying a prospect and designing a solution may be transferable, Urban NEXUS solutions developed for one place may not be transferable to another. Therefore, the Urban NEXUS approach is fundamentally a process of solution customization, and depends on the valuable input from all relevant stakeholders.

As an **institutional agenda**, the Urban NEXUS approach urges governments at all levels and international development organizations to institute fundamental reforms in policies, institutional arrangements, as well as project development and finance guidelines in order to significantly reduce isolated, uncoordinated and ultimately inefficient urban development approaches. Anchoring the Urban NEXUS in institutions and institutional processes and thus ensuring long-term systemic reforms, strengthens integrated urban development in spite of intermittent, possibly conflicting political interests or political change.

Implementing the Urban NEXUS Approach

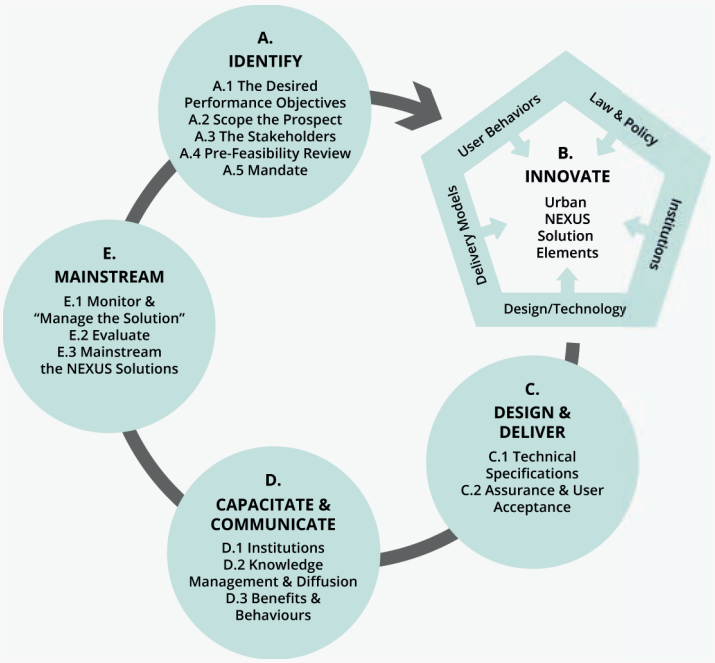
The Urban NEXUS Development Cycle

Building upon established concepts and practices of integrated planning, the Urban NEXUS Development Cycle provides a strategic design process for collaboratively translating integrated policy and planning objectives into feasible projects, technical solutions, and operations.

Examples given in this study show that the cities with the most successful practices in terms of development innovation have been the first to establish design processes, capacities and institutions to complement their planning schemes; thus designing more integrated solutions in collaboration with the public and private sector. To offer other city makers a framework for such a development innovation process, the following sub-sections briefly outline each stage of the Urban NEXUS Development Cycle:

Key strategy question:
What process will be used to accelerate the preparation, testing, monitoring & evaluation, and scaling of an Urban NEXUS solution?

Figure 1:
The Urban NEXUS Development Cycle is a process for translating integrated planning objectives into policies, projects, systems, and places.



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Key strategy questions:
What are the targeted increases in organizational and resource productivity? How will we measure Urban NEXUS success?

And what are the prospects for productivity enhancing synergies and benefits that can be gained by integrating two or more of your operations or systems?

A. IDENTIFY. The four primary Urban NEXUS Practice Objectives – increased systemic effectiveness, increased demand-driven suitability and customization, increased productive efficiency, and increased resilience and adaptive capacity – are identified and adapted locally. To achieve the strategic objectives, stakeholders then identify the local Urban NEXUS integration prospects. Prospects for building synergies can be found in five Areas of Integration:

- **Integration across Scales** of the built environment, infrastructures, local and regional supply chains and resource cycles, and policies and operations of local, regional, sub-national and national jurisdictions;
- **Integration of Systems** of resource extraction and power generation, food cultivation, processing, manufacture, resource supply and waste management etc. by establishing cascades and cycles of resources between systems;
- **Integration of Services and Facilities** to avoid the underutilization of valuable fixed assets by integrating services and facilities conventionally separated by sectoral functions;
- **Integration across Silos** consolidating institutional interests and managerial and professional "silos" arising from the organization of urban areas and systems into separate jurisdictions, utilities, and departments; and finally
- **Integration of Social Relations and Behaviors** to enable all stakeholders' engagement in the above integration dimensions, and counter legacies of cultural, social, and political division.

Key strategy question:
What innovations, measures and reforms are required to enable the Urban NEXUS prospect?

B. INNOVATE. The identified stakeholders collaborate in a structured innovation process to develop a set of politically, institutionally, and economically viable measures in the Areas of Urban NEXUS Innovation spanning the range of law and policy, design and technology, delivery models and financing, communications and changing user behaviors, and institutional design and development.

Key strategy questions:
Are there already locally established or piloted technical and operational solutions this project can build on and improve?

Which system performance measures will be used to evaluate system-wide outcomes?

C. DESIGN and DELIVER. The design and delivery of the solution includes prototyping and piloting it in a real-world operating environment. This study included the implementation of two such pilot projects in Nashik, India and in Dar es Salaam, Tanzania. These cities took first steps in implementing an Urban NEXUS approach in an exemplary way. In the limited duration of the pilot projects, the Urban NEXUS brought together a wide range of stakeholders who had never before been sitting together at one table, thus generating new "institutional nexus". They collaboratively designed and implemented innovative solutions and programs for optimizing water, energy and land resources in peri-urban agricultural practices (Nashik), and improving the learning environment at two municipal schools while installing integrated energy efficient technologies, rainwater catchment and vertical food production systems (Dar es Salaam) to demonstrate the benefits of Urban NEXUS thinking to local communities and government officials.

Key strategy questions:
What capacities, skills and behaviors will be required to establish a new solution, and ensure that it is maximized?

What will be the best channels for such communication and capacitation?

D. COMMUNICATE and CAPACITATE. The three main areas of capacity building typically required to establish a new solution are: training operational staff on managing their parts of the solution; encouraging behavioral change and building required skills of beneficiaries; and enabling the relevant institutions to establish a systematic process for introducing and supporting it in new locations or facilities.

E. UPSCALE and MAINSTREAM the Urban NEXUS. Mainstreaming in many cases is a matter of designating or creating an entity that specializes in the scaling of all the unique aspects of the given Urban NEXUS solution; an entity with the capacity to address location-specific problems and to "manage the solution" within different contexts.

Key strategy questions:
Which performance outcomes would you like to see replicated and up-scaled?

What were the main challenges to learn from and success factors to mainstream in existing and future initiatives?

Accelerating action and strategic cooperation towards Urban NEXUS solutions

The Urban NEXUS provides a necessary and crucial alternative to continuing with "business as usual" approaches to urban development, services and infrastructure. When decision makers actively counter sectoral thinking and divided responsibilities, they can encourage the collaborative development of the solutions urgently required in cities and metropolitan regions. In doing so, this will not only optimize the use of limited natural, financial, and human resources and institutional performance, it will improve resource productivity and quality of life.

For this purpose, this study inspires innovative actions towards local and regional NEXUS solutions and provides a framework for action with the Urban NEXUS Development Cycle for their collaborative design and implementation. However, there are tested and demonstrated factors for success for decision makers, civil society actors and international development cooperation agencies to apply:

- Identify "hotspots". When identifying priorities for Urban NEXUS projects, consider the areas, or "hotspots", where this approach would have the most multiplier or ripple effects to maximize the reach and benefit of the initiative.
- Bring all stakeholders around the same table by creating "Urban NEXUS Task Forces". Urban NEXUS Task Forces created to oversee Urban NEXUS projects at the urban and regional level serve the purpose of linking relevant departments and levels of government together with other key stakeholders (experts, civil society, private business, NGOs and multi-lateral organizations). Urban NEXUS Task Forces are a simple way to kick-off, strengthen and sustain cross-departmental collaboration offering stakeholders a taste of "breaking the silos". Eventually, the goal is to institutionalize such multi-stakeholder collaboration.
- Encourage all governmental authorities and stakeholders at all levels to be part of Urban NEXUS solutions, which should re-connect scales and optimize complex cross-boundary resource flows (e.g. river basin management).
- Promote supportive framework conditions for Urban NEXUS solutions at all levels. Urban NEXUS projects regardless of their size and scope are embedded in regulatory and administrative frameworks. For example, national "silos" in regulation, public procurement, budgeting and accounting processes, etc., can hinder innovative integrated approaches and cross-departmental cooperation at the local level. Supportive national and decentralized frameworks regarding legislative mandates, financial support and incentives are therefore crucial for the up-scaling of successful local and regional Urban NEXUS initiatives.

What is the role of international development cooperation?

The German Development Cooperation under the lead of the Federal Ministry for Economic Cooperation and Development have played a vital part in the initial development of the Urban NEXUS approach. For the future, the approach is intended to spread out to international and local partners in order to multiply implementation, assessment and learning experiences off the beaten track of mono-sectoral thinking. In doing so, the Urban NEXUS thinking offers a new perspective to the achievement of ambitious global objectives on sustainable urban development, i.e. in the course of debating the New Urban Agenda at the Habitat III coference or the Sustainable Development Goals within the post-2015 Development Agenda.

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Part 1. Introducing the Urban NEXUS

1.1 Why the Urban NEXUS?

Key messages

- The interlinkages of urban systems, and the Urban NEXUS as an approach, represent an important opportunity to optimize cities and metropolitan regions in order to address local, national and global sustainable development objectives, while meeting the challenges of resource scarcity, environmental pollution and degradation of ecosystem services.
- Urban resource flows are determined, amongst other things, by urban form and infrastructure and the various technical, political, social and economic systems supporting them. These are typically fragmented across various departments, jurisdictions, services silos, civic organizations, utilities and companies, and professional disciplines.
- Conventional fragmented and sector-specific approaches to urban policy, design and management miss out on possibilities to more efficiently address human needs, community priorities, and local, regional and global resource challenges.
- Identifying and implementing integration prospects to further optimize systems and services cannot be left to coincidence. It requires a defined implementation approach: the Urban NEXUS.

Cities are where we must address global and local resource constraints

Policy makers at all levels, and practitioners from across the public, private, philanthropic and civil society sectors have now long recognized that human civilization is facing increasingly urgent resource constraints, and that sustaining social and economic development within planetary limitations will require a dramatic optimization of the way we use resources. The Urban NEXUS approach described in this study describes a process for identifying and developing opportunities to further optimize urban systems and services, involving all sectors to meet basic human needs while increasing resource sustainability. The approach was developed as a "how-to" framework based on over 30 concrete urban and metropolitan examples of offering real entry points for Urban NEXUS integration.

The productivity of cities and urban regions is determined by the various jurisdictions, utilities and service departments, civic organizations, companies, and disciplines that share and divide the responsibility for the city's social and economic development, urban form, and infrastructures. However, the prevailing fragmented nature of urban institutions and services systems and urban management approaches does not reflect and respond to cities as complex, fast-changing, and highly interdependent systems– and to the great potential that they hold.

So called "silo-thinking" and isolated solutions aimed at just one sector or service area miss out on opportunities to more productively resolve the challenges facing our urbanized world, and focus attention on selecting trade-offs rather than developing co-benefits.

As has already been established in other publications (Hoff, 2011[i]; Bonn2011

Nexus Conference report2[ii] ; FAO, 2014 and ICLEI&UNEP 2013[iii]), integration across jurisdictions and sectors creates opportunities to optimize resources and develop co-benefits, increasing policy effectiveness, and social and economic productivity and resilience. However, the discovery of such opportunities, which are viable from a political, market and institutional perspective, cannot be left to coincidence or random invention. It requires a defined and relatively specialized approach. The Urban NEXUS Approach, explored in this study offers an action-oriented practice for the identification and development of good prospects to support growing populations and economies to achieve much more with much less.

The Urban NEXUS is an approach to the design of sustainable urban development solutions. The approach guides stakeholders to identify and pursue possible synergies between sectors, jurisdictions, and technical domains, so as to increase institutional performance, optimize resource management, and service quality.

It counters traditional sectoral thinking, trade-offs, and divided responsibilities that often result in poorly coordinated investments, increased costs, and underutilized infrastructures and facilities. The ultimate goal of the Urban NEXUS approach is to accelerate access to services, and to increase service quality and the quality of life within our planetary boundaries.

As a method for designing and governing urban systems, the Urban NEXUS approach guides local governments and relevant stakeholders to identify good prospects for achieving multiple urban policy objectives through each of their investments, projects, or programs.

An Urban NEXUS prospect by definition, indicates an opportunity to integrate the routine operations or practices of two or more of a city or metropolitan region's assets, systems, scales, services, and social groups or behavioral patterns in order to optimize resources and deliver greater benefits. This requires intensive coordination and collaboration between the departments, jurisdictions, services silos, civic organizations, companies, and disciplines that share responsibility for the development of the city and metropolitan region.

To identify and understand potential Urban NEXUS prospects, the existing interactions and interdependencies in urban policies, systems and locations – or "nexus points" – need to be jointly explored by stakeholders. Urban NEXUS prospects are only real prospects if they are operationally feasible within the current operating environment, and negotiable with the key stakeholders and users. Such prospects can be identified at different scales, given the different scales of articulation of urban systems, ranging from single assets and very local places to global networks of trade, migration, andcommunications.

An **Urban NEXUS solution** integrates two or more systems, services, policy or operational silos, jurisdictions and/or social behaviors.

As Urban NEXUS solutions typically involve a set of coordinated measures that range the areas of technology, policy, planning, finance, business models, institutional design, and communications – the solution is often a "solution set" of integrated measures. The process for identifying a good prospect and designing a solution may be transferable, but given the complexities and nuances of different urban settings, the Urban NEXUS solutions developed for one region may not be transferable to another or even locally replicable, in

spite of similarities between the "nexus points". **The Urban NEXUS Approach, therefore, is fundamentally a process of solution customization.**

As an **institutional agenda**, the Urban NEXUS Approach urges governments at all levels and international development organizations to institute fundamental reforms in policies as well as project development and finance guidelines in order to significantly reduce isolated, uncoordinated and ultimately inefficient urban development approaches. Anchoring the Urban NEXUS in institutional arrangements fosters long-term systemic reforms and strengthens integrated urban development in spite of intermittent, possibly conflicting political interests or political change.

There are many successful examples of Urban NEXUS solutions, as described in the case studies presented in this report. However, many of these successful cases achieved their Urban NEXUS outcomes due to very unique local leadership and circumstances. The elaboration of a general Urban NEXUS approach in this report aims to guide other leaders and managers of cities and metropolitan regions to accelerate the process and broaden the scope of Urban NEXUS innovation.

An opportunity to link global development goals and objectives with the world's urban realities

Over the last decade, governments at all levels, international institutions, the private sector and NGOs have themselves developed a "nexus" of common purpose regarding the latent potential of cities.

Figure 1:
The Urban NEXUS provides an opportunity to simultaneously address local, national and global objectives

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This is reflected in the goals of the international community, in the evolving urban development policies and strategies of many nations, and in the advancing best practices of metropolitan regions.

Collectively, the above-mentioned actors have long recognized the adverse global impacts of uncoordinated, fragmented approaches to rapid urbanization. One often repeated indicator is the persistence of a population of nearly one billion "slum dwellers"[iv] in the world, proving the inadequacy of past urban housing, infrastructure and services approaches. Inefficiencies in urban energy provision and demand-side management have made urban regions the point sources of global climate change, with as much as 80 percent of the world's greenhouse gas emissions generated in cities.[v] Even the positive benefits of urbanization, such as access to higher protein diets, are associated with the degradation of the world's fisheries and sensitive terrestrial ecological systems. [vi]

Reflecting this reality, the international community has increasingly recognized the importance of cities and the roles of regional and local governments as partners in addressing global challenges. This recognition began with the United Nations endorsement of Local Agenda 21 in 1992, the Habitat Agenda in 1997, the establishment of the Cities Alliance in 1999, and with the engagement of local government associations in the international climate and biodiversity convention processes. Even as cities are places where global challenges are aggravated, they also hold great potential as places of productivity, creativity and efficiency.

Yet, urban governments and stakeholders have hardly developed their cities to their potential as centers of social, economic and environmental problem solving. It is towards this end that the Urban NEXUS approach is being developed by a wide range of institutions: from local governments and NGOs and international city networks, to national governments and international organizations like the UN Food and Agriculture Organization (FAO). Within the context of this wide-ranging effort, the following study seeks to elaborate an accessible, widely applicable way to discover and approach Urban NEXUS prospects, bridging gaps between widely supported international development goals and persistent, on the ground actualities.

Applications of the Urban NEXUS approach in individual cities and metropolitan regions may start small, as stakeholders learn how to work together differently. But at scale, Urban NEXUS solutions can have profound impacts. These impacts are illustrated by the case studies presented throughout Parts II and III of this study. Collectively, the cases selected for this study indicate how Urban NEXUS solutions can not only address resource challenges in developed cities but also how they contribute to the ultimate achievement of international development objectives, such as the United Nations' Millennium Development Goals (see Table 1 below), in cites with poor resources – financial, professional and institutional.

> *"The Urban Nexus approach provides a useful framework for meeting the needs and demands of a growing urban population. Slums or urban low-income areas present a particular challenge, considering that currently close to 1 billion people live in slum conditions and that by 2030 this figure will have doubled. Slum dwellers often live without safe drinking water, have no decent toilets, leave alone environmentally safe disposal systems. They are rarely connected to modern energy and there is no proper solid waste collection system. In short, slums are public health hotspots and are directly associated with the urban crisis in many developing countries."*
>
> **Dr. Uschi Eid**, Chair of the Board United Nations Secretary General's Advisory Board on Water and Sanitation
>
> *Statement provided to ICLEI for this Urban NEXUS study, March 2014.*

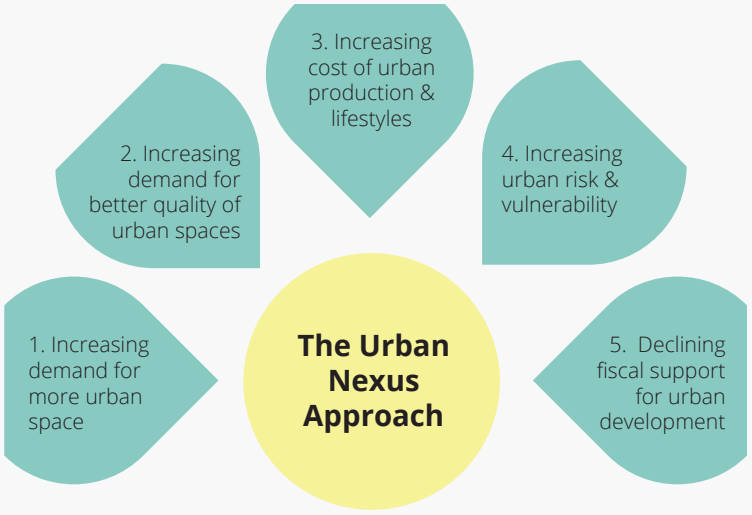
"In this rapidly urbanizing world, the Urban NEXUS approach that brings together water, energy and food in the urban context, cannot be discussed without the concept of city region food systems. In other words, the "urban" cannot stand alone, but it is interdependent with its surroundings, the ecosystem and the people within, and outside the boundaries of the cities.
This requires us to tackle the issues we face today in a holistic manner. With limited natural resources, increase in extreme weather events and volatile global economy, cities must take the nexus approach for a more resilient and sustainable development. Producing 'more with less'."

Dr. Ren Wang,
Assistant Director General, Agriculture and Consumer Protection Department, FAO.

Responding to global urban challenges: real-world drivers for an emerging Urban NEXUS

The Urban NEXUS approach responds to the challenges of five current urban mega-trends that all compel more coordinated, responsive and efficient approaches to urban investment and development:

Figure 2:
The Urban NEXUS responds to the challenging demands of a rapidly urbanizing world



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1. **Increasing scarcity and demand for more urban space: the 21st century will remain a century of rapidly increasing demand for urban places.** Over the next decades and on a worldwide basis, urban migration and agglomeration economies will intensify the expansion of urban and metropolitan regions and the renewal of existing urban areas. Global urban populations will increase by 1.4 billion between 2010 and 2030 according to United Nations' forecasts, and by another 1.4 billion between 2030 and 2050. With current rates of urbanization, this will result in a tripling of the world's urbanized surface area by 2030.

2. **Increasing pressures to improve the quality of urban spaces: the 21st century will be confronted by equally compelling pressures to improve the quality of urban spaces.** In 2010, UN-HABITAT estimated that about 889 million people were living in so-called slums – underserviced urban areas where residents do not have clear, legal land title, quality housing, and even basic infrastructure and services. UN-HABITAT estimated that the number of slum dwellers will further increase by nearly 500 million by 2020[vii]. At the other end of the quality spectrum, the economic competitiveness of urban regions is also a function of the quality of serviced urban locations--meaning the quality of urban infrastructure, educational system quality, research and cultural facilities, and quality of life for employees (e.g., commute times, safety and security, quality residential areas).

3. **Increasing costs of urban production and lifestyles: changing consumption patterns are contributing to substantial upward pressure on the basic cost structure of 21st century urban regions and their industrialized economies.** Despite the inequalities in and across urban

regions, urban population growth is associated with increased resource consumption. As societies urbanize, energy consumption patterns shift from biomass as the primary fuel in rural areas to electricity and extracted, refined fuels in urban areas. Urban and metropolitan energy demand for transportation, lighting, heating, cooling and appliances further alter energy demand patterns. Food consumption switches substantially from high carbohydrate diets to high protein diets. Food waste increases. In most urban areas potable water is supplied by extensive, linear pump and pipe systems, and consumption also increases on a per capita basis, leaving high volumes of waste water.

4. **Increasing urban risk and vulnerability: cities and metropolitan regions face increasing risk exposures and vulnerabilities due to 20th century approaches to urban development combined with increasing climate, health, and economic risks.** Damages from natural disasters have risen from an estimated $20 billion per annum in the 1990s to about $100 billion per annum during the 2000–10 decade[viii], due to three key factors that are associated with the character of 20th century urbanization: the growing density of urban populations and assets along exposed coastlines and in seismically active regions; the low quality of urban construction; and the limited factoring of natural disaster risk exposure in the design of infrastructure. Further, the realities of global climate change have increased urban exposures and vulnerabilities to tropical storms, sea level rise, flooding, extreme heat events, droughts, and fire.

5. **Declining fiscal support for urban development: the 21st century is one of increasing public sector fiscal constraint.** Global economic fundamentals, the recent financial system crises, and public policy trends together substantially reduce government capacity at all levels to invest in urban infrastructure and regeneration. Standard and Poors estimates that the gap between government capital expenditures and global infrastructure requirements could reach $500 billion per annum between 2014 and 2030.

These trends and challenges differ in intensity and form in cities and metropolitan regions in the global South and the global North. The Urban NEXUS introduces an approach to local solution customization that is applicable to the distinct challenges facing cities in both development contexts.

For example, in cities of the South, the challenges related to informal urban settlements and economies are not adequately met by the conventional effort to introduce forms of service provision and resource management from the North. Furthermore, development projects in cities of the South are often undertaken via top-down and technocratic support from international financing institutions. This heavily shapes and often predetermines the objectives, innovation, scope of intervention and stakeholder integration often excluding local authorities and communities. In this context, an Urban NEXUS institutional agenda is crucial for building the right capacities within local governmental institutions, and for strengthening collaboration with national governments, civil society and businesses, while providing access to more sustainable, resource-efficient and cost-effective infrastructures and service delivery models suited for the local context (*see also the text box, The Current "Nexus" Problematic and Potentials in Cities of the South on p. 23*).

On the other hand, in cities of the North, contemporary austerity measures and declining fiscal support for urban development requires innovation in historic institutional and managerial practices to better optimize resources and urban service delivery models. An increasing awareness of the optimization opportunities that lie in the regeneration of ageing infrastructures and building stocks drives the search for Urban NEXUS solutions.

> *"For rapid urban growth to be sustainable, in the context of climate change and food security, there is need for "decoupling". Essentially, this means enhancing the quality of life while simultaneously minimizing resource extraction, energy consumption, and waste generation, and safeguarding ecosystem services. Decoupling will depend on how cities are planned and on how city-based energy, waste, transportation, food, water, and sanitation systems are expanded and/or reconfigured. In this regard, there is a clear role for food systems and urban agriculture. Indeed, well planned and managed urban agriculture can play a key role in decoupling, as part of the overall food systems within a city-region."*
>
> **Rafael Tuts,**
> Coordinator, Urban Planning and Design Branch United Nations Human Settlements Program, UN- Habitat

See also the full complementary article on "Local food production contributing to climate change adaptation, resource efficiency and poverty alleviation" by Marielle Dubbeling (RUAF) in Annex B

Table 1: Urban NEXUS solutions can advance the achievement of the Millennium Development Goals

THE MILLENNIUM DEVELOPMENT GAP			THE URBAN NEXUS
Millennium Development Goal (Sample)	**Current Trends In underdevelopment** (The United Nations reports [ix])	**Conventional Solution** (Generalized examples)	**Urban NEXUS Solutions**
Achieve full and productive employment and decent work for all, including women and young people (target under MDG 1)	Although there has been a reduction of the number of workers living below the $1.25 a day poverty line, 384 million workers live below that line today.	A variety of uncoordinated and sometimes conflicting policies, subsidies, training and business support programs established by different ministries and tiers of government – to boost investment and growth in a specific industry, labor market segment, and location.	**Establishing clear livelihoods pathways from informal to formal sector enterprise.** Such a program typically requires the integration of policies at national, sub-national and local levels. Example: An integrated program of land tenure reform, micro-enterprise development, banking services, and public and private procurement policies establishing a clear livelihood pathway to develop informal low-wage micro-enterprise livelihoods into registered small business.
Halve, between 1990 and 2015, the proportion of people who suffer from hunger (MDG 1)	Globally, about 870 million people are estimated to be undernourished. More than 100 million children below the age of five are still undernourished and underweight.	A mix of uncoordinated and sometimes conflicting public subsidies, welfare supports, farm support services, on the one hand, and market-based foreign investment and food sector de-regulation initiatives that sustain uncertainty regarding crop allocation (e.g., corn for food or biofuels?), prices, and technologies in the food sector.	**Establish comprehensive community-based health, education, and food facilities.** Such facilities typically require the integration of jurisdictions, policies and departments at national, sub-national and local levels. Example: An integrated facility that coordinates provision of maternal and child health and nutrition, child and adult education, community gardens and kitchen as a multi-purpose community hub.
Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling (MDG 2)	In 2011, 57 million children of primary school age were out of school. Globally, 123 million youth (aged 15 to 24) lack basic reading and writing skills. 61 per cent of them are young women. The children of educated mothers – even mothers with only primary schooling – are more likely to survive than children of mothers with no education.		
Reduce by two thirds, between 1990 and 2015, the under-five mortality rate (MDG 4)			
Halve, by 2015, the proportion of the population without sustainable access to basic sanitation (target under MDG 7)	The UN estimates that 2.5 billion people in developing countries still lack access to improved sanitation facilities.	Investment in separate waste management systems and infrastructures for solid, liquid, industrial, construction and other waste streams, often managed by different tiers of government in an uncoordinated fashion. Lack of linkage between sectors that produce and supply wastes (e.g., consumer product packaging) and sectors that have to manage the wastes.	**Establish integrated waste-food-watershed management systems for resource recovery rather than waste removal.** Such a system typically requires the integration of urban and rural markets within an urban region beyond municipal administrative boundaries. Example: An integrated system of community-based composting and biological treatment facilities in informal communities, food waste collection micro-enterprises, bio-fertilizer production and community management of forests and farming.

Each of the examples provided in Table 1 illustrate how more integrated local approaches to urban programs, facilities, and systems can also offer substantial solutions to global development challenges. The examples further illustrate how comprehensive solutions of this nature also require collaborative approaches spanning jurisdictions and sectors, disciplines and organizational silos. The Urban NEXUS approach, described in this study, presents a process to support such collaborative, integrated action.

1.2 Example of an Urban NEXUS Approach: turning a proven idea into a mainstream practice

Key messages

What, then, does an Urban NEXUS approach look like on the ground? And how does it differ from conventional approaches to urban challenges?

- A conventional urban management approach applies technically distinct solutions through administratively distinct units. The fragmented nature of urban systems and urban management does not reflect and respond to cities as fast-changing and highly interdependent systems. This results in a wide range of inadequately addressed 20th century urban development challenges including: efficacy problems, suitability problems, efficiency problems, and resiliency problems.
- The Urban NEXUS approach to urban management addresses multiple urban policy aims through single integrated solutions and investments, to address this development challenge.
- In Curitiba, Brazil six distinct urban challenges were addressed in a concerted way with the comprehensive River Corridor Urban NEXUS, the Transport Corridor Urban NEXUS and Food-waste Urban NEXUS.

A wide range of recognized urban best practices cases give proof that local governments in both the North and South can identify, develop, scale and benefit tremendously from Urban NEXUS solutions.

Consider for instance the case of Curitiba, Brazil during its rapid growth in the 1970s-80s as a city located in the flood plain of converging rivers:

- The city experienced biannual floods. During some years, the flooding caused extensive loss of life and damages. Among the primary victims are poor migrants from rural areas, who build vulnerable, low quality squatter settlements along the river banks.
- Meanwhile, the city's underdeveloped road system was becoming clogged with poorly regulated bus operators and a growing number of private automobiles.
- The city offered few amenities to its growing population. On a per capita basis there were few parks, recreational and cultural facilities. Heritage areas lack reinvestment and are in decay. Natural habitats are being destroyed by uncontrolled clearing and poor quality building.

The Current 'NEXUS' Problematic and Potentials in Cities of the South

The wasteful, and in most cases poorly functioning, practices of urban resource provision in the South come from attempts to apply methods of provision from the North, which are all too often reinforced by development cooperation and investments formulated and financed by international financial institutions (IFI's). This has resulted in 'institutional cultures' that perpetuate inefficiencies in a situation where 'traditional cultural sensitivities' and evolved local practices are both ill-adapted to the attempted methods of provision and may also be resistant to new approaches proposed in the framework of an Urban NEXUS. Finally, all too often local expertise and financial capacity of city authorities are insufficient to implement the conventional systems and methods, with the result that these tend to work very poorly.

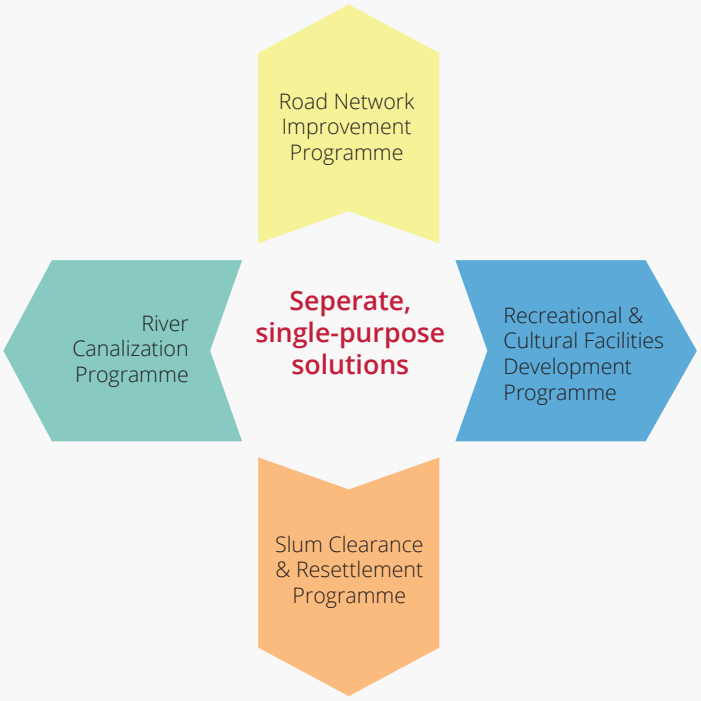
Adrian Atkinson, Consultant
Find his full article in Annex B

- With this kind of growth and congestion, the city's attractiveness as a place for business investment was stagnating.

Confronted by such challenges, Curitiba had the choice to undertake a conventional approach to urban improvement involving a series of distinct investment and management programs, each within a distinct urban management silo. This approach is illustrated in Figure 3, below.

For instance, public works to control flooding might not be coordinated with the development of new affordable housing for residents of the affected riverside communities. Crude slum clearance and displacement could trigger new slum building in another vulnerable area. These coordination problems might be amplified by political differences between the leaders in different government

Figure 3:
A Conventional Urban Management Approach implements separate, single-purpose solutions through administratively distinct units



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jurisdictions and levels. In such a circumstance, it would likely take years, if not decades, for relevant jurisdictions to align behind an investment program and to select between the alternative technical solutions.

Even when coordination problems are overcome and investment programs are established for flood control, roads, housing etc., these are designed according to the distinct and standards for each of the relevant technical domains, for example, civil engineering, planning, building codes, health codes etc.

For instance, in many flood prone cities as in Curitiba, national and international development finance institutions and civil engineering professionals have promoted the canalization of rivers. Similarly, transportation engineers have viewed the best solution to traffic congestion to be widening and expansion of the city's ring road and highway networks, often cutting through important

commercial, residential, and natural areas. River corridors that had been cleared for canalization were historically treated as ideal corridors for new roadways. Concerns about riparian habitats, likely limited to an entirely separate environmental protection and management unit, would be of secondary interest. The provision of parklands would likely be addressed in a separate program, led by a distinct parks department.

In retrospect, in spite of the benefits that such standardization and specialization can bring, the 20th century approach to urban development and management demonstrated four key weaknesses in responding to the challenges of rapid urban growth.

Challenges of conventional 20th century urban development approaches

Efficacy Challenges. When urban challenges are addressed through single purpose infrastructures and systems, they are generally also managed as separate silos, reducing the potential to coordinate, customize, and optimize assets and services to achieve greater city-wide impact at less cost. The division of urban policy making, capital budgeting, planning, and management into multiple jurisdictions and departmental silos frequently results in delayed and poorly coordinated investments. It is not uncommon for an investment program in one area – for instance, the expansion of articulated water supply – to cause major problems in another area, such as in the area of drainage and sanitation.

Suitability Challenges. The design and management of urban infrastructure and services systems by separate, specialist agencies and departments, each managing a distinct part of city operations according to often international disciplinary standards, limits the ability of city administrations to customize solutions for unique local conditions and opportunities. Such an institutional approach is also inherently supply-driven, focused on delivering solutions that satisfy the norms and requirements of the department or agency and its technicians, rather than exploring alternative ways to address the need from a demand-side perspective, engaging with the end users. This is particularly a problem when a city government or resident population in a developing nation cannot afford internationally standardized solutions and technologies.

Efficiency Challenges. Poor coordination and lack of customization to local conditions and priorities increases the overall capital requirements and operating costs for urban services. Solutions are designed to address single, specialist challenges and not to address multiple challenges simultaneously. As a result, the resources input into any one solution—such as power supply, potable water, fuels, chemicals and waste water effluents—are only used once for that single purpose rather than being efficiently applied to support another solution. One result is fiscal strain. In the late 20th century, for instance, one could travel city-to-city across the developing world, visiting internationally financed sewage treatment plants that often stood idle because required power, treatment chemicals, and maintenance could not be afforded.

Resiliency Challenges. Fixed and capital intensive infrastructures and facilities, can prove difficult to adapt to the new conditions of new eras. Design for a narrow, current range of environmental and operating conditions exposes facilities to costly if not catastrophic failures in the face of changing risks and during extreme events.

Breaking the "silos" in thinking and action

"Silo -thinking" refers to the mind-set and practice where an organization such as a municipality or a company is organized and works around the concept of individual functions, departments or sectors.

Entire resource systems often represent such "silos", right from the natural resource base (e.g. ground water) to their separate facilities (municipal pumping facilities, distribution for irrigation), utilities (regional water company), and institutions (regional water protection board) that manage them, right up to separate national ministries that deal with them (e.g. the Ministry of Water Resources for ground water, or Ministry of Environment for wastewater and sewage).

Although sometimes very efficient within their own structures, the efficiency of overall operations is reduced by such fragmentation as information is not shared, co-benefits from collaboration and integrated actions are lost, and the cumulative benefits from combining budgets are not realized. "Silo cultures" encourage institutional introversion, competition or reduced morale to the detriment of a productive collective culture.

In summary, the 20th century practice of urban systems and management does not reflect and respond to cities as complex, fast-changing, and highly interdependent systems. The Urban NEXUS approach seeks to address aforementioned challenges as also reflected in the Urban NEXUS Practice Objectives (*see section 2.5*).

Some cities recognized the weaknesses of the 20th century approach. In the period of the 1970-90s, Curitiba designed, implemented and scaled a set of solutions to its flooding, housing, transport, and natural amenities challenges that were better coordinated, more responsive, less costly and resource intensive, and more easily managed and adaptable to changing circumstances. They did this by inventing what can now be understood as two Urban NEXUS solution sets – one addressing the river corridors and one addressing the transportation corridors – integrated together to address the city's major development challenges (*see Figure 4 below*).

The Curitiba River Corridor Urban NEXUS

International development finance institutions had urged the city to canalize its rivers to solve the flooding problems, but the long-term costs of such a solution were deemed to be prohibitive to the city administration. As an alternative, long before it was considered an acceptable technical approach, city engineers decided to re-establish and enhance the natural flood plains of the rivers to manage flood waters. The solution involved the creation of a chain of 28 parks containing diverse recreational and cultural facilities and protected natural habitats, linked by an extensive system of cycling trails. In other words, the city's flood control "infrastructure" was designed to serve multiple functions. Retention ponds were created to hold back flood waters due to river surges or heavy rainstorms, but also to support pleasure boating. Sports fields and parks were designed with aggregates and soil mixes that sped percolation of flood waters into the groundwater table. Cultural facilities were designed for each of the city's diverse ethnic communities, establishing a sense of ownership and identity for the new park system, inhibiting further invasions and unregulated development in the river plains. All of these investments were made at 1/5 of the cost of constructing canals – while very substantially reducing flood risks. The simultaneous reduction of risks and development of recreational, cultural, and habitat resources along the rivers increased the values of private properties alongside the flood plain, ultimately also increasing municipal tax revenues.

Taking this approach presented two immediate challenges: displaced private landowners within the river corridors did not wish to lose their properties and related property development rights; and informal squatter communities would need to be resettled in less hazard prone areas. Such issues might have scuttled the city's innovative vision. However, in an Urban NEXUS approach the search for solutions begins with consideration of how to turn problems into benefits, and wastes and liabilities into assets in other areas of urban development and management.

The Curitiba Transport Corridor Urban NEXUS 1970-1990

The demands by riverside property owners to retain their development investment opportunities, combined with overall demand for increased housing supply (in a city whose population grew by 6% annually for nearly three decades) can be leveraged into an opportunity for integrated housing and transportation development. In the case of Curitiba between 1972- 1988, these challenges were channeled into the development of some of the most

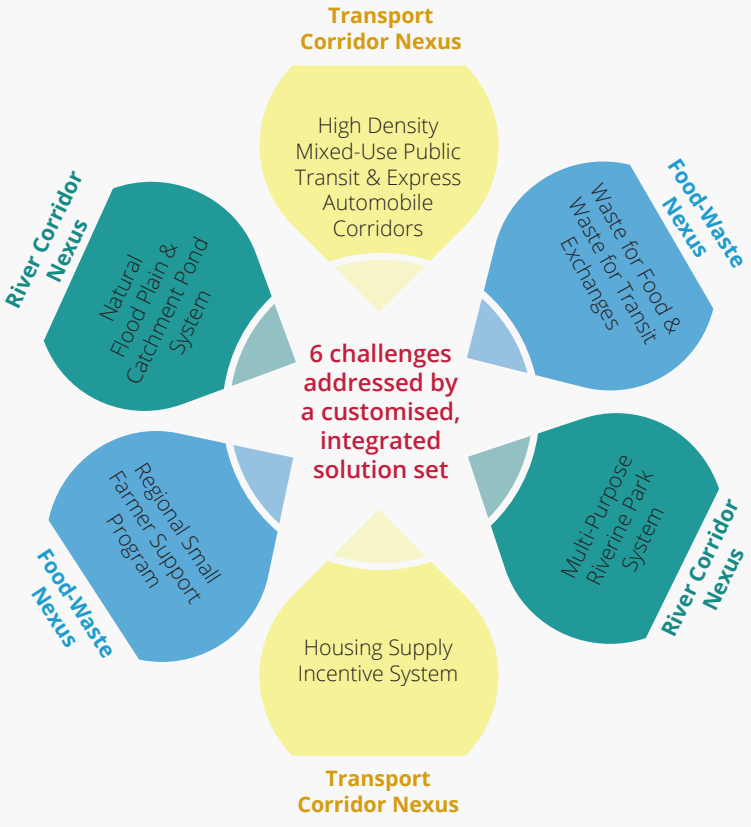
innovative and famous urban transportation corridors in the world: the Curitiba structural axes.

To clear the city's flood plains property owners were traded properties and high-rise development (i.e., air space) rights where the city most wished to concentrate residential population growth – immediately abutting a new bus rapid transit (BRT) system. This creation of valuable development rights along the BRT corridors significantly reduced the need for an expensive riverside and park land acquisition program, or politically charged expropriations.

With growth concentrated along the city's five structural axes, the competition between growing bus fleets and private automobile fleets was eliminated by integrating both modes of transport into a unique trinary road structure that provided separate express bus and automobile lanes in and out of the central city, maintaining the vital function of the city's historic city core. Similarly, along the axes express bus routes were connected with both local and concentric feeder routes and bus system "integration stations".

Through these and other measures, such as Curitiba's waste for transit tickets exchange program, Curitiba modeled an entirely different way of designing urban infrastructure, services and amenities. In addition to the leadership of Mayor Jaime Lerner and his stable team of city managers, the city's success depended upon the creation of distinct quasi-public institutions and a matrix management approach within the city administration. In hindsight today, the approach taken by Curitiba – and by initiatives in other best practices cities – can be generalized as a new form of development initiative planning and management: the Urban NEXUS approach.

Figure 4:
An "Urban NEXUS" approach to urban management in Curitiba collaboratively addressed multiple urban policy aims through each integrated solution and investment



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The Urban NEXUS for "productive" cities and metropolitan regions

The Urban NEXUS approach supports collaboration to generate more effective, suitable, efficient and resilient solutions to pressing urban development challenges. Whether focused on challenges confronting low income informal sector communities or on wealthy corporate sector districts, the Urban NEXUS approach identifies economically viable and politically and socially suitable ways to increase benefits from investments in urban infrastructure, utilities, facilities, services, and places. Put differently, just as industrial innovation focuses on increasing productivity in the economic sector, the Urban NEXUS approach seeks to increase the productivity of resources, urban finance, assets, and services in the urban sector. The result is greater resource efficiency and enhanced quality of life.

In this study we use the concept of "productivity" broadly. Productivity is historically associated with the efficiency of economic production, with an emphasis on the amount of output (in volume or financial terms) associated with the amount of capital and labor input. In the 1990s, economists and the business community broadened their evaluation of productivity, by tracking the amount of economic output associated with other factor inputs, such as energy. Meanwhile, ecologists have used the concept of productivity to understand the evolving energy and nutrient efficiency of ecosystems via their nutrient cycles as they mature through different stages of ecosystem development. Urban ecologists and ecological economists have merged these divergent ways of understanding productivity. Today, urban ecology seeks to understand the productivity of urban systems and regions from a human capital, social capital, economic/financial capital, and natural capital perspective.[x]

It is from such a perspective that this study presents a framework for developing, evaluating, and piloting Urban NEXUS initiatives and investment programs. Expanding the scope of NEXUS thinking from its original focus on cross-optimizing three resource systems – specifically on the energy-food-water NEXUS – the Urban NEXUS approach presented in this study supports a broader exploration of opportunities arising from integrated social, economic and natural resource measures. Furthermore, whereas the original exploration of the energy-food-water NEXUS has engaged policy makers and technical and managerial professionals, this study focuses on elaborating a more participatory, multi-stakeholder approach towards the design of Urban NEXUS initiatives.

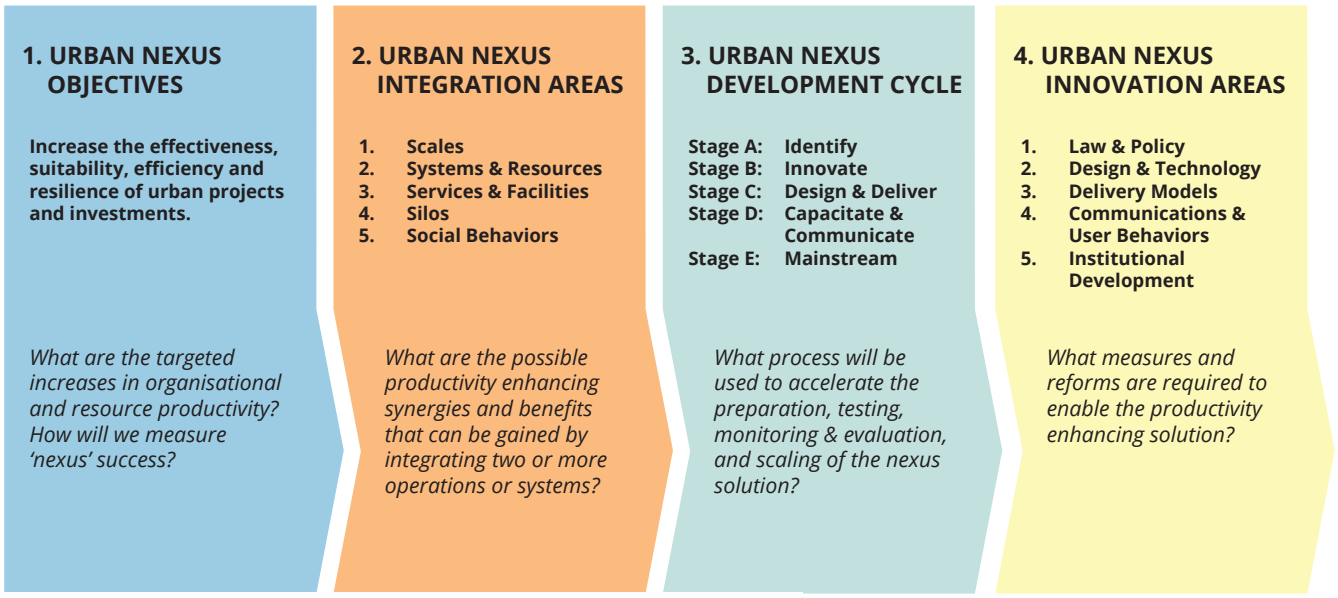
The resulting Urban NEXUS approach is summarized in Figure 5 below (explained in more detail on p. 40). This figure also provides an outline of the main sections of this report.

According to this framework, four Urban NEXUS objectives – effectiveness, suitability, efficiency and resilience – are used as principles for the design of systemic solutions to increase urban productivity (as described in this chapter).

The prospects for increasing effectiveness, suitability, efficiency and resilience are explored in five arenas where integration measures can typically be found to increase urban productivity; that is, in re-integration across the

- Scales of urban governance and operations;
- urban resource Systems and the resource cycles they create;
- urban Services & facilities;
- the fragmented organizational and technical Silos of departments and professional disciplines; and
- Social Behaviors.

Figure 5:
The Urban NEXUS Approach focuses on identifying and developing prospects for achieving multiple urban policy objectives through single investments, projects or programs



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These five arenas of potential reform and integration are further explored in **Part 2** of this study. Part 2 also provides a further historical and conceptual overview of the development of the Urban NEXUS concept, with reference to the movement towards more integrated planning and management in both the public and private sectors since the early 1990s.

Part 3 of the study describes the Urban NEXUS Development Cycle, and how Urban NEXUS integration potentials in one or more of the above five arenas can be identified and developed into practicable solutions, using a multi-stakeholder innovation process. The section uses case examples to describe how innovation of a systemic nature typically requires measures and reforms in five areas of practice (i.e., the Urban NEXUS innovation areas). These innovation areas are: Policy & Law, Design & Technology, Business & Delivery Models, Communications & User Behaviors, and Institutional Development.

Part 4 presents recommendations and conclusions regarding the Urban NEXUS approach for local and regional decision makers, national decision makers, development cooperation agencies, and for further research.

> *"It is true that much of the meaningful effort to create sustainable livelihoods for global citizens is taking place - and will take place - in cities. In order to have success in the effort there is need for a "systems" perspective, where one does not only look at the intended effect of an initiative, but also at its effects in all other areas of urban life. In this broad perspective there is one challenge that is normally neglected, namely how to avoid a huge and destructive inflow of new people to any city that is particularly successful in creating a good life for its citizens. This difficult question needs an answer in order to achieve success in the Urban NEXUS."*
>
> **Prof. Jorgen Randers,** Author of 2052: a global forecast for the next 40 years

Notes

i. Hoff, H. (2011). Understanding the Nexus. Background Paper. Retrieved January 2014, from: http://www.water-energy-food.org/en/news/view__255/understanding-the-nexus.html

ii. Martin-Nagle R. et.al. (2011). The Water, Energy and Food Security Nexus – Solutions for the Green Economy. Conference Synopsis. Retrieved January 2014, from: http://www.water-energy-food.org/en/whats_the_nexus/messages_policy_recommendations.html.

iii. ICLEI and UNEP (2013). Towards Resource Efficient Cities: A global city survey. Retrieved June 2014, from: http://www.iclei.org/fileadmin/PUBLICATIONS/Papers/GI-REC_Global_Survey_Report_Final_2013_ICLEI-UNEP.pdf (Note: The global survey found that integrated and participatory governance and innovation are the most important success factors for projects/programs for resource efficiency in cities.)

iv. The term "slum" usually has derogatory connotations and can suggest that a settlement needs replacement or can legitimate the eviction of its residents. However, it is a difficult term to avoid but is not used here with derogatory connotations. Where the term is used in this study, as per the definition used by the International Institute for Environment and Development (IIED) it refers to settlements with some of the following features: a lack of formal recognition on the part of local government of the settlement and its residents; the absence of secure tenure for residents; inadequacies in provision for infrastructure and services; overcrowded and sub-standard dwellings; and location on land less than suitable for occupation. For a discussion of more precise ways to classify the range of housing sub-markets through which those with limited incomes buy, rent or build accommodation, see Environment and Urbanization Vol. 1, No. 2, Retrieved June 2014, from: http://eau.sagepub.com/content/1/2.

v. The World Bank (2010). Cities and Climate Change: An Urgent Agenda. The World Bank, Washington D.C., p. 15. Retrieved January 2014, from: http://wbi.worldbank.org/wbi/document/cities-and-climate-change-urgent-agenda.

vi. Other ecological stresses are tied to wider trends of population, consumption, and industrial inefficiency. These include water stress, peak oil, and species losses. Water stress, for instance, is caused by the unequal distribution of water on the planet as well as by a rate of water use that has grown twice as fast as the rate of population increase over the last century

vii. United Nations Human Settlements Programme, UN-HABITAT (2010). State of the World's Cities 2010/2011: Bridging the Urban Divide. UN-Habitat, Earthscan, London

viii. The data cited in this table are quoted or summarized from www.un.org/milleniumgoals. Retrieved: March 2014.

ix. Laframboise, L. and Loko, B. (2012). Natural Disasters: Mitigating Impact, Managing Risks. IMF Working Paper, WP/12/245. Retrieved January 2014, from: https://www.imf.org/external/pubs/ft/wp/2012/wp12245.pdf.

x. Roseland, M. (2012). Toward Sustainable Communities: Solutions for Citizens and Their Governments - Fourth Edition. New Society Publishers, Gabriola Island, British Columbia.; Also see: Roseland, M. (2000). Sustainable community development: integrating environmental, economic, and social objectives. Progress in Planning. Vol. 54, pp. 73–132.; And: Hancock, T. (2001). People, Partnerships and Human Progress: Building Community Capital. Health Promotion International. Vol. 16, No. 3, pp. 275-280.

Part 2. Developing the Urban NEXUS Approach

2.1 From integrated planning and systems thinking to the Urban NEXUS design

Today's interest in the Urban NEXUS reflects more than two decades of planning innovation, project experiments and best practices research in the area of "integration". These efforts marked a continuous evolution of the understanding of cities and urban regions as complex systems of systems—as agglomerations of political, market, infrastructure, resource, legal and institutional, ecological, community and cultural systems that are connected and connecting on a worldwide basis.

Although a systemic understanding of cities is accepted in scientific domains, it has not yet been sufficiently translated, in practicable ways, into the fields of urban planning, management, and governance; and even less applied in real-world projects, designs, and operations.

Reflecting the need for a "NEXUS" approach, integrated management has long been a pursuit in various sectors, such as Integrated Water Resource Management (IWRM) and Integrated Solid Waste Management (ISWM), which emerged as an initial response to growing recognition on the fragility of ecosystem services and ineffective fragmented administrative structures. However, integrated planning and management has not proven sufficient since planning initiatives have failed to be integrated within the conventional operations of local governments through systemic institutional reform or to sufficiently trigger such reforms. For more a more detailed overview on the historical and conceptual movement towards more integrated planning and management in both the public and private sectors since the early 1990, please also refer to Brugmann and Flatt's brief background paper.[i]

The Urban NEXUS is a continuation of the search for practical ways to counter the modernist legacy of siloed, uncoordinated city planning and development. The Urban NEXUS approach reflects a way to move beyond integrated planning and towards a new practice of policy, project and solutions design.

Addressing Rural-Urban Resource Conflicts: Co-Management of Water, Energy and Wastewater Flows for Water and Food Security

In India, one of the immediate implications of urbanization is on the ability to manage water for municipal and industrial water needs. In megacities, the dependence on imported water is as high as 90%. In regions, with limited surface water, the dependence on groundwater and the associated energy needed for its use in irrigation is already very high. As a result, India's urban-rural resource cycles for water, energy and food, form a complex nexus of production and consumption, highly reliant on the management of their respective sectors to sustain and enhance their provision. In response, **integrated urban water management** is gaining acceptance in developing as well as developed economies.

M. Dinesh Kumar, Executive Director of the Institute for Resource Analysis and Policy (IRAP), and is based in Hyderabad, India

Find the full article in Annex B

2.2 The history of the Urban NEXUS approach

Key messages

- The prevalence of the Urban NEXUS approach today is the collective achievement of a network of institutions, academics, policy-makers, firms' experts, civil society, NGOs and communities – particularly pivotal were efforts from various bodies and agencies of the German government, and the launching of idea at the Bonn2011 Conference: the Water, Energy and Food Security Nexus - Solutions for the Green Economy.
- NEXUS dialogues and conferences are being established worldwide to discuss ways forward, and to establish NEXUS thinking within global sustainable development debates and processes.

The prevalence of NEXUS thinking and approaches today is the collective achievement of a network of institutions, academics, policy-makers, firms and experts that is championing the integration of policy, infrastructure design, and resource management to address global and national resource constraints. In particular, the efforts of the German Federal Ministry for Economic Cooperation and Development (BMZ) and of the former Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and German Development Cooperation (GIZ and KfW) have been pivotal in recent years to establishing the NEXUS approach in theory, policy and practice.

In 2011, these efforts were launched with the Bonn2011 Conference: the Water, Energy and Food Security Nexus - Solutions for the Green Economy, co-organized by BMZ, BMU and GIZ. In addition to gathering over 100 institutions and 550 forward-thinking stakeholders from the water, energy and food sectors to discuss solutions to current global challenges and ensure that the NEXUS constituted a key theme in the Rio+20 2012 process, the conference introduced the NEXUS as a new policy and practice approach, with its background paper "Understanding the Nexus".[ii]

This background paper itself represented the scale and scope of the emerging NEXUS network, authored by Holger Hoff of the Stockholm Environment Institute (SEI) with contributors from the Food and Agriculture Organization of the United Nations (FAO), International Food Policy Research Institute (IFPRI), Stockholm International Water Institute (SIWI), TERI-The Energy and Resources Institute, World Business Council for Sustainable Development (WBCSD) and WWF. Within the context of the Rio+20 process, the paper discussed ways in which cross-sectoral management can improve resource efficiency, reduce resource and financial trade-offs, and forge the path to a Green Economy. Notably, at this stage in the emergence of the NEXUS approach, the focus of NEXUS opportunity was clearly fixed on the water, energy and food security "NEXUS". Today, and in the current study, the prospects for the Urban NEXUS are being further elaborated across other resource areas, as well as in social and economic development policy and practice.

The foundational 2011 conference paper does not explicitly define the NEXUS; it rather provides the arguments for the NEXUS approach as presenting a policy opportunity to simultaneously address the three dimensions of sustainable development:

- **Access to basic services** (i.e., the social dimension) to uphold and address human rights to water, sanitation and nutritious food,
- **Productivity of resource use** (i.e., the economic dimension) to reduce waste deter over-use and increase economic productivity, and
- **The valuing of ecosystem services and biodiversity** (i.e., the environmental dimension) in social and economic processes and decision making.

The opportune areas for such integrated policy were further outlined by the BMZ (2011)[iii] as the "NEXUS Opportunity Areas" including: increased policy coherence, accelerated access to resources, creating more with less, minimizing resource wastage, effective use of natural infrastructure and mobilized consumer influence (see text Box A). The current study seeks to further elaborate how these broad policy objectives can be articulated into the identification and design of practical Urban NEXUS Prospects.

Although the benefits of a NEXUS approach are clear, its implementation is less straightforward. The Bonn2011 Conference Synopsis, "Making it Work and Moving Forward"[iv], started addressing the primary hurdles underlying NEXUS implementation. Attendees closed in general agreement that the

Lessons from New York City's Green Roof Incentive Program

In 2007, the City of New York was resistant to the use of green infrastructure, including green roofs, to manage stormwater. At the time, more than 30 billion gallons of combined storm and sewage water overflow were being released into the New York Harbor per annum due to the antiquated sewage system, designed to drain the combined effluent into surrounding waterways. City engineers thought 'hard infrastructure' such as concrete pipes and tanks were legitimate interventions whereas 'green infrastructure' approaches such as green roofs and parkland were only useful for beautification and recreation. In 2008, S.W.I.M. developed a specialized working group among contractors, environmental organizations, business owners, economic development corporations, and community organizations to advocate for a green roof incentive program based on the scientific and economic benefits of green roofs. Research had concluded that a green roof cost sharing program would cost less than hard infrastructure solutions to manage stormwater while creating additional benefits.

Rob Crauderueff, Crauderueff & Associates, Co-Chair Stormwater Infrastructure Matters (S.W.I.M.) coalition

Find the full article in Annex B

institutionalization of the NEXUS approach requires significant societal and behavioral changes both in the way we connect with one another, as well as how we conceptualize risk within the public and private spheres.

The former requires the revamping of outdated institutional structures and planning system procedures to enhance horizontal linkages between sectors and vertical linkages between the local/subnational, national and international scales. Meanwhile, addressing the risk sensitivities of public and private sector actors towards more integrated approaches requires incentives and a shift in price-setting behavior to reflect the true value of resources in relation to their scarcity.

Since the Bonn 2011 conference, other events and networks have explored the NEXUS approach. These conferences have proven effective hubs to support an emerging community of NEXUS researchers and practitioners. In 2014, more conferences have sought to anchor the Water-Energy-Food NEXUS within global sustainable development debates and processes, e.g. the International Conference on Sustainability in the Water-Energy-Food Nexus held in Bonn (19-20 May 2014). Though typically focused on the opportunities arising from integration of water, energy, and food systems, their scope is quickly expanding to encompass unique urban challenges ranging from waste, mobility, and land-use to education, health and social equity.

Dedicated efforts are also being made to develop systematic ways to apply a NEXUS approach. For instance, in 2013 the German Development Cooperation, GIZ GmbH on behalf of the German Federal Ministry on Economic Cooperation and Development (BMZ), in cooperation with United Nations ESCAP, and ICLEI South East Asia launched a programme focused on identifying and developing NEXUS solutions from a ground-level practitioner perspective in ten cities in China, Indonesia, Mongolia, the Philippines, Thailand and Vietnam. The program, Integrated Resource Management in Asian Cities - the Urban Nexus, supports three-year pilot projects in ten cities. The projects include the setting up of NEXUS Task Forces in each project city to coordinate actors, identify NEXUS prospects, and pursue them through integrated planning and resource optimization measures as well as supports experience exchange and debate at a regional level[v]. Case studies on demonstration projects are then reflected in the framework of national-local dialogue forums in order to make the NEXUS approach sustainable.

Nearly two decades of integrated planning practices, combined with an extensive literature about integrated approaches and conference discussions about the NEXUS idea, highlight the need for a more detailed, elaborated process for the design of Urban NEXUS initiatives. The Bonn 2011 conference and related efforts to define the NEXUS opportunity and to establish practical NEXUS solutions have thus far been focused on natural resources efficiencies, and more specifically on the so-called water-energy-food NEXUS. This specific sectoral and technical focus has demonstrated the benefits of NEXUS thinking, but the potential application of the NEXUS as an approach to development policy, planning and project design, addressing the full range of social, economic, and environmental challenges within cities and their urban systems, services, facilities, and neighborhoods has as yet been little explored. For this purpose the NEXUS approach needs to be elaborated into an accessible and adaptable approach that supports stakeholders to harness NEXUS prospects and solutions. The elaboration of such an approach is the aim of this study.

2.3 The logic of Urban NEXUS practice

Key messages

- The Urban NEXUS approach enables stakeholders to collaboratively identify and develop prospects for achieving multiple urban policy objectives through each of their investments, projects, or programs. The outcome of a carefully designed Urban NEXUS initiative, solution set or investment program is more effective and optimized use of the city's resources – human, financial, built and natural.
- The Urban NEXUS approach proposed in this study has four main components: 1) setting local Urban NEXUS Objectives, 2) identifying Urban NEXUS Integration Areas, 3) the Urban NEXUS Development Cycle of implementation, which includes 4) exploiting the Urban NEXUS Innovation Areas (*see figure 6, p. 40*).
- Rio de Janeiro's Favela Bairro slum upgrading program provides an example of the five main areas/dimensions of Urban NEXUS Integration: scales, systems, services, silos, and social practices.

This section highlights the ways in which an Urban NEXUS approach can contribute to the achievement of a wide range of city development strategies, whether focused on pro-poor development, eco-efficiency, livability, or city/regional competitiveness and economic development. The section shows how the Urban NEXUS approach offers institutionalized agenda setting by applying integration principles to the design of urban sector policies, programs and investments. The outcome of a carefully designed NEXUS initiative, solution or investment program is increased productivity and access: more effective and optimized provision and use of the city's resources—human, financial, built and natural.

Favela Bairro: "slum-upgrading" with the architecture of an Urban NEXUS program

In many developing country cities like Rio de Janeiro, some favelas (slums) have populations of more than 100,000 residents and equal the scale of the formal city in terms of population and number of business enterprises. The integration of these matured slum communities into the formal life of a city remains one of the most complex challenges in the urban sector worldwide.

In general, there have been two main conventional approaches to urban slum "management" around the world. The first has been slum clearance by authorities, often violently executed, and the relocation of residents to new low-income settlements of marginal quality, generally on the urban periphery. The second conventional approach has been the incremental and limited upgrading of slums, generally taking a siloed approach in which improvements of different kinds – sanitation, roads, health services etc. – are poorly coordinated and delivered through time-limited programs. Partial measures, such as the construction of storm drains, may in themselves be a positive improvement, yet their benefits are often overwhelmed by a lack of improvement in other areas, such as the

institution of solid waste collection services to prevent storm drains from getting clogged.

After taking conventional approaches for some decades, the City of Rio de Janeiro and the state water company (CEDAE) with financial support from the Inter-American Development Bank established the Favela Bairro ('Favela-to-Neighborhood') program in 1995 to steadily develop 73 informal communities into serviced, formal city neighborhoods.

Residents were substantially involved in the planning and design of water, sewerage, drainage, street lighting, street paving, parks and sport areas, and reforestation investments, as well childcare, other social service centers and computer centers. In parallel, policies and laws were reformed to facilitate land titling and to establish special building code standards for favela homes so that they could be compliant with the law. Training programs were run on public health, community development, and micro-enterprise.

The coordinated implementation of these infrastructure and social services measures required substantial new institutional arrangements and inter-sectoral coordination. Municipal departments organized into cross-departmental Favela Bairro teams working together on each favela project. City and state level jurisdictions worked in similar and unprecedented partnership. The implementation of upgrading projects in each favela also involved residents' associations, NGOs, the church, and foundations. An international design competition was held early on in the program, involving dozens of architectural firms and schools in the search for solutions to difficult building and space allocation issues in steep and crowded favela sites.

Other municipal initiatives complemented the Favela Bairro upgrades, demonstrating an integrated approach. Following the implementation of upgrading projects municipal offices staffed by architects and social workers called POUSOS – Centers for Urban and Social Assessment were established in the favelas to coordinate efforts with residents.

In the years following the Favela Bairro program, such re-development measures in favelas were coordinated with legal and institutional measures to formalize property ownership, eliminate territorial control by drug cartels, and to establish favela communities as self-governing neighborhoods. Juridical barriers to the granting of land titles were initially addressed by the empowering of resident associations to issue notarized proof-of-ownership certificates to established residents.

Ultimately, new state laws were passed allowing the government to transfer titles to established residents on occupied public lands as a form of legal donation and to secure titles collectively for the entire favela community.

Drawing lessons from the Favela Bairro process, which focused on medium to larger sized favelas, the city then also applied a similar integrated program approach in smaller favela settlements. As a result, the city has committed to scaling up the approach across all of Rio de Janeiro's 815 favelas with the Morar Carioca program (also called "Favela Bairro Phase III") envisaged to be part of the social legacy of the 2016 Olympics. Nearly two decades of work has produced substantial development benefits and integration of Rio de Janeiro's formal and informal cities[vi], as well as unexpected shortcomings and disappointments[vii]. But no medium or large city, not to mention a mega-city, has ever so ambitiously worked towards such complete integration.

The Favela Bairro program, together with related initiatives of the City of Rio de Janeiro, effectively illustrates the critical elements of an Urban NEXUS initiative. Such an initiative ideally explores five areas of integration: integration across scales, systems, services, silos, and social behaviors (i.e., demand-side practices). It designs the integrations solutions in each of these five areas and addresses the four main Urban NEXUS objectives: efficacy, suitability, efficiency, and resilience. Applying this framework (*see Table 2 below*), we can understand the successes of the Favela Bairro program in Urban NEXUS terms.

Table 2: Favela Bairro and related programs, Rio de Janeiro – the architecture of an Urban NEXUS initiative

		Urban NEXUS Integration Areas				
		SYSTEMS (Re)-integration	**SCALES (Re)-integration**	**SERVICES (Re)-integration**	**SILOS (Re)-integration**	**SOCIAL BEHAVIORS (Re)-integration**
Urban NEXUS Objectives	**Efficient**	Water, drainage, sewerage, roads & other physical measures are designed and implemented simultaneously.	Resident Associations, local and state government, NGOs and international development institutions work under a single work programme and plan.	Education programmes are delivered in concert with the establishment of new social facilities. Resident Associations coordinate the delivery process.	Municipal departments and state water and power utilities integrate into a single programme unit. Decision making and resource allocation is coordinated.	Comprehensive and participatory development plans support norm-setting and self-regulation of negative social behaviours within the favela, such as deforestation and associated landslide hazards.
	Suitable	Engineering & design teams collaborate with residents to customise designs to locations and resident preferences.	The cooperating partners establish a work process in which all are guided by the local conditions of each favela.	Resident Associations coordinate resident participation in facilities selection, location, and design.	Resident Associations are strengthened as intermediaries with formal institutions, establishing effective communication of issues during implementation.	Granting legal titles and addresses to residents gives them fuller rights as residents and access to formal credit markets. The pathway to integration in the formal city is clearly established.
	Effective	Coordinated design & delivery, supported by policy reforms, prevented typical delays and half-measures compared with normal siloed efforts.	Work completion is accelerated through delivery as a single programme team.	Provision of services is done in concert with stabilisation of the community via both UPP pacification and land titling.	Policies, legal reforms, and court action at local and state levels are instituted in a coordinated fashion with the upgrading programme.	Elimination of governance by criminal organisations enables more transparent development decision making.
	Resilient	Customised infrastructure and services designs reduce operating and maintenance costs and allow residents to contribute to maintenance.	Focus on a few favelas at a time allows the programme team to learn and improve process as they go.	Although unplanned, multiple cycles of engagement (via Favela Bairro then UPP Social) enable response to community as it evolves.	Interdepartmental coordination and local-state cooperation have become norms, as well as establishment of municipal staff presence in larger favelas.	The parties have recognized the centrality of favela community to sustaining benefits and affordability. There is wide social awareness, across social groups, about the problems of gentrification.

The Urban NEXUS approach focuses on engaging stakeholders in a process of proactive innovation to secure Urban NEXUS prospects in various dimensions of potential integration. The Urban NEXUS Approach as illustrated earlier in Figure 5 (again in Figure 6 below), is elaborated in the sections to follow as a generic framework for cities to develop their own Urban NEXUS initiatives.

The proposed Urban NEXUS approach has four main components:

1. The Urban NEXUS Objectives. The general Urban NEXUS objectives are translated into locally specific performance objectives for the Urban NEXUS initiative or program. These local objectives are used as principles that guide consideration and design of Urban NEXUS solutions.

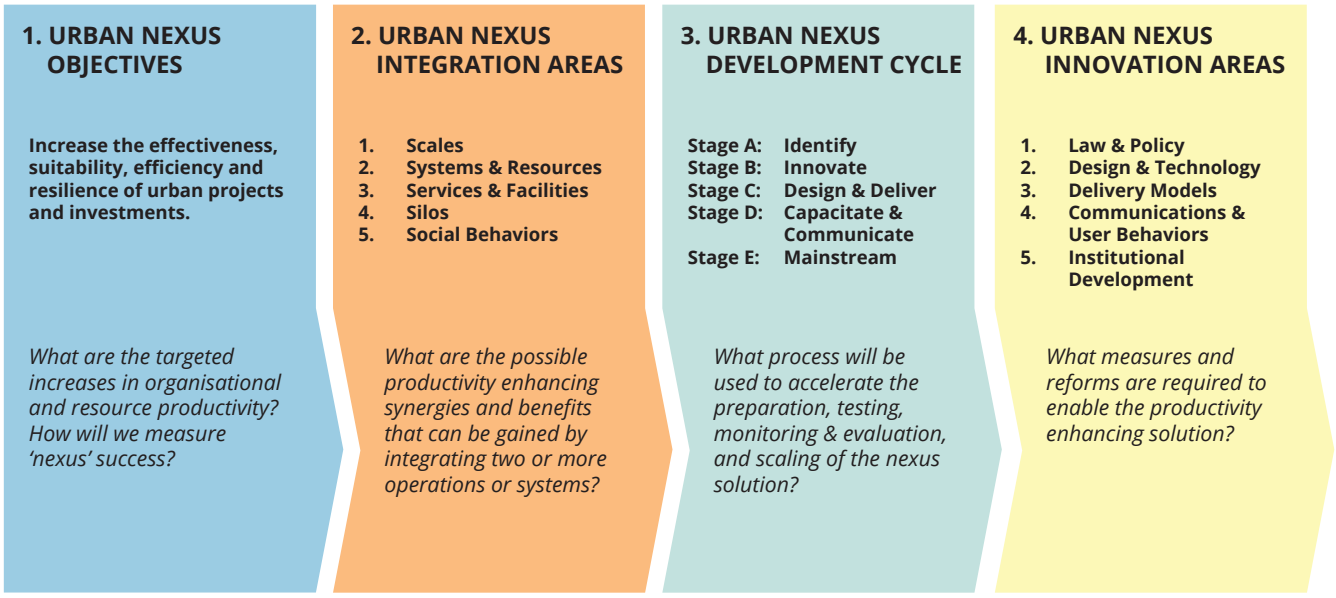
2. The Urban NEXUS Integration Areas. The prospects for Urban NEXUS solutions are identified and explored in five areas of possible urban integration.

3. The Urban NEXUS Development Cycle. To develop a set of politically, institutionally, and economically viable Urban NEXUS measures in one or more areas of integration, the stakeholders collaborate in a structured innovation process in order to identify, design, deliver, communicate and mainstream the Urban NEXUS solution.

4. The Urban NEXUS Innovation Areas. The set of measures (i.e. "the solution set") generally involves innovation or reforms in five areas of practice so as to establish a truly systemic solution.

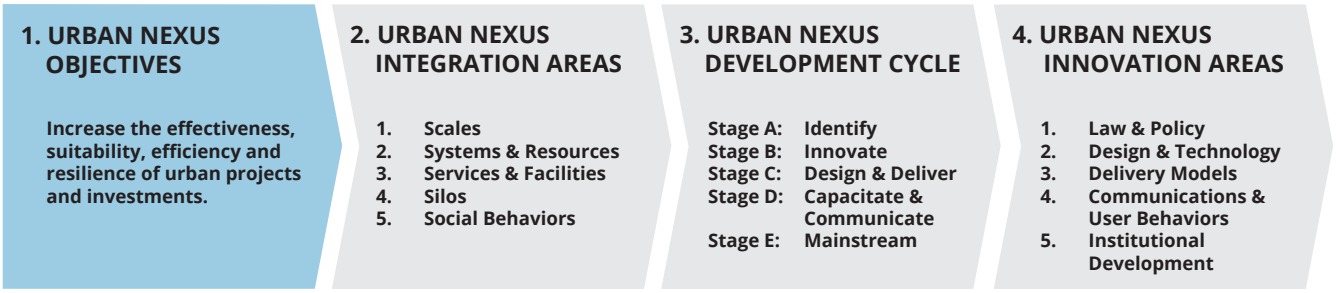
Each component of the Urban NEXUS Approach in Figure 6 addresses a key strategy question for practitioners and participating stakeholders. The Urban NEXUS Objectives and Urban NEXUS Integration Areas are further described in the following sections of the report. The overall process and innovation areas to be explored in the entire cycle of a specific Urban NEXUS initiative are elaborated upon in Part 3 of the study.

Figure 6: The Urban NEXUS Approach provides a framework for practice



GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS © ICLEI, GIZ and TNP

2.4 Urban NEXUS Practice Objectives



GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS. © ICLEI, GIZ and TNP

Key messages

- As a preliminary framework to guide the evolution of Urban NEXUS practice, the four primary objectives of the Urban NEXUS are increased: systemic effectiveness; demand-driven suitability and customization; productive efficiency; and resilience and adaptive capacity.
- These general Urban NEXUS objectives are translated into locally specific performance objectives for the Urban NEXUS initiative or program, so other factors of productivity enhancement could surely also be considered as core objectives. These local objectives are used as principles that guide the consideration and design of Urban NEXUS solutions.

Key Strategy Question for stakeholders: What are the targeted increases in organizational and resource productivity? How will we measure Urban NEXUS success in the specific urban and regional setting?

As described in the preceding sections, the Urban NEXUS approach specifically addresses a number of shortcomings in urban planning and management for meeting global development challenges (see section 1.1), with a focus on advancing "integration" as a design and management principle. The focus on integration has its own purpose: to increase urban and resource productivity, so as to deliver greater benefits at a better quality with equal or less resources.

The study has highlighted four main objectives underlying urban productivity enhancement, and proposes these as the key primary objectives for Urban NEXUS practice innovation: increased effectiveness, increased suitability and customization, increased efficiency, and increased resilience or urban solutions. These objectives are not proposed as a final and complete list; other factors of productivity enhancement could surely be considered as core objectives. But as a preliminary framework to guide the evolution of Urban NEXUS practice, these four primary objectives provide an ambitious starting point.

Increased systemic effectiveness

Ideally, the integration measures that differentiate an Urban NEXUS Approach would do more than offer incremental improvements over current urban policy or management approaches. The integration measures in an Urban NEXUS initiative would address opportunities to improve the fundamental systemic performance of a city or metropolitan region.

eThekwini/Durban, South Africa Mariannhill Landfill Conservancy produces energy from waste while restoring local ecosystems

A sustainably designed landfill using a closed loop system to prevent toxic material from contaminating the surrounding, the Mariannhill landfill site also controls the release of GHGs (greenhouse gases) through a gas-to-electricity plant, which generates electricity while treating methane. The landfill is also a conservancy, with several varieties of indigenous plants (aided by a Plant Rescue Unit), and a registered national birding site. In addition, it involves the community in the maintenance of the conservancy, provides a new public space to the city and contributes to public awareness concerning waste management by offering educational workshops and school visits.

Find the full Urban NEXUS Case Study No. 6 on eThekwini/Durban at www.iclei.org/urbannexus

For example, the recovery of urea (a quality source of nitrogen fertilizer) from municipal sewage could be understood as an incremental efficiency measure in an eco-efficiency context. However, in an Urban NEXUS initiative such an undertaking might be one aspect of the establishment of a new nutrient cycle for the region, linked to a program of regional agricultural industry development and support. The urea solution would be one of a set of Urban NEXUS solutions. The use of integration as a design principle would enable systemic integration of these distinct solutions. Such systemic thinking would include measures and reforms to establish the market dynamics for sustaining and scaling the Urban NEXUS solution set as a comprehensive program. By changing market dynamics, the overall Urban NEXUS solution set might instigate fundamentally new categories of productivity, such as the integration of agriculture into residential buildings or the establishment of a high-rise farming subsector in the now-integrated agriculture, building, and food processing and service industries. Urban and peri-urban agriculture has great potential as an element in integrated Urban NEXUS programs *(see case studies on Amman, El Alto, Vancouver, Oakland Food Council, and Mexico City's Mercado del Trueque in Annex B)*. In summary, through its integration measures, once incremental solutions are formed into an Urban NEXUS solution set that substantially improve policy and stakeholder effectiveness in achieving key regional development objectives.

Consider the example of biogas technology. Incrementally speaking, proven technologies can be used to cost-effectively process biogas from municipal organic wastes. Initial applications used this fuel to power waste management or other municipal facilities. The first, systemic Urban Nexus initiatives integrated the productivity enhancements achieved in the waste management system with emissions policy and performance objectives in urban public transit systems. As illustrated in the cases of Lille, France (*see box*), and Linköping, Sweden, bio gas fuel produced in the municipal waste management system was used to support the development of a clean, efficient biogas bus fleet—thus also achieving other Urban NEXUS objectives (e.g., resilience of fuel supply). Lille has replaced its entire diesel bus fleet with methane generated from the city's organic waste stream. In Linköping, the fuel is also made available for private vehicles. Further system integration opportunities were pursued. As part of the same waste-to-energy process, compost fertilizer was also produced on both cities to support regional agriculture. The result is the beginning of a systemic integration of each city's waste, transportation, and agricultural systems, supporting each to be more resource and financially efficient, more resilient, and more effective in achieving air quality and other objectives of climate change adaptation policy.

Lille, France
Biogas Buses fuelled by waste-to-energy plant

The metropolitan area of Lille is seen as a pioneer in waste-to-energy transport technology. In the early 90s the responsible authority "Lille Métropole Communauté Urbaine" (LMCU) started testing the operation of buses fueled with biogas produced from sludge of the community's wastewater treatment. What started like a pilot project has now grown into a large scale production of biogas in a specifically built bio-waste treatment plant that also produces a biological fertilizer from its end products to be used in agriculture. The produced biogas fuels the entire bus fleet and the waste collection fleet of the community and also supplies a great number of private households. The initiative successfully integrates waste-management, energy and food security and contributes to noise reduction and a cleaner air quality and a more efficient transport system.

Find the full Urban NEXUS Case Study No. 07 on Lille at www.iclei.org/urbannexus in Annex B

From black to green to gold: Farming with wastewater in Hyderabad, India, and Hermosillo, Mexico

Increasingly, a ***resource-from-waste*** recovery paradigm (Scott et al. 2004) is recognized to offer virtuous-cycle opportunities for policy-making and public engagement to address urban growth and resource recovery challenges. Ongoing experience in Hyderabad, India and Hermosillo, Mexico – to name just two examples – offers several lessons learned. These include decentralized options for partial primary treatment of wastewater, e.g., settling and aeration lagoons, or initial diversion and partial remediation of wastewater through fields used to cultivate animal fodder – alfalfa, perennial cut-and-carry grass, etc. – followed sequentially by irrigation of crops for human consumption.

Prof. Dr. Christopher Scott, University of Arizona
Find the full article in Annex B

Case Study: Chris Hani Municipality – Integrated Biogas Project-Integrated design solution with bio-digester at a school achieves multiple benefits

In a rural school previously utilizing ventilated improved pit latrines (VIP's), a flush toilet Biodigester based sanitation solution was implemented (based on flush toilets to provide decent and safe sanitation) to treat sewage (the outputs being nutrient rich clean water, algae for animal feed, composting and gas) and the following benefits were achieved: 1.Decent, dignified and safe sanitation, 2.Increase in quality nutrition, food security and associated positive health and learning impacts, 3. Generation of a local energy supply for cooking of school meals saving ~ US$1200 on imported Liquid Petroleum Gas (LPG) per annum 4. Bio-fertilizer production ~ US$650 per annum, 5. Savings in school feeding scheme costs ~ US$370 per annum, 6. Water recycling ~ US$65 per annum, 7. Greatly reduced stress on sewage works and associated infrastructure, 8. Reduced exposure to pathogens, 9. Return on investment ~ 10 to 15 years; life of over 30 years

This project proved that locally adapted Nexus solutions work well, ultimately increasing nutrition through the integration of use of the nutrient rich water and onsite compost to a school garden, significantly saving on school feeding costs, reducing infrastructural stress and supporting an overall improvement on health.

Muna Lakhani, Institute for Zero Waste in Africa
Find the full article in Annex B

Increased demand-driven suitability and customization

Ideally, the integration measures that differentiate an Urban NEXUS approach would do more than engage stakeholders and users in the evaluation of problems and possible solutions, as is already the usual mode of engagement in integrated planning. The integration measures in an Urban NEXUS initiative would engage stakeholders in the co-design and co-delivery of the solution set in order to address unique local needs in ways that match or exceed the standards of the best alternatives. In a best case scenario, "suitability" in an Urban NEXUS initiative is the establishment of a customized, financially sustainable solution that meets key policy objectives and the best global standards.

For instance, the Austin Energy Star program integrated the roles and business processes of the municipality, home builders, brokers, and home buyers to achieve and exceed standards for energy efficiency by providing incentives to apply the most optimal solution for each building design, building site, and market segment *(see text box)*. Similarly, the collective, coordinated effort of government departments, utilities, NGOs, churches and Resident Associations in the Rio de Janeiro Favela Bairro program established the city's capacity to customize solutions for each favela—a critical capacity for success in the difficult terrain of slum upgrading. In both instances, the use of integration to increase the collaborative capacity for customization resulted in a higher performance outcome than had been achieved through conventional siloed enforcement of rigid building standards (in the Austin case) or through siloed slum improvement projects (in the Rio de Janeiro case), such as installation of pit latrines or drains. The Tianjin Eco-City in China is another example of collective efforts across national governments around a customized solution *(see Urban Nexus Case Study on Tianjin in Annex B)*.

Urban NEXUS initiatives in the areas of slum upgrading and low-income service

Austin, Texas, USA
Energy Green Building Program: rolling out green rating programs for eco-efficient construction and consumer empowerment

In 1991, the public utility Austin Energy together with the City of Austin launched the Austin Energy Green Building Program. The program includes training workshops for builders on the construction of eco-homes and a rating system informing home buyers about the eco-efficiency of houses on sale while at the same time incentivizing builders to exceed national building standards. The system was developed through inter-departmental collaboration within the City of Austin as well as external partnerships with universities, research institutions, building market associations and the International Code Council. The incentive has led to significant improvements of water management and energy efficiency as well as reduced emissions and construction waste.

Find the full Urban NEXUS Case Story on Austin (Case Story 2014-No. 01) at www.iclei.org/urbannexus

Tianjin Eco City, China
Inter-governmental Urban NEXUS collaboration to realize an innovative Eco-City

Tianjin Eco-City was launched as an inter-governmental partnership between China and Singapore and involves the collaboration of private consortia from both countries, along with inter-ministerial working groups. Through integrated bilateral planning, both countries combined expertise and standards to create new benchmarks for sustainable urban development. The Eco-City functions as a laboratory for emerging eco-technologies and provides an arena for international companies to enter into the North Chinese market. It was built on formerly polluted land and will stand as a good practice example of ecological recovery and sustainable land and community planning.

Find the full Urban NEXUS Case Study No. 05 on Tianjin at www.iclei.org/urbannexus

New Delhi, India
Sulabh International Social Service Organisation revolutionizing sanitation, harnessing biogas, and emancipating manual scavengers

Sulabh International Social Service Organization, a nonprofit entity, works to eliminate social discrimination and the notions of 'untouchability' in India by working at the intersection of sanitation infrastructure and India's lowest castes that are condemned to the cleaning and carrying of human waste. In order to address this wicked challenge, the organization has developed and manufactured an environmentally friendly two-pit, pour flush composting toilet called Sulabh Shauchalaya as well as vocational training programs to support integration of the scavengers into the workforce. The public Sulabh facilities transform the human waste into biogas thus employing an alternative energy source whereas the private facilities generate a pathogen-free, odorless dry sludge which can be used as manure.

Find the full Urban NEXUS Case Story on New Delhi (Case Story 2014-No. 21) at www.iclei.org/urbannexus

provision, on the one hand, and in the area of eco-districts development, in another arena, exemplify the way that an Urban NEXUS approach creates capacity to generate responsive, suitable solutions. For instance, like the Favela Bairro program, the case of the Medellin Integral Urban Development Project *(see Urban NEXUS Case Study on p. 48 in Annex B)* demonstrates how a concerted effort to re-integrate silos, services, and social life enabled customization in areas such as pedestrian infrastructure, and the development of green space in densely settled barrios. The cases of Vauban district in Freiburg *(Case Study in Annex B)*, the Portland EcoDistricts initiative *(see case study in box p. 51)*, and the Toronto district heating and cooling system *(see Urban NEXUS Case Study in Annex B)*, further highlight the degree to which the optimization of resource systems and districts depends upon such customization capacity.

Increased productive efficiency

Ideally, the integration measures that establish (and differentiate) an Urban NEXUS approach would do more than increase the amount of output generated from the labor, resource and/or financial inputs into a service area, facility or infrastructure system. Reflecting the systemic focus of the Urban NEXUS approach, a NEXUS solution would seek to establish multiple efficiency improvements across the broader system or group of integrated systems. As a result of such systemic innovation, an advanced Urban NEXUS initiative might change the terms of performance measurement from one of efficient consumption of resource inputs (i.e., reduced waste) to one of a net zero balance (i.e., through resource cycling) or even of net positive resource production.

To use an example, the case of the Sulabh International Social Service Organization in New Delhi *(see Urban NEXUS Case Story in Annex B)* illustrates how even a basic technology, applied in an Urban NEXUS fashion, can establish productive efficiencies in major challenge areas of urban management. In Indian cities traditional public works approaches to sanitation and sewerage management have not worked within the social and institutional context. The design by Sulabh of a customized toilet and composting solution, implemented in a way that addresses problems of under-privileged scavenger castes, has provided a highly efficient, scalable alternative solution. In addition to the 1.3 million private household toilets installed, 8000 public toilets are maintained and operated by Sulabh on a financially sustainable pay-per-use basis. The introduction of biogas plants at 200 public toilets has, like other biogas cases, resulted in net production of gas for cooking. The case addresses other Urban NEXUS and anti-poverty policy objectives by integrating the sanitation solution with scavenger community education and community facilities development. Similar objectives and outcomes are found in the Dhaka and El Alto case studies *(see Urban NEXUS Case Studies in Annex B)*.

The Mariannhill Landfill Conservancy case in eThekwini/Durban, South Africa *(case study in box p. 41)* illustrates the use of an Urban NEXUS approach to convert a single purpose facility into a multi-purpose solid waste, energy, biodiversity and social inclusion initiative, demonstrating a highly efficient or 'elegant' deployment of municipal resources to fulfil multiple policy objectives. The Eco-Oil Program in Volta Redonda, Brazil shows similar benefits *(find the ICLEI Case Study on Volta Redonda in Annex B)*.

Increased resilience and adaptive capacity

Ideally, the integration measures that differentiate an Urban NEXUS Approach would do more than enable the "safe failure" of a system, organization or facility. The integration measures in an Urban NEXUS solution and initiative would build local capacity to reduce systemic risks and vulnerabilities by creating back-up

resources and systems. Towards this end, the ongoing collaborative effort between sectors and jurisdictions would establish a new regional adaptive capacity: the ability to anticipate changes in conditions and emerging risk factors, and to establish preventative responses to these changes.

Consider the case of JVSV-Joint Venture Silicon Valley *(case study in box)*. The establishment of a multi-sector civic organization in this region of more than 20 government jurisdictions has pioneered both regional efficiency and resilience initiatives. One initiative explored how local and county governments in the region could coordinate procurement, human resources processes, and infrastructure development. More than $500 million in annual savings were identified in the aggregate $14 billion annual budget of Silicon Valley jurisdictions. In addition to increasing public sector resilience, JVSV led the region's first effort to prepare a region-wide disaster preparedness strategy (the region faces very high earthquake risk). This includes the development of a Silicon Valley Disaster Resiliency Center to integrate regional disaster planning, response services, and to provide advanced training and technology development.

Another example can be found in the Western Province of Sri Lanka, where integrated approaches to food production and climate adaptation have helped to use urban agriculture as a means to reduce vulnerability of the urban poor as well as to enhance their coping capacity *(see Urban NEXUS Case Story in Annex B)*.

Integrated approaches to food production and climate adaptation in Sri Lanka

The Western Province in Sri Lanka is the most urbanized province in the country. Food (transport) and construction are two major sources of greenhouse gas (GHG) emissions. Food production in the province is not sufficient, and importing food from other areas of the country is threatened by negative climate impacts on both agricultural production and transport. Cultivable land, often located in low-lying areas, is being converted to residential and commercial uses, at the same time significantly altering natural water flows and drainage. Flood-related disasters are projected to increase, as will economic and social vulnerability to other effects of climate change.

Since 2005 the Western Province has promoted home gardening and urban agriculture as part of the country's policy aimed at achieving food sovereignty and promoting domestic food production.

Two clusters of abandoned paddy lands were selected, located in medium- to high-risk flood zones. Their sustainable rehabilitation included the promotion of more salt-resistant and local varieties of paddy (which are high in demand and fetch good market prices), alongside the cultivation of vegetables in raised bunds to generate additional income. Impact monitoring by the University of Moratuwa and the University of Colombo shows that households involved in the production and sale of urban food can increase their income and reduce their food expenditures, improving both food security and dietary diversification. Flooding incidences and impacts are estimated to be lower when paddy lands are preserved and well-managed. And when computing the difference between the amount of GHG released during the production and transportation of a ton of each of the selected vegetables to Kesbewa and the amount of GHG emitted when this amount of vegetables is produced locally, GHG emissions can be lowered by 74,89 tons per year.

Experiences in Sri Lanka have shown that urban agriculture can help reduce the vulnerability of the urban poor and enhance their coping capacity by: i) diversifying food and income sources; ii) keeping low-lying

Silicon Valley, California, USA
Joint Venture Silicon Valley, a regional public-private network addressing quality of life

Started in 1993 in order to maintain Silicon Valley's competitive edge, Joint Venture Silicon Valley provides analysis and action on issues affecting the region's economy and quality of life, in a context of constant seismic risk. The organization builds the framework for regional thought, analysis and action by assembling Silicon Valley's leaders in business, government, academia, labor and the non-profit sector. The Board assesses the challenges of economic development, infrastructure, transportation, communications, education, health care, disaster planning and climate change thus building on regional capacities while joining sectors and jurisdictions.

Find the full Urban NEXUS Case Story on Silicon Valley (Case Story 2014-No. 13) at www.iclei.org/urbannexus

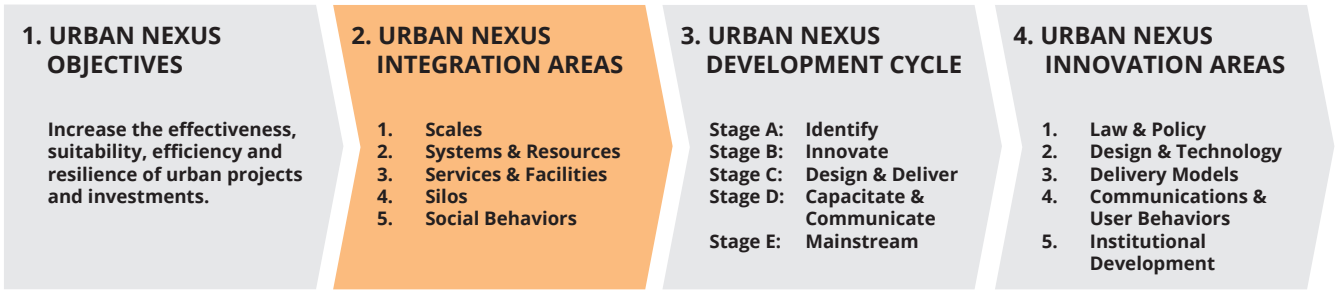
zones free from construction so that floods have less impact; iii) reducing storm water runoff; and iv) establishing green open spaces that can stored and absorb excess water. At the same time, local production may help reduce urban energy use and lower GHG emissions by requiring less energy for transport, cooling, storage and packaging. Therefore, urban agriculture can be a low-cost adaptation strategy, bringing with it potentially significant co-benefits in the form of food security and job creation.

Marielle Dubbeling, Director of the Resource Centre on Urban Agriculture and Food Security, RUAF

Find the full article in Annex B

In preparing to discover Urban NEXUS prospects and to develop an Urban NEXUS initiative, in conclusion, at the outset of an Urban NEXUS initiative the above four general objectives are translated into specific objectives relevant to the local operating context. These objectives are defined in such a way so as to clearly establish the self-interest of different sectors, jurisdictions, and stakeholders to explore the Urban NEXUS prospect. Once such a "nexus" of common interest is articulated, the exploration and design of integration solutions begins.

2.5 Urban NEXUS Integration Areas



GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS . © ICLEI, GIZ and TNP

Key messages

Five areas of integration prospects are explored for the development of an Urban NEXUS solution:

- *Integration across Scales:* integration of the different scales of the built environment and of its infrastructures; of the region's supply chains and resource cycles; and of the policies and operations of local, regional, sub-national and national jurisdictions.
- *Integration of Systems:* integrating formerly separately designed and managed systems of resource extraction and power generation, food cultivation, processing, manufacture, resource supply and waste management, by establishing cascades and cycles of resources between systems
- *Integration of Services and Facilities:* avoiding the underutilization of valuable fixed assets by integrating services and facilities conventionally separated by sectoral functions, and e.g. different uses throughout the 24hours of the day.
- *Integration across Silos:* consolidating institutional interests and managerial and professional silos arising from the organization of urban areas and systems into separate jurisdictions, utilities, and departments; and finally
- *Integration of Social Relations and Behaviors:* changing behaviors and attitudes to enable all stakeholders' engagement in the above integration dimensions, and countering legacies of cultural, social, and political division.

Key Strategy Question for stakeholders: What are the targeted increases in organizational and resource productivity? How will we measure Urban NEXUS success in the specific urban and regional setting?

Following the definition of context-specific performance improvement objectives *(Section 2.5)*, the scoping of Urban NEXUS solution prospects can begin. Not all problems will have "nexus" solutions – nor will they require them. Depending upon the ambition for improvement, less systemic solutions may be satisfactory. The specific focus of an Urban NEXUS approach, however, is to understand how systemic productivity improvements can be achieved through fundamental design and implementation of integration measures. Five dimensions of possible integration are explored for the development of an Urban NEXUS solution. These are the Urban NEXUS Integration Areas:

Integration across Scales

This involves integration of the different scales of the built environment and of its infrastructures; of the region's supply chains and resource cycles; and of the policies and operations of local, regional, sub-national and national jurisdictions.

Urban NEXUS approaches increase the productivity of facilities, infrastructures or whole metropolitan regions by better articulating the linkages and synergies between them. For example, in many urban and metropolitan regions of the world the arterial road networks are disconnected from, and compete with, active transportation choices such as walking and cycling. An example of scale integration would be the redesign of specific parts of the road hierarchy to enable more effective mixing of modes along certain corridors, or the establishment of transport integration stations and nodes via transport oriented design (TOD).

The Favela Bairro example (*p. 37 and Table 2, and see also the Case Story in Annex B*) provides a different example of integration across scales. One of the success factors in the program was its capacity to respond and customize solutions at all scales of the "system" that maintained the historic isolation of informal communities within the city. Resident Associations and NGOs worked at the scale of households and lanes, while the work of municipal teams was integrated with the work of state water and power utilities. The IUP in Medellín is a similar example (*see Urban NEXUS Case Study in box p. 48*).

Policy and management integration between political jurisdictions at different scales has been a typical problem in governance and the efficient deployment of development resources. Large metropolitan regions typically illustrate the challenge of multi-level governance – both horizontally and vertically, as functional areas of citizens and resource systems do not respect jurisdictional boundaries of different municipalities (horizontal), and utilities may be organized at different levels of government (vertical).

The Joint Venture Silicon Valley case *(find the Urban NEXUS Silicon Valley Case Story in Annex B*) provides an example of a scale integration solution that addresses the long-standing lack of regional capacity for planning, fiscal, infrastructure and disaster response coordination. Another example is the Metro Vancouver regional administrative body, which incorporates 21 urban and some rural municipalities, and provides the ideal platform for a holistic Regional Food Strategy based on local production and self-sufficiency that would not have been possible at the municipal level alone (*see Urban NEXUS Vancouver Case Study in Annex B).*

Integration across scales can span from the very local to distant global geographies. Fair Trade and other product standard systems, for instance, involve distant producers and their cooperatives, global companies, NGOs, retailers, and individual consumers in an integrated effort to affect the quality of life of producers and to enable more sustainable consumer lifestyles.

Medellín, Columbia
The Integral Urban Development Project

Through Integral Urban Projects (PUIs), the City of Medellin, under the guidance of the Autonomous Municipal Company of Urban Development, set out to reintegrate its most segregated and violent neighborhoods. The concept, also known as urban acupuncture, encompasses the improvement of built environments, the establishment of public spaces, environmental preservation and restoration as well as the strengthening of community services. This includes the installation of cable cars and outdoor escalators to make districts more accessible and connected to the rest of the city. Social programs and business development centers fight unemployment and foster education and economic sustainability. The interventions were realized together with a large number of municipal and national agencies, private partners, academic institutions and international development agencies.

Find the full Urban NEXUS Case Study No. 8 on Medellín at www.iclei.org/urbannexus

Integration of Systems

Another opportune area for the Urban NEXUS is the integration of formerly separately designed and managed systems of resource extraction and power generation, food cultivation, processing, manufacture, resource supply and waste management. Systems involve more than the built environment and infrastructures; they include the policies and regulations, business models and processes, financing arrangements, human resources planning, data management, etc., that make them function in predictable ways according to basic standards of performance. System integration initiatives establish

cascades and cycles of resources between systems, such as the use of biogas from household organic waste in district combined heat and power (CHP) plants, and the extraction of nutrients from waste water. Rainwater harvesting systems for reducing the demand on municipal pumped water supply, for example, also reduce energy consumption and are an increasingly popular solution, which many cities in India – most recently Chennai – are making a required feature in new buildings.

In early Urban NEXUS initiatives collaborators tended to focus on technological and engineering opportunities to integrate systems. Today, further productivity improvements are being sought in complementary integration of policy, planning and business management systems. Urban NEXUS initiatives integrate the supply and demand side of resource usage, for instance, through coordinated changes to home design, heating and cooling equipment and appliances, metering, utility rates, and even mortgage financing and home insurance to affect different energy consumption patterns in ways that synergize with the supply constraints and efficiencies of power producers. Eco-districts, exemplified in the cases of Kronsberg, Hannover *(see Urban NEXUS Case Study in Annex B)* and Vauban *(see box on next page)*, demonstrate the full range of system integration opportunities, as does the Toronto Deep Lake Water Cooling case *(Urban NEXUS Case Story in Annex B)*. In the Toronto case, the technology and engineering applied to create an integrated heating and cooling system for downtown Toronto was perhaps less innovative than the business model established to ease the transition from privately owned heating and cooling equipment in skyscrapers to a district service model. Similarly, as much as the designs applied in the Kronsberg district were central to its achievements, the systems integrating role of the KUKA-Kronsberg Environmental Communications Agency cannot be overlooked. KUKA plays a central role in support of the integration of demand side changes (e.g., patterns of resident behaviors and lifestyles) with the new building and energy solutions.

Integration of Services and Facilities

Urban services and facilities have conventionally been separated by sectoral functions, resulting in the underutilization of valuable fixed assets. For example, the school systems in many cities are segregated (i.e., both legally and socially) from other service systems and facilities such as health clinics or public recreational and cultural facilities. School buildings often receive little use during night time and weekend and holiday hours, even when there may be inadequate health, recreation or training facilities in their neighborhood locations. Reflecting such separation, each area of public service is typically managed by a distinct administrative department, overseeing distinct standards and procedures that impede productive and efficient integration of services. One result is the increased costs associated with separate operations that could be consolidated; and the reduced benefits to users who need to organize their schedules around multiple locations and separated tasks.

São Paulo's Cities Without Hunger program (see box) illustrates an Urban NEXUS initiative focused on re-integration of education, income generation, nutrition, waste management, and community development activities focusing on community-scale food production systems. The Mariannhill Landfill project *(see Urban NEXUS Case Study on p. 41 and in Annex B)* illustrates how a public facility – a solid waste landfill – can be developed to serve additional purposes including energy production, biodiversity protection, and community green space provision.

Sao Paolo, Brazil
Cities Without Hunger Cities: a community garden project to end Sao Paulo's poverty cycle

Cidades Sem Fome, a Sao-Paulo based NGO, incentivizes urban agriculture on vacant plots in disadvantaged neighborhoods throughout the city. The initiative is supported by the government on the national and municipal level and through several funds as 65% of the produce goes to the participating families while the remaining 35% of the yield is sold to markets throughout the city or purchased by the government for school meals. The gardens enhance the residents' self-sufficiency lowering their dependence on social welfare. The sites also include waste management and recycling initiatives, the composting of organic wastes to be used as fertilizers. Additional projects have been launched, such as Hortas nas Escolas (gardens at schools) for awareness raising and teaching.

Find the full Urban NEXUS Case Story on São Paulo (Case Story 2014-No. 4) at www.iclei.org/urbannexus

Integration across Silos

This involves the integration of institutional interests as well as managerial and professional silos arising from the organization of urban areas and systems into separate jurisdictions, utilities, and departments. These organizational units mirror the dis-integrated design of urban resource use, infrastructure, services, and facilities. Such organizational "siloing" is complemented by a further siloing of practices within each administrative area according to the distinct standards of separate professional and technical disciplines. For instance, roads departments are not only focused primarily on roadway corridors for private vehicle transportation, but are also dominated by the concerns and considerations of civil and transportation engineers. Such organization belies the reality, for instance, that road corridors have always also been corridors of small business commercial life, micro-enterprise livelihoods, and community public life. Their optimized development depends equally therefore on expertise in small scale enterprise and community development.

The result of such siloing in all areas of urban management is significant failures of coordination in the maintenance of services, as well as impediments to the introduction of more customized and efficient solutions. For instance, it is not uncommon for a municipal roads department to poorly coordinate the road maintenance program with the maintenance activities of water, sewerage and energy utilities whose infrastructure is located beneath road corridors. Similarly, rigid engineering and other professional standards may impede improved neighborhood designs or the establishment of Urban NEXUS utility solutions such as rooftop photovoltaic production or neighborhood cogeneration. Many of the case studies provided in this study highlight the gains that can be achieved from inter-departmental and inter-jurisdictional integration. The Joint Venture Silicon Valley (JVSV) case *(see Urban NEXUS Case Story in Annex B)* describes the efforts of stakeholders in one region to overcome the shortcomings associated with the division of a dynamic economic and cultural region into many separated local government jurisdictions. JVSV engages those local governments with the resident private sector, unions, NGOs and community groups to advance necessary regional disaster preparedness, infrastructure, and social objectives. The Lille and Linköping biogas cases *(find the Lille Case Study and the Linköping Case Story in Annex B)* illustrate what can be achieved when solid waste, energy and transportation departments integrate their efforts. The Favela Bairro and Medellin IUP program cases *(see both the Urban NEXUS Case Study and Case Story in Annex B)* highlight the extent to which integrated, inter-departmental and inter-jurisdictional teams may be a prerequisite for successful slum upgrading initiatives.

Integration of Social Relations and Behaviors

Finally, a variety of factors create patterned inefficiencies and challenges to the productivity of the primary and greatest resource of all cities – their people. Legacies of cultural, social, and political division (e.g., colonialism) reinforce social ills and tensions and result in the considerable under-engagement and under-employment of whole segments of urban populations and their unique capabilities and skills. Present day failures in economic policy and development foster socio-economic divisions based upon participation in the formal and informal economies, which can be geographically mapped in cities. As much as 80% of the enterprises in Mumbai for instance, are in the city's informal sector, neither having access to the finance and services of formal sector enterprises, nor contributing tax revenues to the city's further development.[viii]

Issues of ethnic, racial, and economic class segregation aside, modern urban planning itself has produced a patterned separation of daily life into different areas based upon the separation of routines for employment, recreation

Hannover's Institutional NEXUS: merging municipal departments for synergies between economic and environmental affairs

Growth and sustainable development are not contradictions. Merging the Department for Environment with the Department of Economic Affairs has enabled us to realize the highest ecological standards while proving that urban economy and ecology enhance each other's potential. These actions enabled us to save on significant public expenditures through sustainable improvement measures across numerous sectors, including water, energy and waste. Without combining the departments, Hannover would have undergone greater economic and ecological loss.

Hans Mönninghoff, Former Vice Mayor and Head of the Department of Economy and Environment

Find the full article in Annex B

Freiburg, Germany
Vauban Eco-District: a sustainable model for "learning while planning"

Initiated in the mid-'90s, the eco-district of Vauban, located at the periphery of Freiburg, is the result of a successful collaboration between civil society, the municipality, engineers and architects to achieve a sustainable, collectively-envisioned urban environment. Built on the site of a former military barrack on the, Vauban Eco-district combines the preservation of building stock with passive house standards, solar energy and a co-generation energy plant as well as the preservation of an adjacent biotop. The planning of the mixed-use and car reduced neighborhood has been realized with great community involvement, with input mainly coming from citizen initiatives represented by "Forum Vauban".

Find the full Urban NEXUS Case Story on Freiburg (Case Story 2014-No. 10) at www.iclei.org/urbannexus

and family life into regulated development zones. One result is an increasing allocation of time, public resources, fuel and household income to commuting and other driving activities. For more than a decade economists in North America have published estimates of the impact of traffic congestion on urban productivity. A recent study by the conservative C.D. Howe Institute estimates that the greater Toronto regional economy loses $7.5 to $11 billion per annum due to traffic congestion, including lost work time.[ix]

Social re-integration and the resulting increases in urban productivity can be pursued at many scales in accompaniment with integration efforts in the other above outlined integration areas. For example, a number of cases cited in this study, report on the efforts of local governments to re-integrate waste, energy, and agriculture cycles. Related to this Urban NEXUS thrust, a 2003 study of the community gardens movement in New York City[x] highlighted the extent to which communities use the process of establishing and maintaining urban gardens as a social development solution. Urban agriculture at the community scale has served to support land tenure for lower income communities in the face of development pressures. The study found that in addition to provision of food the gardens were used as sites for a wide range of social and educational events and citizen mobilization activities such as voter registration. Reflecting their important social integration function, fifteen NGOs and government agencies in New York City were supporting 700-1000 community gardens involving an estimated 14,000 gardeners *(for other examples of social re-integration, refer to Case Studies on Sao Paolo p. 49, Sulabh p. 44, and for Dhaka and Amman in Annex B)*.

The eco-districts case studies cited in this study (*see Vauban p. 50, Kronsberg p. 70, and Portland see box)* show how more intensive efforts to integrate systems, silos, and services at the district scale also households to be efficient consumers and producers of their resources, and to maintain and improve their own facilities and amenities.

The identification of Urban NEXUS prospects involves the exploration of integration possibilities across the above five areas of integration potential. This requires assessment of:

- the actual physical and systemic intersections of urban flows;
- the activities and uses in specific places, facilities, and infrastructures; and of
- policies and strategies at different levels of government, and at different parts of an urban regions resource or product supply chains.

The Urban NEXUS approach identifies potential increases in productivity (i.e., efficiency, benefits and resilience) that can be achieved through re-design and re-development of these intersection points – whether this is done technically, programmatically, politically, behaviorally, and/or commercially. Once a prospect is identified, an Urban NEXUS initiative then considers what sectoral and institutional impediments must be addressed to pursue the identified prospects. Finally, to develop prospects into practicable solutions, the Urban NEXUS initiative works with residents, users, and operators to design and test the measures that will establish more integrated approaches.

In summary, an Urban NEXUS initiative or program identifies and establishes interfaces between urban systems, services, jurisdictions, resource management routines, and social behaviors to increase overall systemic productivity and effectiveness, and to achieve strategic objectives:

- in the generation, conversion, and consumption of resources at local, metropolitan and global scales,

Portland, Oregon, USA
EcoDistricts non-profit of "city makers" from private and public spheres to advance eco-districts

EcoDistricts, an entrepreneurial non-profit organization established in 2009, functions as knowledge platform and offers a framework strategy for sustainable city renewal on the neighborhood level. An annual summit is organized with planning experts for knowledge exchange and the sharing of best-practice examples. The initiative was first tested in four pilot districts in the City of Portland. Currently a new project on a larger scale with an expansion of guidelines for sustainable city re-development, the Target City program, is launched and tested in major American Cities.

Find the full Urban NEXUS Case Story on Portland (Case Story 2014-No. 18) at www.iclei.org/urbannexus

- when providing various urban, educational, and social services,
- when developing and managing urban facilities and infrastructures
- when designing new resource management and urban services systems (across municipal departments and jurisdictions)
- when developing strategies and solutions to mitigate and manage catastrophic risks.

It is within this context that the following section elaborates a basic cycle for Urban NEXUS initiative conception, design and development – the Urban NEXUS Development Cycle. The process is elaborated in a general way with the intention of its adaptation to national and local contexts, as well as its further development and improvement by an international network of Urban NEXUS practitioners.

Notes

i Brugmann, J. and Flatt, J. (2014), "From integrated planning and systemic thinking to Urban NEXUS design", brief background paper to the study Operationalizing the Urban NEXUS, GIZ and ICLEI.

ii Hoff, H. (2011), Understanding the nexus. Background Paper. Retrieved January 2014, from: http://www.water-energy-food.org/en/news/view__255/understanding-the-nexus.html

iii BMU & BMZ (2011), Messages from the Bonn2011 Conference: The Water, Energy and Food Security Nexus – Solutions for a Green Economy. Retrieved May 2014, from: http://www.water-energy-food.org/en/whats_the_nexus/messages_policy_recommendations.html

iv Martin-Nagle R. et.al. (2011), The Water, Energy and Food Security Nexus – Solutions for the Green Economy. Conference Synopsis. Retrieved January 2014, from: Water-Energy-Food.

v Erlbeck, R. (2013), Integrated Resource Management in Asian Cities: The Urban Nexus. GIZ in cooperation with UN ESCAP on behalf of the German Federal Ministry for Economic Cooperation and Development. Retrieved June 2014, from: http://www.waternexussolutions.org/contentsuite/upload/wns/all/Nexus_Fact%20Sheet%2010_2013.pdf

vi For an evaluation of Favela-Bairro second phase development impacts, see Soares, F. and Soares, Y. (2005). The Socio-Economic Impact of Favela-Bairro: What do the Data Say? Office of Evaluation and Oversight (OVE), Inter-American Development Bank, Working Paper 13. Retrieved June 2014, from: https://ideas.repec.org/p/idb/ovewps/0805.html

vii Among more controversial actions in the City of Rio's approach to its favelas is the coordinated police and social services program called the Pacifying Police Unit (UPP) established in 2008 to drive out the criminal organizations that had come to control many favelas. The UPP, was accompanied by the "UPP Social" program (later to become the Rio+Social since August 2014), which again demonstrated an integrated approach as the Municipality's program that united all social, environmental and cultural actions in the pacified areas of the city, coordinating further work between residents, state and federal governments, NGOs, foundations, private companies and UN-Habitat to establish full municipal services and to develop and implement a customized social services program for each of the favelas in the UPP program.

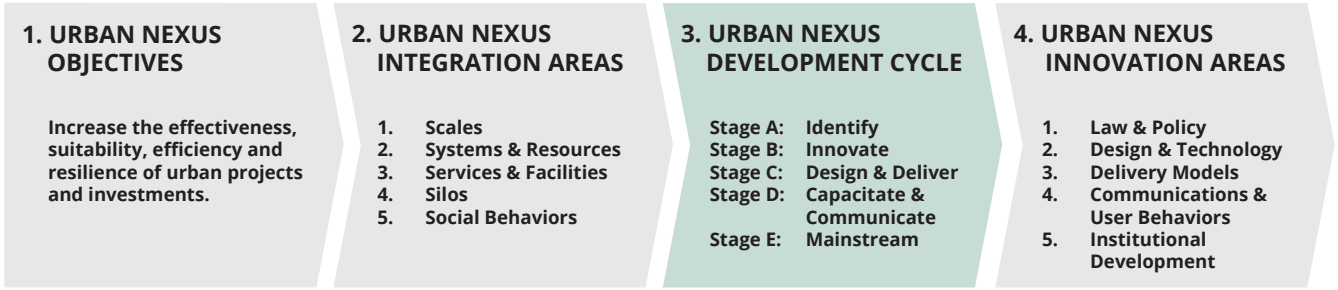
viii The author has used the number of employment establishments that do not officially have a source of electricity or other power as a proxy for the number of establishments associated with the informal sector's economic system. Further data on Mumbai employment establishments can be found in the Mumbai Metropolitan Region report entitled Population and Employment Profile of Mumbai Metropolitan Region (MMRDA, 2003).

ix Dachis, B. (2013), Cars, Congestion and Costs: A New Approach to Evaluating Government Infrastructure Investment. Commentary No. 385. CD Howe Institute, Ottawa. Retrieved May 2014, from: http://www.cdhowe.org/pdf/Commentary_385.pdf.

x Saldivar-Tanaka, L. and Krasny, M. (2004), Culturing community development, neighborhood open space, and civic agriculture: The case of Latino community gardens in New York City. Agriculture and Human Values. Volume 21, Issue 4, pp 399-412.

Part 3. Implementing the Urban NEXUS

3.1 The Urban NEXUS Development Cycle and Innovation Process



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Key messages

- The logic of the Urban NEXUS Development Cycle is informed by empirical examples from cities around the world, and experiences from two Urban NEXUS pilot projects in Nashik, India, and Dar es Salaam, Tanzania.
- At a time when urban development practice requires the optimization of urban places and systems – and not just their construction – embedding the Urban NEXUS perspective into urban projects large and small is an essential part of the 21st century urban development process.
- Urban projects based upon the Urban NEXUS perspective build upon established concepts and practices of integrated planning. However, in contrast to the earlier emphasis on multi-stakeholder planning the Urban NEXUS Development Cycle focuses on the strategic re-design of places, assets, and operations in order to realize integrated plan objectives.
- The examples given show that leading cities in urban best practices have been the first to establish such design processes, capacities and institutions in addition to their planning schemes.

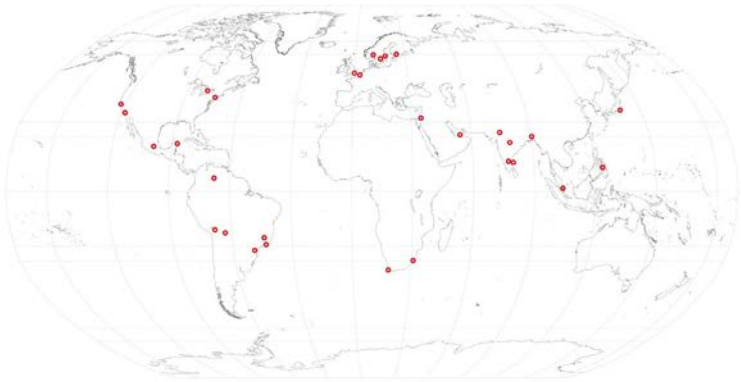
Key Strategy Question for stakeholders: *What process will be used to accelerate the preparation, testing, monitoring & evaluation, and scaling of Urban NEXUS development solutions in your city region?*

A framework for practice based on empirical examples and pilot project experiences

The Urban NEXUS Development Cycle is developed on the basis of experiences from various projects in cities around the world, dating back as far as the 1990's to Urban NEXUS projects currently in their inception. Many such examples are provided in case study boxes and references throughout Parts 2 and 3 of the study, and in Annex B.

In addition to the innovations of Urban NEXUS pilot projects in the cities depicted above, two cities hold particular importance to this study: Dar es Salaam, Tanzania and Nashik, India. From December 2013 - August 2014, both

Figure 7:
A global overview of "Urban NEXUS" projects



GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS. © ICLEI, GIZ and TNP

Dar es Salaam and Nashik took first steps testing the Urban NEXUS Development Cycle. Putting theory to practice to harness cross-sectoral collaboration and optimize energy, water and food security in their respective metropolitan regions, these Urban NEXUS projects brought together a wide range of stakeholders who had never before worked together, thus generating new institutional nexuses.

Within a mere eight months, both Urban NEXUS pilot project cities, identified great prospects for Urban NEXUS integration, implementing Urban NEXUS solutions at different scales (school facilities, the neighborhood, and ward area

Dar es Salaam and Nashik, similar to other rapidly developing metropolitan cities, host a complex set of ecological, social, economic, political, administrative and institutional systems. The Dar es Salaam metropolitan region faces a multitude of risks and vulnerabilities, including a lack of access to resources – particularly energy and water; a back-log of municipal services (e.g. transport, water, drainage and waste management); a burgeoning informal sector, high poverty and unemployment rates, in turn linked to malnutrition and health challenges; and an on-going need to create social and economic development.

In the Kinondoni district, two schools were identified as ideal community hubs and spaces that can act as education facilities for children and adults alike, by showcasing methodologies for increased resilience that can be replicated in homes, while boosting local economic development. Urban NEXUS solutions for the Tandale Elimu and Hekima schools were developed to repurpose rainwater for urban agriculture that can provide nutritious food for the students, while minimizing flooding impacts and energy consumption. The schools' utilization of vertical gardens also serves to showcase agricultural and waste management opportunities in densely populated areas *(for more see Part 3, Section A.3, and the Urban NEXUS Case Study 01)*.

Whereas in the agricultural hub of Nashik, rapid urbanization and housing speculation has resulted in an increase of idle land no longer available for agricultural use, groundwater depletion and large water wastage in the agricultural sector. The Urban NEXUS approach taken resulted in a set of integrated solutions with the aim of addressing these multiple issues *(see box, and the Urban NEXUS Case Study 02)*.

Nashik, India
Urban Nexus pilot project: bringing speculative land back to agricultural use and improving water and energy efficiency

The city of Nashik consumes large amounts of pumped water for agriculture. Energy intensive groundwater pumping has led to a decreased water table and increased energy consumption – a cycle which continues to prevail. Additionally, land once allocated for agricultural use along Nashik's periphery and within the city, has been sold, much which remains idle, thus reducing land available for food production.

Through an Urban NEXUS approach integrating 30 representatives from departments and institutions across the vertical and horizontal levels of governance, the Nashik Municipal Corporation developed an approach for the management of land, water, energy and food security. This resulted in an i) an agricultural pump set efficiency performance evaluation, ii) the creation of a groundwater recharging system, iii) mapping biogas potential and iv) the promotion of agro-education/ tourism among school children.

The project implementation of the Urban Nexus approach resulted in adoption of relatively common measures, as mentioned above, but in an integrated manner with an aim to cater to multiple issues in one go in the ward area.

Find the full Urban NEXUS Case Study No. 02 on Nashik at www.iclei.org/urbannexus

in Nashik) for enhanced customization. During the course of the projects, it became clear that the Urban NEXUS approach is a social-institutional learning process to find solutions and learn by doing together. Given the complexity of governance in metropolitan regions, both cities benefitted from following the framework of the Urban NEXUS Development Cycle.

From integrated planning to designing the solution

The Urban NEXUS Development Cycle, elaborated in the sections below, is conceived as a process. Integrated planning processes are used to clarify the vision, goals, work areas and objectives that critical stakeholders seek to achieve together. The implementation and solutions to achieve integrated planning objectives, however, require a proper process for innovation, solutions design and delivery.

As it is, urban development and urban politics is full of risks that are difficult to manage, making cities very risky and complex environments in which to innovate. Therefore, institutions and businesses are prone to avoid the risks of innovation by persisting with status quo approaches, making small improvements, while finding ways to work around ambitious integrated plan commitments. Development innovation, therefore, is not a natural outcome of having a well-defined plan.

A testament to this fact is the wide gaps often found in both developed and developing country contexts between planning objectives and standards, on the one hand, and operational realities, on the other. Local planners may even withhold approvals for (re)development projects that are consistent with new town planning goals, because interests in their real-world markets, communities and the political landscape would be disrupted by the innovations required under new planning schemes. As well, it is not uncommon for those municipal departments most responsible for the maintenance of established standards (e.g., engineering, roads, emergency services) to initially resist if not undermine the implementation of new plans developed through a local planning department or multi-stakeholder processes.

Integrated planning, therefore, may only identify the areas of potential integration that may give rise to an Urban NEXUS solution. The solution itself – the mix of measures that enable the achievement of planning objectives – requires the design of alternative market signals, business models, systems and schemes that would be acceptable to stakeholders and address their diverse interests while also achieving integrated planning goals. It comes as no surprise therefore that the most ambitious "best practices" cities, in terms of development innovation, have been the first to establish design processes and capacities to complement their planning schemes.

For instance, Curitiba's Institute for Urban Planning Research (IPPUC) served as the design studio for the development of most aspects of the city's bus rapid transit (BRT) corridors, including the design of the trinary road system, the famous bus loading tubes and "integration stations" that together optimized the BRT. The IPPUC established a stable a home for solutions innovation, where Jaime Lerner and members of his group (including successor Mayor Cassio Taniguchi) to continue solution design activities during alternating terms out of elected office. The provision of this leadership "home" established the political and institutional continuity of effort required to establish and scale such unique and untested solutions.

Another approach used is the establishment of boards or panels of urban designers. In the 1970s, a number of North American municipalities such

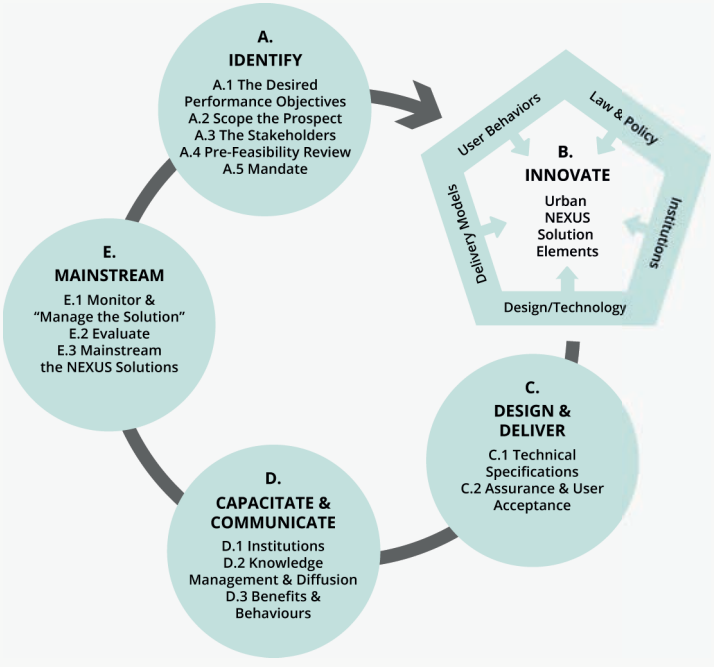
as Vancouver established independent urban design panels to engage the broader design professions in reviewing development proposals. These review processes, preceding and upstream of development project approvals and investment commitments, instigate pro-active design recommendations, guidelines and strategies that shape the character of future development projects and of the local development industry itself.

More recently, a number of European cities have used international design competitions and expositions to engage design professionals from around the world to catalyze innovation in the local development market, effectively building and broadening local development industry capacity and expertise. For instance, in Malmö, Sweden an international housing exhibition was organized in 2001 to serve as a platform for government-university-industry-citizen collaboration in the design of the Bo01 mixed use residential district. The exhibition was linked to newly established eco-efficiency guidelines and performance targets in the brownfield redevelopment area. The use of a major design exposition significantly aided the discovery and review of approaches to meet the new targets, and also built public and political awareness and support for their achievement. Another such example is the International Building Exhibition IBA in Hamburg, Germany.

In their very different ways – whether through an institution, a department, a process, or an event – each of the above examples demonstrates ways in which cities can build capacity to design more integrated solutions in collaboration with the public and industry, upstream of critical investment decisions.

It is with this design strategy orientation in mind, that the following project Development Cycle for Urban NEXUS initiatives *(see Figure 8)* is introduced as a general design process for translating integrated planning objectives into Urban NEXUS policies, projects, systems, and places.

Figure 8:
The Urban NEXUS Development Cycle is a process for translating integrated planning objectives into policies, projects, systems, and places



GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS

Integrated urban or metropolitan land-use planning

Proper land-use regulation and enforcement is central to the success of many types of Urban NEXUS initiatives. Urban and peri-urban land is an increasingly valuable and scarce resource – whether for human settlement, industrial or commercial purposes, food production or environmental preservation and disaster mitigation (e.g. flood plains).

This demand for available land is exacerbated by property speculation taking land out of productive use. Further, the sprawl of urban expansion resulting from inefficient use and scarcity of available urban space leads to difficulties and inefficiencies in providing infrastructures and access to urban services to growing marginalized settlements.

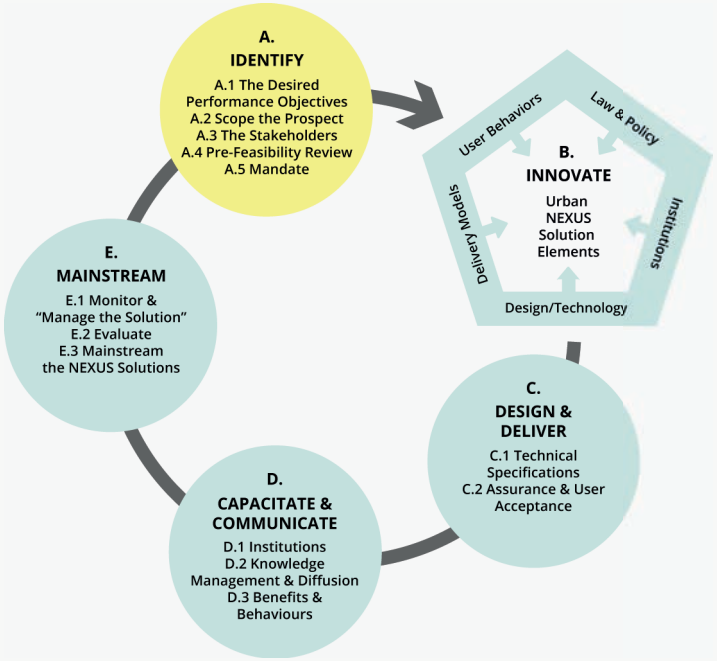
Particularly in cities of the global South, the failure of land-use planning and regulation to keep up with the pressures of rapidly expanding informal settlements, highlights the crying need not only for more comprehensive development planning, but also for effective institutions to coordinate and enforce such plans. Throughout Asia the World Bank has supported the establishment of rather technocratic offices for such purposes, and it is likely that a reformed version of these will be the bodies to coordinate Urban NEXUS initiatives in the future.

Each of the stages of the Urban NEXUS Development Cycle are explained in detail in the sections below. The first stage, A. is to Identify the prospective areas for Urban NEXUS solutions together with all stakeholders. Stage B. is a structured multi-stakeholder Innovation process to develop solution elements in areas spanning the range of policy, technology, planning, finance, business models, communications, user behaviors, and institutional design. In Stage C. these are Designed and Delivered (implemented), and stage D. involves the Capacity building and Communications necessary to ensure the uptake and optimization of the solutions. Stage E. focuses on mainstreaming the Urban NEXUS solutions, and the monitoring and evaluation that in turn feeds into the next round of identification, innovation etc.

Throughout this process, collaboration between actors across sectors is crucial, and allows the Urban NEXUS to build on integrated urban development practices.

3.2 Stage A: Identify the Urban NEXUS Prospect

Figure 8:
The Urban NEXUS Development Cycle.
Stage A: IDENTIFY



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The first stage in an Urban NEXUS initiative is to identify and evaluate specific Urban NEXUS prospects that are available within the current local context. An Urban NEXUS Prospect is used here to mean a practicable prospect of integrating one or more systems, services/products, facilities, policies, or organizational silos to achieve integrated planning goals and targeted productivity outcomes. We propose a general five-step process for identifying and evaluating Urban NEXUS prospects.

The process begins by specifying the Urban NEXUS initiative objectives. Specific objectives are then used to identify possible measures to achieve these objectives. The key stakeholders needed to develop those measures can then be engaged. Together, the stakeholders can then evaluate the practicability of these Urban NEXUS measures. On this basis a mandate for an Urban NEXUS initiative can be formulated. These steps for Urban NEXUS prospect identification are further outlined below:

Key steps in identifying the Urban NEXUS prospect

A.1 First, for each potential initiative translate the general Urban NEXUS objectives—i.e., efficiency, suitability, effectiveness, and resilience—into context specific objectives for the initiative.

A.2 Scope the potential Urban NEXUS integration areas (i.e., integration between systems, scales, services, silos, and social behaviors) to support the achievement of the objectives.

A.3 Identify the stakeholders who would need to be involved to develop and support the innovations, reforms and other measures required as part of an overall Urban NEXUS solution in each of these areas.

A.4 Work with stakeholders to do pre-feasibility or strategic reviews of the identified measures. Pre-feasibility review requires evaluation of the strategic landscape for realizing the identified prospects.

A.5 On the basis of stakeholder discussions and pre-feasibility review, recommend the areas to be further explored. Establish the formal mandate required to support collaborative innovation of a solution (i.e., a set of Urban NEXUS integration measures) to achieve the initiative's objectives. It is often advisable to agree in advance on the performance metrics for a mutually acceptable solution. These metrics are then used to guide the design and innovation phases of the Urban NEXUS Development Cycle.

A.1 Define the Desired Initiative Objectives

Urban NEXUS-specific initiative objectives need to be discerned in order to guide the discovery of a NEXUS prospect (i.e., an increase in productivity or elegance through integration). The elaboration of Urban NEXUS objectives requires the consideration of ideal or additional performance possibilities for a product, service, facility, infrastructure, or built area, if the existing constraints of established systems and assets, policies, jurisdictions, departments, or business models can be addressed.

The elaboration of Urban NEXUS initiative objectives requires taking a systemic and fresh look at all the components of a system and at all factors impacting the achievement of integrated planning goals. Is there a better way to more comprehensively meet the needs of the resident or user? Can resources be more effectively deployed by changing the nature of service and resource demand, as opposed to supply? Can a product, asset or infrastructure be developed to serve many more functions and objectives? Can resources be re-used and assets re-purposed through cycles and cascades to increase overall resource productivity?

To further illustrate, **Table 3** *(below)* provides an example of the translation of the four general Urban NEXUS objectives (i.e., efficiency, suitability, effectiveness, resilience) into context- and initiative-specific objectives addressing a significant problem in South African township areas. The example is drawn from an initiative that focused on how to reduce the extensive loss of life and property

Table 3:
Defining Urban NEXUS Initiative Objectives: A clean, safe and affordable home cooking solution for residents of South African urban township settlements

THE MILLENNIUM DEVELOPMENT GAP		
A. General Urban NEXUS Objectives	**B. Initiative- and Place-Specific Objectives (example)**	**C. Related Prospect Areas for integration (example)**
Effectiveness	The solution significantly reduces injury, death, illness, and property destruction from unsafe use of paraffin.	1. Silo integration between municipal housing, health, and social departments.
		2. Scale integration between local, provincial, national policies on fuel standards, housing etc.
	The alternative fuel is available within 100m distance of any township home.	3. Sector integration between local government, fuel companies, appliance companies, NGOs, CBOs.
		4. System and Facilities integration between producers, wholesalers, retail suppliers, local retailers
Suitability/Customization	The alternative cooking appliance is compact for use in shacks, but supports a variety of pot sizes without tipping.	5. Service (i.e., product) integration between fuel, appliance, and pot manufacturers
	The overall solution provides livelihood opportunities for township residents.	6. Service (e.g., distribution and retail) integration between manufacturers, retails, local training and enterprise development programs, micro-finance providers.
Efficiency	The fuel is more cost and energy efficient than all other alternative cooking fuels and stoves.	7. In addition to (5), Sector integration between national fuel standards regulator, national research institutes, manufacturers.
	The fuel dispensed in returnable (i.e., re-usable, recyclable) safety containers.	8. Sector integration between manufacturers, fuel standards regulator, municipal waste department, retailers
Resilience	The cooking appliance may also be used safely with other fuels.	9. Sector and Service (product) integration as in (5) and (8) above.
	The cooking appliance has modular design and a fire resistant stove cabinet to enable attractive multi-burner configuration for growing households.	10. Service (product) integration as in (5) above.

associated with the use of paraffin/kerosene as the primary cooking fuel in low-income South African urban households. The Urban NEXUS solution required national policy reform, product innovation, local business development support and training, and the integration of municipal services silos. In this table the broad Urban NEXUS objectives are translated into initiative- and place-specific objectives *(Column B)*, on the basis of which potential integration areas for developing measures can be identified *(Column C)*.

A.2 Scope the Integration Prospect

Once context- and initiative-specific objectives are defined, the identification and evaluation of integration prospects to achieve those objectives can begin. This process will likely be iterative, i.e., the ongoing review of available integration prospects by stakeholders may result in the revision of the initiative objectives. The design of systemic change typically involves the floating of a concept and, later, the testing of a solution, on which basis the stakeholders can together learn how the new solution interacts with existing systems, behaviors, policies etc. Those interactions and interdependencies provide the basis for re-conceiving the solution and/or reforming existing institutions and arrangements so as to better achieve the objectives.

The stakeholders scope for possible integration prospects in each of the identified five areas of Urban NEXUS integration.

The initial identification of such prospects requires stepping back and taking a more holistic view of current arrangements, the urban environment, resource cycles, patterns of supply and demand, and patterns of work and living. A wide range of methods are available for such purposes. The methods focus on providing a holistic or systemic understanding of conditions and linkages, and on determining how to better integrate separate entities or systems. The following is a sampling of available methods.

Methods used to scope a prospect for increased technical performance:

System balancing: analyzes the inputs, processing methods, end uses, and waste of an entire resource system, such as the energy system for a metropolitan area or a country. System balancing can be used to identify the major inefficiencies and waste flows in a large energy, water, or other material system.

Lifecycle assessment: analyzes the total costs and resource demands of a product or system, from its design and material inputs, through its lifetime of use, and including the costs of wastes and external impacts. Lifecycle assessment can be used to identify hidden costs and inefficiencies in a design, product, service, or system.

Value engineering and Supply chain analysis: are methods used to systemically review the inputs, stages, costs, and alternatives to sourcing, producing, and delivering a service, product or system. Because they provided a systemic overview of complex products and business networks they elucidate areas where overall productivity and performance can be increased.

Methods used to scope a prospect for increased operational performance:

Rapid ethnography: is a method of detailed direct observation of the day-to-day lives of users or residents. Rapid ethnography is used to understand how a particular activity, service, or product fits into the total picture of a person's life.

The role of sustainable consumption and production (SCP) for the Water-Energy-Food NEXUS

The systemic lifecycle approach, considers products, services and infrastructures (such as buildings) from the design stage, through production, transport and use, all the way to the end of its life. While this approach is well known for products and comes with an established methodology, it is not yet widely known in urban circles. This systemic lifecycle approach ties in with the Circular Economy in which materials are reused as much as possible, thus increasing resource efficiency and sustainability. It would be beneficial for the thinking behind the life cycle approach and the Circular Economy to become more known among city officials and urban experts and to be adapted to urban applications.

Michael Kuhndt, Director of the Collaborating Centre on Sustainable Consumption and Production, CSCP

Find the full article in Annex B

Environmental scanning: methods such as PESTEL analysis (analysis of Political, Economic, Social, Technological, Environmental, and Legal influences and constraints on achieving objectives) are used to fully understand trends in the operating environment that will influence the success or failure of a new kind of product or service.

System mapping: is a method used collaboratively by stakeholders from different sectors, silos and social groups to identify how their respective activities interact and are connected, and how their respective plans will influence each other's plans and objectives.

User or customer lifecycle analysis: is a method used in the consumer goods and services sectors to document the full cycle of engagement with a social or user group and to better understand the occasions and opportunities to influence their choices and behavior, as well as to improve the value of a service or product to them.

The extent of these early scoping activities can vary, depending upon budgets and access to technical expertise, which tend to differ significantly e.g. between cities in the global North and South. However, what matters most is taking a fresh, system-wide look at current conditions, factoring the expertise and perspectives of the different stakeholders in the system. The field of participatory development planning provides a variety of scanning, mapping, and scoping methods that apply the same concepts as more technically demanding methods such as lifecycle analysis.

Referring back to Table 3, the summarized South African initiative used a straightforward, accessible rapid ethnography technique to more fully understand the day-to-day lives and, in particular, the cooking and fuel use habits of township residents. A form of environmental scanning was used to understand the technological, policy, economic, and social trends that would influence the scalability of any new fuel and cooking solution. Supply chain analysis was used to understand the potential to increase efficiency, suitability, and efficacy through re-integration of refining, distribution and retail. For instance, the environmental scan identified the potential for involving local township entrepreneurs in the distribution and retailing of the solution. Other technical analyses were used to understand how an economically viable solution would need to perform relative to alternative fuels and stoves.

Following these sorts of scoping analyses, the requirements and opportunities for Urban NEXUS integration solutions were identified (summarized in Table 3 Column C for the provided example).

A.3 Engaging Urban NEXUS Stakeholders

The initial identification of areas of Urban NEXUS integration prospects enables further clarification as to which stakeholders need to be involved, or at least consulted, in the design of Urban NEXUS initiatives and measures. Each initiative will need to determine the nature and extent of involvement of each stakeholder; this depends, among other things, upon the importance of each stakeholder to the function and scaling of each particular integration area or measure.

The early identification and involvement of stakeholders is important for three reasons. First, it enables a realistic assessment of the complexity of, and constraints upon, Urban NEXUS innovation in the relevant integration area(s). Second, it engages a broader range of expertise and knowledge in the early conception of solution options. And third, the participation of stakeholders prepares the way for the political, commercial, and social negotiation aspects of an Urban NEXUS initiative, which are generally just as important as technical

and operational measures. For these reasons, it is important to regularly review whether the essential stakeholders are involved to support the Urban NEXUS initiative's design and establishment.

In the Urban NEXUS pilot project developed in Dar es Salaam, Tanzania (from December 2013 - August 2014), the involvement of technical, as well as political stakeholders from the outset, saved time and resources that otherwise would have been spent on conducting a pre-feasibility study of implementing a biogas plant as part of the Urban NEXUS project at two municipal schools, which technical stakeholders present at preliminary stakeholder meetings were able to assess up front as unfeasible.

As schools are administered under local governments in Tanzania, the project received tremendous support from the Kinondoni Municipality (KMC), the key implementing partner of the project, particularly from the directive of the Municipal Director. The Director's appointment of technical officers to the project, and the close collaboration with the local implementing partner – the Environmental Engineering and Pollution Control Organisation (EEPCO), added valuable human resources and knowledge. KMC brought together a vast array of stakeholders via a community decision making workshop to discuss Urban NEXUS prospects and interventions at the schools using the Strengths, Opportunities, Aspirations and Results (SOAR) approach to reviewing Urban NEXUS approaches and what could be possible in schools in the city. Participants also included religious leaders who could serve as key access points to the wider community in partaking and mainstreaming the Urban NEXUS approach. Community members were represented by the school headmasters, faculty, religious leaders and mtaa (the smallest unit within a ward of an urban authority in mainland Tanzania). Additional private sector organizations, university professors and NGOs also participated in workshops and project design.

In a second Urban NEXUS pilot project in Nashik, India, engaging with a wide range of stakeholders was also crucial for the initial identification of Urban NEXUS prospects to focus on and what could realistically be achieved in the short time frame of the pilot project.

Including actors from water, energy and other relevant authorities at the district, city and state level was important in order to compile data from relevant experts, and to obtain the various authorizations needed to work in the project area. For example, although the district level authorities were not directly involved in the implementation of the project, they were involved in the stakeholder meetings to avoid opposition or blockages from them later, and to facilitate getting any needed support from them later (e.g. additional data).

Involving a broad range of stakeholders in the pilot project development had the additional benefit, and indeed aim, of creating institutional linkages and relations – both horizontally and vertically – between various governmental departments/actors, i.e. triggering cross-institutional relations with potential longer term benefits.

A.4 Pre-Feasibility Review of Prospects

The identification of possible areas of integration through the above activities does not confirm the practicability of the prospect at the specific point in time. This step, A. 4 Pre-Feasibility Review of prospects, therefore involves an initial strategic evaluation or pre-feasibility review of prospects by stakeholders to determine which are worth pursuing under current conditions and constraints. Note that only a review is recommended at this stage, and not a full pre-feasibility study (PFS).The difference between a review and a PFS is that a review focuses on institutional, policy, organizational, and stakeholder factors

that would support or hinder the development of the prospect at this time. In a typical PFS, detailed technical and financial factors, including studies such as cost-benefit analysis, would be undertaken once a more detailed solution was developed in stage B (Innovate).

All of the insights and information gathered during the above scoping and consultations are used to inform this review process. The objective is to collectively determine whether to establish a collaborative innovation process in which stakeholders would develop the mix of measures that are required to create the Urban NEXUS solution.

At this stage the focus is to understand what *are the innovation requirements* — and whether the stakeholders agree that it is worthwhile to apply resources to try to meet those requirements. A variety of frameworks may be used for rapid feasibility review. The pre-feasibility evaluation seeks to understand two basic factors of feasibility:

1. Strategic Evaluation: whether momentum can be established, within the real-world setting, to implement the identified integration of systems, scales, services, silos, and social conditions, and

2. Operational Evaluation: to broadly determine what kinds of measures would be needed to constitute the solution set.

A.5 The Urban NEXUS Initiative Mandate and Desired Urban NEXUS Performance Outcomes

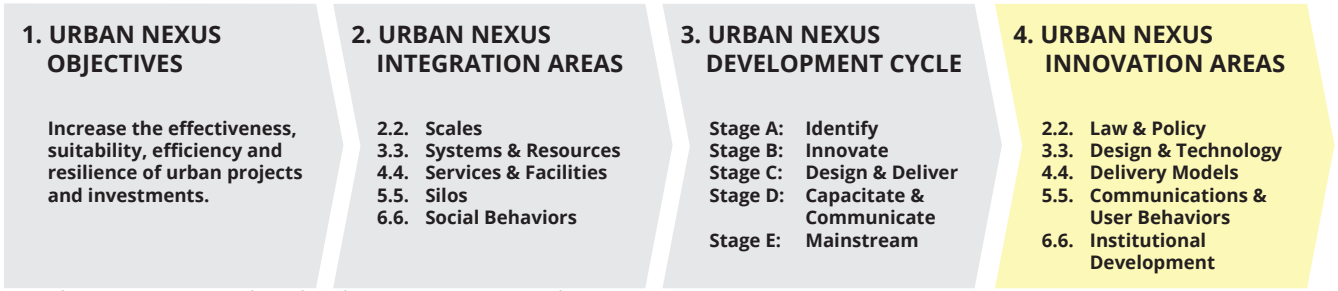
The above steps should have established the following:

- Identification of the perceived prospect for integration
- Evaluation of the strategic feasibility of the prospect, under current conditions
- Identification and early engagement of the stakeholders needed to develop, implement, and benefit from the prospective intervention

In this last step, two additional arrangements are established for successful Urban NEXUS innovation. First, the criteria and constraints for a successful solution need to be clearly defined and agreed upon between the stakeholders. Second, a mandate or mandates need to be secured from relevant authorities, executives, community organizations and property owners to support collaborative work on the design of an Urban NEXUS solution that meets those criteria.

Innovation criteria define the types and levels of Urban NEXUS performance that stakeholders agree must be achieved to merit the implementation of the Urban NEXUS solution. In business innovation the criteria for innovation are often called “the innovation sandbox”. It is useful to think about two kinds of performance criteria and constraints: targeted internal performance/productivity metrics and targeted external performance/productivity metrics. External productivity metrics define measurable ways to evaluate the benefits of the conceived solution to users and residents and in terms of their own quality of life, livelihoods, etc. Internal performance metrics define measurable ways to evaluate the operational benefits of the conceived solution for the institutions, businesses, and other organizations that will deliver and manage the solution together.

3.3 Stage B: Innovate



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Key messages

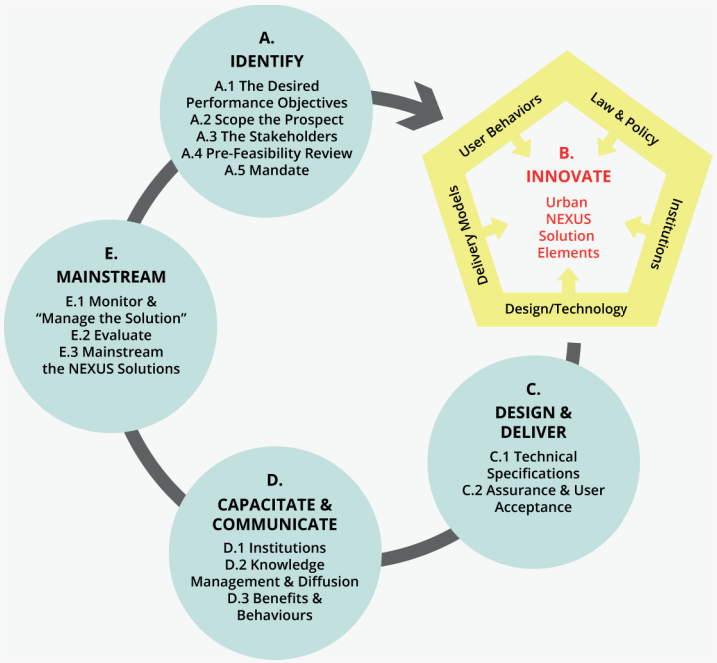
- Having secured a mandate to innovate with clearly defined performance targets, the stakeholders collaborate in a structured innovation process to develop a set of politically, institutionally, and economically viable measures in areas spanning the range of policy, technology, planning, finance, business models, communications, and institutional design.
- This section explains and gives examples of the five main Urban NEXUS Innovation Areas to identify the innovations required to effectively craft Urban NEXUS Solutions from the identified Prospects:
  - B.1 Law & Policy: to support and regulate the market for existing solutions and systems
  - B.2 Design & Technology: to optimize current systems, services, institutional arrangements, and scales of operations
  - B.3 Delivery Models: to optimize the efficiency of the service according to local conditions
  - B.4 Communications & User Behaviors: to educate and secure the benefits of the solution
  - B.5 Institutional Development: to coordinate the integration of different systems and stakeholders, or to manage an entirely new kind of system
- Continuing the Urban NEXUS Development Cycle (with step C), these innovations are then integrated into the design and delivery of the Urban NEXUS solution.

Key Strategy Question for stakeholders: *What innovations, measures and reforms are required to enable the Urban NEXUS prospect?*

Once a mandate is secured to explore the identified areas of Urban NEXUS prospects, including the criteria and constraints for design of an overall, systemic solution, then the process of developing solution concepts may begin.

Solutions that bridge and alter established systems, scales, sectors and silos of urban management, and that alter basic patterns of activity and resource usage, generally require a wide variety of measures in each of the five basic innovation areas. This breadth of measures and their integration into a comprehensive solution is what makes an Urban NEXUS solution systemic.

Figure 8:
The Urban NEXUS Development Cycle.
Stage B: INNOVATE



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The five areas of systemic innovation are:

B.1 Law and Policy

Established laws and policies are designed to support and regulate the market for existing solutions and systems. Conversely, they are designed to provide disincentives to alternative solutions. A simple example is the required innovation in building standards required when introducing an Urban NEXUS approach to household-level energy management and production. Passive housing, whereby the residents regulate home temperatures through their own body heat and household activities (e.g., cooking, washing) requires entirely new building allowances and standards - as well as user education and behavior changes. Solar rooftop energy production typically requires legal reform to allow households to sell their excess energy production back into the electricity grid.

B.2 Design/Technology

Established designs and technology are optimized for current systems, services, institutional arrangements, and scales of operations. When integration between scales, services or institutions takes place, for instance, new technologies and designs are often required to achieve the more optimal outcome. A simple example is the widely familiar solution *(see the Lille, Linköping, Mariannhill and Volta Redonda cases, listed in the Annex B)* of using household organic waste as a nutrient supplement in parks management or in agriculture, potentially also producing biogas, and thereby reducing landfill costs and pollution problems. The separate collection of household organic waste by municipal waste management services instigated widespread innovation in the design of waste bins and collection vehicles, or in the design of public transit buses and fleets.

Linköping, Sweden
Agricultural Waste to Biogas Power Plant: biogas powers public transport in Linköping

In 1996, the Linköping Waste-to-Energy biogas plant was launched in joint cooperation with the local biogas utility, local abattoirs, farmers and the Technical Office of the City of Linköping. It has been designed to utilize waste from agriculture and slaughterhouses, feeding the city's bus fleet and a number of private vehicles with biogas. Today, the program has expanded to include organic waste collected from school canteens and restaurants throughout the city through the installation of macerators to meet the growing demand for biogas. The plant also supports local farming through the production of bio-fertilizer. The project releases pressure on local landfills, reduces GHG emissions from landfill waste disposal and strengthens the local transport system and food production.

Find the full Urban NEXUS Case Story on Linköping (Case Story 2014-No. 14) at www.iclei.org/urbannexus

B.3 Delivery Models

Modern delivery models for utilities and municipal urban services have generally reflected a centralized, scaled provision of services that limit the ability of the end user to contribute to the solution or to optimize the efficiency of the service according to their own conditions. For instance, the conventional approach to municipal sewage treatment and storm water management has focused on large, centralized collection and treatment infrastructures. The integration of end users, building design, and landscaping into the achievement of sewage and storm water management objectives has required fundamental changes in municipal delivery models. Today, part of the delivery of storm water services may involve the provision of equipment to homeowners to direct rainwater into storage tanks for home use, or into re-landscaped yards or water features. The improvement of sewage treatment services may involve the provision of education and collection services for toxic and hazardous substances, as well as the introduction of regulations and fines, to prevent their disposal into sewers and drains. Increasingly, the establishment of more productive infrastructure and utility systems involves public-private partnership models; and the delivery of tailored services for informal settlements is involving public-NGO-private partnership models, as exemplified in the Favela Bairro case *(p. 37 and Table 2, and case study in Annex B)*.

B.4 Communications and User Behaviors

New policies, designs, and delivery models typically require the widespread education of affected institutions and their employees, who now must manage differently, and in coordination with others. The general public and end users of new service models and routines must also be educated to secure the benefits of the solution. For instance the Toronto Deep Lake Water Cooling system *(see box)* required commercial building managers to switch from managing their own heating and air conditioning equipment to managing the temperature of the coolant returned back into the district system. In the Favela Bairro program, the residents of favela communities had to learn how to manage their household grey water systems. This important aspect of innovation is too often taken for granted, resulting in the poor or improper use of a solution, and eventual social and political rejection.

B.5 Institutions

Finally, the establishment and scaling of an Urban NEXUS solution may require substantial institutional innovation. This generally arises from the need to coordinate the integration of different systems and stakeholders, or to manage an entirely new kind of system. For example, new institutions were established to manage the Toronto district cooling system *(Urban NEXUS Case Story box above)* and the Curitiba bus rapid transit system *(Urban NEXUS Case Story in Annex B)*. In the instance of the integrated eco-district Kronsberg (Hannover, Germany) a communications agency was established both to educate new residents about the operation of their homes and to establish community activities *(see box below)*.

An Urban NEXUS solution, therefore, often consists of a set of diverse, mutually reinforcing measures in each of the above five innovation areas. These diverse measures must themselves be integrated in a coordinated fashion: this is what makes the measures a true Urban NEXUS solution.

The process of innovation to achieve mandated performance targets may begin with the consideration of innovations and measures from past practices.

Toronto, Canada
Keeping the business district cool with the integrated potable water and Deep Lake Water Cooling System

Eager to tap into the potential of Lake Ontario, the City of Toronto had long decided to use the lake's chilly water for district heating. However, since the water used for cooling could not be released back into the lake due to its high temperature causing damage to ecosystems, the City devised a new solution. A loop has been created that feeds the lake water first into the cooling system of Toronto's financial district and then after slight re-cooling, into the city's potable water system from which it goes back to the lake after treatment. The system saves large amounts of energy and GHG emissions which would have otherwise been spent on cooling and uses a valuable resource in a two-fold way. To oversee and finance the project, the City of Toronto created a new integral institution, the Enwave Energy Company, now a private-public-partnership.

Find the full Urban NEXUS Case Story on Toronto (Case Story 2014-No. 25) at www.iclei.org/urbannexus

Hannover, Germany
Kronsberg Eco-District: Scaling up institutional integration with KUKA

In 1992, to address urbanization and a lack of accommodation, the City of Hannover began planning Kronsberg, a new eco-district at the south-east edges of the city. Due to its proximity to the upcoming 2000 World Exposition in Hannover, the incentive was high to present a good-practice example of ecologically and socially integrated district planning in alignment with Agenda 21 principles. The district was a multi-departmental collaborative effort between the EXPO Planning Group, Environmental Planning Group and the Directorate of Health, Youth and Social Services. Additionally, in order to realize the districts' ambitious ecological and behavioral targets, the City founded the unique Kronsberg Environmental Liaison Agency (KUKA), which served as an institutional locus to oversee and coordinate the project, provide skilling and qualifications for builders and planners, initiate social projects and events and serve as an onsite community consultant for residents. Today the district incorporates several eco-friendly design elements such as rainwater management, waste reduction mechanisms, passive and low energy houses, solar energy and co-generation, incentives for sustainable transport choices, landscape preservation and social and cultural projects.

Find the full Urban NEXUS Case Study No 04 on Hannover at www.iclei.org/urbannexus

Oftentimes, new levels of performance can be achieved if these separate, tested measures, from across the five key innovation areas, are now applied together systematically. The stakeholders may together review how a combination of such measures, adapted to the specific opportunity at hand, might result in an integrated and more optimized solution.

The development of a fundamentally new solution, both during the initial conception and throughout the pilot phase, involves iterative testing of the different measures and how they can be refined to support and optimize the total outcome. This iterative review begins during the early conception of measures with the stakeholders. Such discussions highlight the measures that need to be specifically tested for efficacy during a pilot phase. The iterative refinement and eventual optimization of measures as an integrated solution set continues even during the first years of operation. When establishing a systemic solution there is a unique need to adjust the set of measures until they work well together to achieve targeted outcomes; and then to further adjust them in the face of changing realities.

Such a process of invention and adjustment further highlights the extent to which developing an Urban NEXUS solution requires effective multi-party coordination, the development of collaborative capacity between jurisdictions and established silos, and a spirit of negotiation among stakeholders to achieve and continue to improve the available 'optimal' arrangement. Establishing these conditions for collaborative innovation often requires unique institutional arrangements, such as those established in California's Silicon Valley region through the creation of Joint Venture Silicon Valley *(see p. 45 and Annex B)*.

3.4 Stage C: Design and Deliver

Key messages

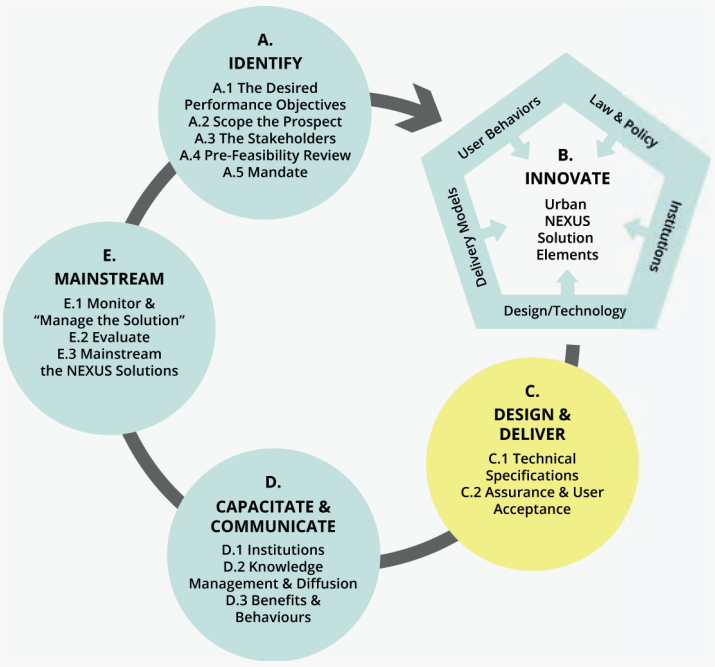
- The design and delivery of the solution includes prototyping and piloting it in a real-world operating environment.
- The design of the solution should consider new metrics for evaluating performance, which must be related to one or more of the defined objectives and performance targets established in the initial initiative mandate (i.e. from Stage A: Identify).
- The effectiveness of each measure should be tracked and evaluated during the piloting and refinement of the overall solution to ensure that the individual measures are contributing as necessary to the performance of the overall integrated solution.
- On the demand side, when introducing a fundamentally new solution it is critical that specific resources and effort be applied to understanding the end user's response to the solution.

Once the general Urban NEXUS solution is finalized by stakeholders, it must be prototyped and piloted in a real-world operating environment. Piloting is a critical aspect of the innovation process, in that it provides information about real-world requirements and responses without disrupting or replacing the established solutions. Piloting provides the information required by decision makers to determine whether the new solution should be introduced as a replacement for established approaches and operations.

Prototyping an Urban NEXUS solution within a pilot project requires that each measure within the solution set is specified at a level of detail appropriate to each of the technical and operational domains involved. These specifications become the key performance indicators for further technical and operational design of the solution and for its performance evaluation through the piloting stage. The delivery of such a systemic solution in a pilot requires a unique project management approach, assuring that each contributor to the solution actively tracks whether their contribution is meeting specifications—and whether specifications must be adjusted.

Figure 8 illustrates how the performance metrics for a new, systemic solution are developed over the course of an entire Urban NEXUS initiative. The logical connections between metrics defined at each stage enable the systemic

Figure 8:
The Urban NEXUS Development Cycle
Stage C: DESIGN and DELIVER



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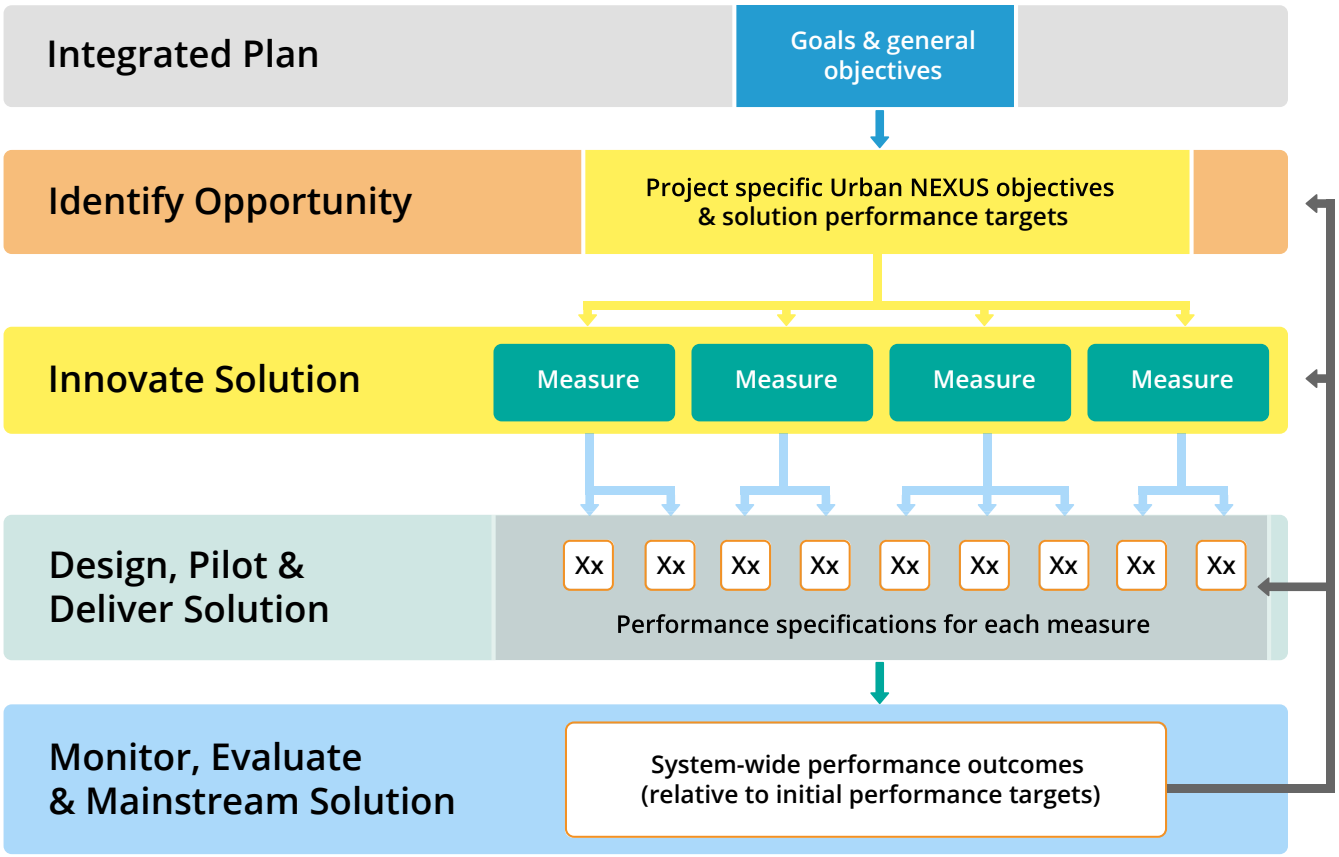
performance of each measure to be tracked and evaluated during the piloting and refinement of the overall solution set. For instance, each measure developed during the Innovation phase relates to one or more of the defined objectives and performance targets established in the initial initiative mandate (i.e., during the "Identify" stage). This ensures that the individual measures are contributing as necessary to the performance of the overall integrated solution. Finally, during the scaling and mainstreaming of the solution, success is monitored and evaluated according to overall system-wide outcomes. This, in turn, supports the evaluation of the final solution relative to the initial initiative mandate.

Conventional urban development projects generally have a quality assurance component, through which the delivery of inputs according to agreed performance metrics is monitored by an external evaluator or through a collective effort of the contributors to the solution (i.e., the "suppliers"). In an Urban NEXUS initiative, an entirely new and systemic solution is being tested and introduced by a wide range of contributors. For this reason, the

emphasis on collective learning during the assurance process is increased. In effect, each of the contributors to the initiative is undergoing its own internal innovation effort. Ideally, therefore, all of the key stakeholders in the initiative will participate in and contribute resources to the quality assurance effort as part of the initiative's ongoing learning and innovation process.

Figure 9:
The specification of a new Systemic Solution in the Urban NEXUS Approach



GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS. © ICLEI, GIZ and TNP

In the Urban NEXUS pilot project in Nashik, India, one of the measures included a performance evaluation of agricultural pumps used in the area in order to suggest the most efficient and locally suitable pumping solutions. An auditor was involved to test existing pumps in the area, as well as the performance of new pumps at the end of the project. In the next stages of project evaluation and potential replication or up-scaling, more emphasis will be placed on how this performance contributes to the overall systemic solutions as well as on aspects of collective learning.

A typical quality assurance procedure for suppliers has four basic elements:

- Systematic measurement of delivery of each component or measure according to the agreed specifications
- Monitoring of the processes through which delivery occurred to evaluate and understand how the process of delivery might be affecting results
- Documentation of issues that produced results different than those anticipated
- Provision of feedback to the relevant contributor, so as to ensure learning about how to improve future delivery

On the demand side, when introducing a fundamentally new solution it is critical that specific resources and effort be applied to understanding the end user's response to the solution. For example, when introducing the district heating and cooling system in Toronto *(Annex B)* great attention had to be given to educating and collaborating with building managers to adapt management routines so that the new source of heat and cooling was optimized both for the individual building and for the overall system. Similarly, when programs such as Favela Bairro and Medellin IUP *(Annex B)* introduce low-tech, small scale waste water management systems into settlements, households need to be supported to use and maintain them effectively. User acceptance is critical to understanding whether the conceived solution delivers desired impacts and outcomes from an Urban NEXUS initiative. When fundamental or systemic changes are made in the user's environment, and in the intended beneficiary's life and community, unanticipated challenges and effects are common. The piloting of a new solution therefore should be organized in a way that provides a rich understanding about the wide array of possible effects the solution may have, including aspects of life that were not originally considered.

In Dar es Salaam's Urban NEXUS pilot project, for example, it had to be considered how the project component of building a wall around the project schools would not only create a safer school environment, but also change the way the community could use the new environment. Negative effects had to be evaluated. For instance, users could no longer take shortcuts through the school grounds, which had to be negotiated in the stakeholder engagement processes. As a result, the construction of the school wall and gate was a condition to safeguarding the new Urban NEXUS technical solutions and designs. However the decision was taken to have the wall double as an educational mural on sustainability, climate change and Urban NEXUS thinking, adding life to the school grounds and presenting an opportunity for additional education.

Dar es Salaam, Tanzania
Urban Nexus pilot project: linking water and food resources in schools

By creating an institutional Urban Nexus for infrastructure systems and services at schools in Kinondoni, Dar es Salaam harnessed opportunities to link water and sanitation, energy, food and waste, which would have otherwise been missed with a singular development application (such as water). By piloting in two schools, and then applying the lessons learned to policy, regulation and practice to upscale across all schools (and other public spaces such as clinics and municipal buildings) in the city over time, a substantial impact on planning and service delivery can potentially be achieved.

Find the full Urban NEXUS Case Study 01 on Dar es Salaam at www.iclei.org/urbannexus

3.5 Stage D: Capacitate

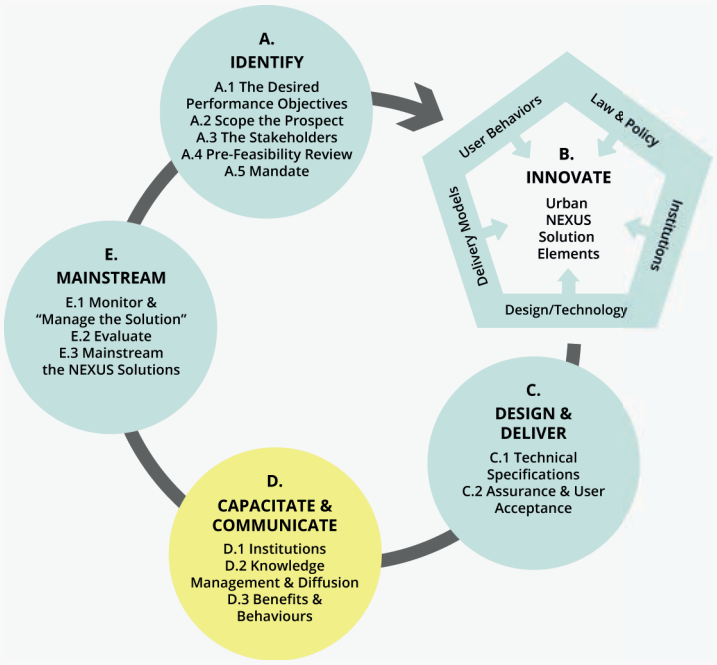
Key messages

- Building capacity is a crucial component to advancing and sustaining any Urban NEXUS solution. The three main areas of capacity building typically required are: training operational staff on managing their parts of the solution; informing and capacitating the intended beneficiaries and end users of the benefits and required skills; and enabling the relevant institutions to establish a systematic process for introducing and supporting the solution set in new locations or facilities (up-scaling).
- Urban NEXUS thinking should be built into the curriculum of urban planning and management courses, training institutions, and professional associations.

Once the piloting of a solution set is completed, then a new decision is generally taken regarding when, where and how the solution set is more fully and widely introduced as a replacement to the existing approaches and operations. The assurance and user acceptance activities undertaken during the pilot provide a basis for understanding not only how to refine the solution, but also indicate the required marketing, education and training supports to scale up the new solution.

There are typically three main areas of capacity building required to establish a new solution.

Figure 8:
The Urban NEXUS Development Cycle.
Stage D: CAPACITATE and COMMUNICATE



GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS

Firstly, the operational staff of all the key contributors needs to be informed and trained about how to manage their parts of the solution such that they deliver the desired performance benefits. For example, an Urban NEXUS initiative to transform single-purpose schools into integrated school, health clinics, and community and recreation facilities requires new models of governance, and the retraining of staff including new functions as schedulers, security personnel, and cleaning staff.

Secondly, the intended beneficiaries and end users need to be informed about the benefits to be gained from the solution, and the new behaviors, knowledge, and skills they need to acquire to secure those benefits. Effective operation of residential eco-homes in the Kronsberg eco-district required the City of Hannover's establishment of the KUKA communications agency (Kronsberg-Umwelt-Kommunikations-Agentur), which demonstrates an integrated approach to public relations, stakeholder education, training and, ultimately, effective and optimal use of the Urban NEXUS solution *(see the text box p. 70, and the Urban NEXUS Case Study 04 on Kronsberg, Hannover)*. Another example of a dedicated communications agency is found in the case of Metro Vancouver's Regional Food Strategy program *(Urban NEXUS Case Study No. 3 in Annex B)*.

Thirdly, the institution or institutions that will lead the scaling up of the solution need to establish a systematic process for introducing and supporting it in new locations or facilities. Consider for instance the successful model of district-scale urban regeneration in Barcelona. After establishing a unique model of redevelopment in central city districts like Raval, the legislative and planning reforms, community consultations, business and partnership models, and financing innovations and incentives used were transferred and adapted as a

sort of redevelopment operating system in other target districts.

Where new districts or developments do not provide the occasion for creating such capacity building institutions, cities should consider which existing educational institutions and training providers could be engaged as a partner in the Urban NEXUS initiative to provide capacity building support. International initiatives and organizations working at the local and national levels may also be involved in a capacity building role. Examples of international organizations already working on NEXUS concept implementation include ICLEI-Local Governments for Sustainability, the UNEP-led Global Initiative for Resource Efficient Cities, the International Initiative for a Sustainable Built Environment (United Nations Economic and Social Commission for Asia and the Pacific – UNESCAP), the Stockholm Environment Institute, and more, shall assist in such capacity building and be the future champions of integrated NEXUS thinking and practice.

3.6 Stage E: Mainstream

Key messages

- Urban NEXUS approaches benefit from the establishment of institutions and mandates to support and enable replication and up-scaling.
- It is often through innovative institutional solutions like URBS in Curitiba or the NeighborSpace Trust in Chicago that Urban NEXUS innovations for one initiative are scaled up and instituted as the new "conventional" practice. "Mainstreaming" in many cases is a matter of designating or creating an entity that specializes in the scaling of unique aspects of the Urban NEXUS solution, addressing challenges and "managing the solution" within different contexts.
- Monitoring and evaluation (M&E) is still often pursued in a dis-integrated way, with "performance" generally still monitored separately within the silos and sectoral divisions. An Urban NEXUS-oriented approach would apply the principles of measuring system-wide performance outcomes, across sectors, systems, silos and scale; focusing on context- and initiative-specific objectives so as to support the establishment of customized solutions; and supporting learning amongst stakeholders in the process of developing, piloting and mainstreaming their Urban NEXUS initiatives.
- Developmental evaluation should be undertaken with stakeholders at each stage of the Urban NEXUS Development Cycle to draw lessons about the process of conceptualization and specification of Urban NEXUS solutions; lessons from pilot activities about the different measures that are part of the solution, and how to improve them; and to document and jointly evaluate the innovation journey itself.

The scaling of new Urban NEXUS solutions into the new "conventional" practice generally requires a new institutional solution to advocate and manage the scaling process. The most innovative cities, like Barcelona, Chicago or Curitiba, have been those that have captured and articulated their unique approach to innovation and transformation – and then scaled the process in part by creating new institutions to support it.

Chicago, USA
CHICAGO NEIGHBORSPACE

The lack of green open spaces in the City of Chicago led to an initiative in which the City, the regional governments and community movements joined forces to establish the so-called NeighborSpace land trust. The trust purchases vacant land in the city and distributes it to community groups for their gardening and conservation activities. Not only does the initiative offer up to date mapping of vacant land on their website to help mainstream urban agriculture, Chicago NeighborSpace also offers a platform with a tool lending library and space for gardeners to exchange tips and tricks.

Find the full Urban NEXUS Case Story on Chicago (Case Story 2014-No. 3) at www.iclei.org/urbannexus

Consider the case of NeighborSpace in Chicago *(see box and Annex B)*. The initial straightforward idea of converting derelict sites into neighborhood parks and gardens was developed in iterative fashion into a scalable Urban NEXUS solution involving the integration of systems and silos (i.e., between legal, parks, emergency services, water, and social services departments, and with neighborhood civic organizations) across city and county jurisdictions. In addition to the resulting physical re-establishment of land productivity – from hazardous lots to food producing gardens – the initiative focuses on the use of a garden to build neighborhood social cohesion and community-based management capabilities. For this reason, the scaling up of the solution requires skill and sensitivity regarding the institutional, resource and social dimensions of the solution set within the context of each different community. Scalability was achieved through the creation of a customized legal entity—a land trust—to receive legal title to these city-owned properties and to prepare them as community-run gardens and parks, ultimately transferring rights to incorporated community associations. "Mainstreaming" in this and many other cases is a matter of designating or creating an entity that specializes in the scaling of the all the unique aspects of the Urban NEXUS solution, addressing problems and "managing the solution" within different contexts.

Other examples of institutional solutions for the up-scaling of Urban NEXUS solutions are the creation of the Enwave district heating and cooling utility for Toronto's central business district and the creation of the URBS urban services company in Curitiba, which oversaw the scaling of the city's bus rapid transit system.

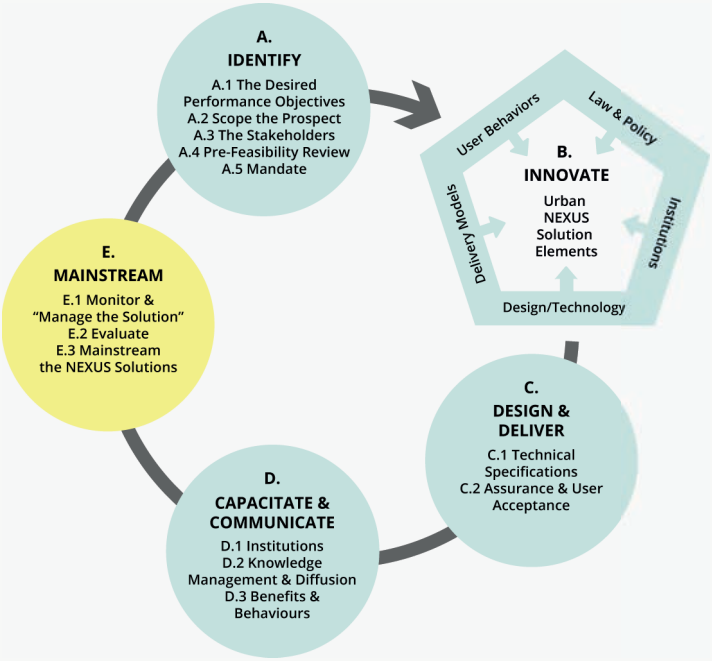
Short of establishing a distinct institutional solution, an established organization may join the initiative to develop the capacity for local mainstreaming by supporting routines for monitoring, evaluation and refinement of the solution. Monitoring and evaluation (M&E) should be designed to make it efficient for collaborators to capture the technical, political, institutional, and social lessons from early applications. M&E allows an organization that was developed to specialize in one set of solutions to adopt and advance a new form of practice.

Monitoring and evaluation (M&E) is still often pursued in a dis-integrated way. "Performance" is generally still monitored separately within the silos and sectoral divisions of the distinct institution, utility, or department etc., and according to their distinct priorities—and not for the system as a whole. Benchmarking and performance monitoring is substantially designed to maintain accountability and control over management units. As in private sector corporations, public sector benchmarking focuses on keeping pace with levels of operating performance relative to similar types of operating units in other jurisdictions.

Considerable effort has been made to establish city- and system-wide performance evaluation frameworks; however, these efforts are constrained by the modern management bias towards standards and standardized approaches. For example, even the most innovative and advanced green building standards and sustainability rating systems, the standardized measurement of performance is given priority to the standardized measurement of performance over the complex and unique contexts that actually determine ongoing operating performance outcomes.

A building can receive a high-level sustainability rating but may not in fact be effectively managed to achieve the rated level of performance. As well, it may be located in a very low-efficiency district (e.g., burdened by heavy, polluting traffic congestion) or connected to very low-efficiency systems (e.g., an under capacity storm water and waste water system). Total system-wide and region-wide performance is still rarely measured.

Figure 8:
The Urban NEXUS Development Cycle.
Stage E: MAINSTREAM



GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS

An Urban NEXUS-oriented approach would apply the following principles:

1. The approach would measure system-wide performance outcomes, across sectors, systems, silos and scales. Institutional M&E approaches should be adapted to integrate these outcome measures into their internal M&E processes.
2. The approach would focus on context- and initiative-specific objectives so as to support the establishment of customized solutions. Standardized and comparative benchmarking would be secondary to this.
3. The approach would support learning amongst stakeholders in the process of developing, piloting and mainstreaming their Urban NEXUS initiatives. In other words, a developmental evaluation approach would be applied.[1]

In essence, the objective of M&E in an Urban NEXUS initiative may not be managerial accountability, control and reporting, in the first instance, but rather ongoing evaluation to support multi-stakeholder learning, experimentation and innovation in the design of the Urban NEXUS solution.

Indeed, relying upon a performance metrics approach as outlined in the Figure 8, developmental evaluation can be undertaken with stakeholders at each stage of the Urban NEXUS initiative

Development Cycle, refining the measures and solutions along the way and drawing conclusions in three aspects:

- Lessons about the process of conceptualization and specification of Urban NEXUS solutions. In the process or integration of separately managed systems, services, silos etc., collaborators will need to repeatedly challenge the assumptions that they bring to the process about what is necessary, contextually appropriate, and technically feasible. Oftentimes at the beginning of an

Networking the Nexus: Mobilizing Research and Collaboration to Support the Urban Nexus

In recent years there has been a notable increase in the number of networks that aim to facilitate cooperation and enable the sharing of sustainability knowledge, policy ideas, and strategies across local jurisdictions and borders.

Networking provides a means through which local authorities can enhance their institutional capacity to plan for sustainability. Sustainability is an evolving process that requires long-term planning and goal-setting, as well as learning: because government staff is bound to change before many long-term goals can be met, it is crucial that sustainable development be understood intimately throughout local authorities and that cross-departmental cooperation occurs (Evans et al., 2006; Polk 2011). Therefore successful planning for sustainable development requires strong institutional capacity within local authorities.

Mark Roseland, Director, Centre for Sustainable Community Development at Simon Fraser University, Vancouver, Canada; and founder of Pando- Sustainable Communities

Find the full article in Annex B

innovation process the givens or ways that we measure options, exclude a variety of alternatives. M&E activities should be used to put these exclusionary assumptions to the test, and to reframe the problem in a way that reveals new opportunities.

- Lessons from pilot activities about the different measures that are part of the solution, and how to improve them. Pilot activity findings need to document all the measures in the solution set and how they reinforce the others. M&E should be designed to make it efficient for collaborators to capture the findings of a technical, political, institutional, and social nature, both quantitative and qualitative. Documentation and group discussion of these findings should enable a deepening understanding of what needs to be reformed and put in place for the new solution to succeed relative to performance targets. This is also critical to understanding what capacities are needed and what communication efforts are required to support the solution.
- The innovation journey itself—needs to be documented and jointly evaluated. M&E should be used to help collaborators learn how to be more effective innovators together in the future. This is particularly valuable in support of the further management, optimization, and "mainstreaming" of the solution, which will likely require whole new modus operandi amongst the relevant institutions, departments, jurisdictions etc. The most innovative cities have been those that have captured and articulated their unique approach to innovation and transformation—and then scaled the process and created new institutions to support it.

Notes

1 Gamble, J. (2008) *A Developmental Evaluation Primer*. J.W. McConnell Family Foundation. Montreal. Retrieved February 2014, from: http://tamarackcommunity.ca/downloads/vc/Developmental_Evaluation_Primer.pdf.

Part 4. Recommendations and Conclusions

Recommendations to local and regional decision makers

Recommendations to national decision makers

Recommendations for ways forward with further research

Recommendations to German Development Cooperation

Accelerating strategic cooperation towards Urban NEXUS solutions

The Urban NEXUS provides a necessary and urgent alternative to continuing with "business as usual" approaches to urban development, services and infrastructure. In order to achieve the collaborative development of solutions urgently required in cities and metropolitan regions, decision makers should actively counter sectoral thinking and divided responsibilities. In doing so, this will not only optimize the use of limited natural, financial, and human resources and institutional performance, it will improve resource productivity and quality of life within our planetary boundaries.

This conceptual study and the Urban NEXUS Operationalization framework (Part 3) provide a methodological approach to the design and implementation of Urban NEXUS solutions. Applying the lessons from existing good practices may accelerate the process for integrative initiatives in cities and metropolitan regions wishing to customize and up-scale such examples, and build capacities and mechanisms for institutional collaboration and communication.

This final section provides key take-away messages and recommendations to local, regional and national decision makers and international development cooperation agencies on how to further the Urban NEXUS approach in each of their domains. Additionally, this section synthesizes how the Urban NEXUS brings with it the opportunity to link global development goals with the world's urban realities; specifically featuring how Urban NEXUS solutions can contribute to the international debate on the Sustainable Development Goals (SDGs). Recommendations are then provided for the next steps in terms of further research and development of the Urban NEXUS approach and tools for implementation. Lastly, this section offers recommendations to the German Development Cooperation on how to continue taking the Urban NEXUS forward.

Recommendations to local and regional decision makers

As the functioning and wellbeing of the world's cities and metropolitan regions relies on significant supplies of resources, local and subnational governments are well positioned to effectively address the challenges of increasing resource inefficiencies, competition and degradation. The following are some recommendations on how to employ an Urban NEXUS approach to harness the benefits of strategic cooperation and integration across sectors and scales:

- **To get started** on how an Urban NEXUS approach will benefit a city or metropolitan region, stakeholders should consider the following questions:
  - What are your city/region's primary objectives and how is dis-integration standing in the way of their achievement?
  - Conversely, how could an Urban NEXUS/re-integration help achieve your objectives?
  - Finally, what are the possible productivity enhancing synergies and benefits that can be gained in your city/ metropolitan region by integrating two or more operations or systems? Which adverse effects might be reduced?
- **Identify "Hotspots".** When identifying priorities for Urban NEXUS projects, local governments should consider the areas, or "hotspots", where this approach would have the most ripple effects. As exemplified by the Urban NEXUS pilot project in Dar es Salaam, schools, for instance, have been found to be particularly

interesting subjects, since they educate not only children but also their communities, as well as City officials and technical staff from various departments (public works, education, health, environment/planning, etc.). If seen as a success, the remaining schools in the district and city at large provide fertile ground for replication and eventually for showcasing and up-scaling the solution to other cities through regional and national education frameworks. Such an approach can be thought of as a form of "urban acupuncture".

Integrating your city/metropolitan region and its physical and social systems for more efficient resource use implies changes in the institutions and governance structures that determine local government operations and management procedures. Some key steps to introduce Urban NEXUS approaches include:

- **Bring all stakeholders around the same table by creating "Urban NEXUS Task Forces".** Urban NEXUS Task Forces created to oversee Urban NEXUS projects at the urban and regional level serve the purpose of linking relevant departments and levels of government together with other key stakeholders (experts, civil society, private business, NGOs and multi-lateral organizations). Urban NEXUS Task Forces are a simple way to kick-off, strengthen and sustain cross-departmental collaboration offering stakeholders a taste of "breaking the silos". Eventually, the goal is to institutionalize such multi-stakeholder collaboration. The case studies identified by the present study, as well as experiences in the two pilot projects in Nashik, India and Dar es Salaam, Tanzania, have shown the great potential of cross-sectoral projects as catalysts for an institutional Urban NEXUS, generating unprecedented communication and collaboration across departments and levels of government.
- **Institutionalize multi-stakeholder collaboration** during (pilot) projects, to guarantee longer-term cooperation and sustainable outcomes. The best cases seen thus far highlight the role of new inter-sectoral institutions, operating at the local or metropolitan/regional scale, whose primary function is the identification and development of Urban NEXUS solutions (e.g. IPPUC in Curitiba, Joint Venture Silicon Valley, NeighborSpace Trust in Chicago, the IPP in Rio de Janeiro, and the Melbourne City Design Division).
- **Customize institutional arrangements** based on the unique local and subnational governance context, available capacities, and the needs identified through projects. The Urban NEXUS approach fundamentally features a process of solution customization, which includes determining exactly which institutions work best for a particular city/metropolitan region.
- **Use and build on existing institutional capacity.** The Urban NEXUS approach is not about reinventing the wheel, but rather realizing the already present organizational structures, institutions or bodies within a city/metropolitan region to capacitate and implement an Urban NEXUS agenda, to institutionalize the mandate for convening actors and to integrate actions across departments and sectors.
- **Integrate Urban NEXUS thinking into all decision-making and management procedures.** An Urban NEXUS approach should be integrated, for example, in review processes preceding development project approvals and investment commitments to instigate pro-active design recommendations, guidelines and strategies that shape the character of urban development

projects and services provision in the medium and long term.

- **Utilize public procurement and tendering processes to boost innovation.** Once Urban NEXUS objectives and opportune areas for integrated and innovative solutions have been identified, decision makers come across difficulties in regulations and processes for the public procurement of innovation. Help can be found from peer learning networks like ICLEI and its Procurement of Innovation Platform: https://www.innovation-procurement.org/fileadmin/editor-content/Guides/PPI-Platform_Guide_new-final_download.pdf
- **Build Urban NEXUS thinking and behaviors** through working with educational institutions, universities, research and training providers to integrate and promote the Urban NEXUS into the curricula for capacity building in local governments, as well as public utilities, private companies, and civil society organizations.

Recommendations to national decision makers

Consistent application of an Urban NEXUS approach fundamentally depends on policy coordination across various sectors, institutions and levels of government, and in its establishment within decentralized systems depends on national policy, regulatory and financial frameworks. The process of Urban NEXUS reform can itself be institutionalized by instituting fundamental processes for Urban NEXUS opportunity identification, evaluation, and innovation in all policy and project or program development at the local, subnational, and national scales. In order to achieve this, the following recommendations can be given:

- **Remember that local governments are embedded in your national regulatory, budgetary, and administrative frameworks,** which often means that national silos in regulation, public procurement processes, budgeting and accounting etc. can hinder innovative integrated approaches and cross-departmental cooperation on e.g. public procurement, at the local level. Consider how you can encourage educational and training institutions that work with local governments to include Urban NEXUS thinking in their capacity building curricula.
- **Use cities and metropolitan regions as laboratories for policy invention**, and look out for innovative local initiatives, policies and practices that provide lessons of national relevance.
- **Adjust financial instruments to support and incentivize Urban NEXUS approaches**, by e.g. linking national development funds or infrastructure financing to reward projects that show an Urban NEXUS approach.
- **Acknowledge and up-scale successful local initiatives** e.g. through national programs, policies and enabling frameworks, such as city-to-city peer learning programs, along with educational campaigns to build capacity from the level of civil society and upwards.
- **Use the Urban NEXUS approach to re-connect scales** and optimize complex cross-boundary resource flows (e.g. river basin management).
- Integrate Urban NEXUS approaches in administrative structures and processes of national institutions and agencies.

- **Support networks for scientific research and development as well as the exchange of Urban NEXUS practices.** This fosters dialogue between researchers and community based organizations and city practitioners, city-to-city peer learning programs, as well as dialogue with national authorities.

Recommendations for ways forward with research

In order to take us forward with regard to the knowledge and practice of Urban NEXUS approaches, more data, research and documentation of valuable lessons learned will be beneficial. In this regard:

- **Develop more documentation of the collaborative *process* of projects and institutional** and governance lessons, for improving knowledge about capacity gaps and requirements for replication of Urban NEXUS solutions. This includes the development of guides to the governance aspects and institutional processes of implementing Urban NEXUS; and the consideration of the potential need to regionalize Urban NEXUS approaches, methods and tools, as well as solutions to be suitable for different contexts.
- **Provide better quantified business cases** for the various types of Urban NEXUS solutions to convince decision-makers of the savings that are to be achieved through integrated approaches. This means, quantitative studies, data on resource savings, and an emphasis on measurability, verifiability, and reportable targets and outcomes (MRV) in projects, programs and policies.
- **Strengthen the understanding of the relationship between social development and the resource-saving dimensions of the Urban NEXUS** (e.g. looking at areas such as gender equality, education, health, risk and vulnerability).
- **Assess and evaluate new institutional set-ups**, and help governmental and civil society actors improve their concepts and approaches.

Recommendations to German Development Cooperation

The German Development Cooperation have played a vital part in the development of the Urban NEXUS approach. The following provides recommendations to the German Development Cooperation for taking the Urban NEXUS further in the domains of 1. international agenda setting; 2. conceptual work and development; and 3. development project approaches:

1. International Agenda Setting

- **Use the Urban NEXUS approach as a contribution to the SDG debate and Habitat III.** The Urban NEXUS offers an action framework for processes and programs at all scales, including the international. The process of Urban NEXUS reform can be institutionalized if it offers a defined approach to opportunity identification, innovation, and evaluation at the local, sub-national, and national scales, as well as in international development assistance organizations. To promote this Urban NEXUS approach as a contribution to the SDG and Habitat III processes, the German

Development Cooperation has the unique opportunity to:

- **Build and support new "urban alliances" to establish an Urban NEXUS perspective within the mechanisms of the preparatory processes for SDGs and Habitat III.** The urgent need to transform urban systems and to develop and maintain complete communities requires the establishment of multi-stakeholder alliances to advance the delivery of solutions and to achieve targeted development outcomes.
- **Mobilize actors at different levels** by promoting the Urban NEXUS as a perspective and approach to integrate action at various scales – regional, national, metropolitan, city, district, neighborhood, facility etc. – as a holistic way to reconnect beyond resources alone and to fight fragmentation in positive ways.
- **Argue for an iterative Urban NEXUS agenda in the preparatory stages for Habitat III. This could be done through** the building of global alliances and introducing the Urban NEXUS approach into the planning, implementation and financing mechanisms of the New Urban Agenda.
- **Consider to develop a funded project to efficiently use the Habitat III process to inform and build support** for Urban NEXUS capacity building within government and society to adapt and optimize solutions more effectively and reconnect different systems within metropolitan regions

2. Conceptual work, further development of methodology and tools

- Identify partners from various levels of government, academia, civil society and the private sector to expand the methodology of the Urban NEXUS approach with practical tools. This could include clarifying the portfolio of German Development Cooperation units and projects in which the Urban NEXUS approach can be demonstrated.
- Feed the Urban NEXUS perspective into training and learning initiatives of partners, e.g. educational institutions that work with local governments, and support the development of the Urban NEXUS perspective in capacity building curricula; and identify and assist those colleges/university departments/institutions that are already interested in the topic.
- And, to avoid repetition *see also the section above on recommendations for further research.*

3. Project approaches

Recommended options for integrating the Urban NEXUS approach in German Development Cooperation projects include:

- Introducing the Urban NEXUS as an approach for designing international development programs and projects. Such pilot projects should be used as entry points for long-term projects integrated with country programs of the GIZ. This includes creating alliances with local and international partners interested in the approach.
- Establishing a regional/global Urban NEXUS implementation approach focused on projects in cities and metropolitan regions. This implies:

- Selecting country and sectors offices/units to take the Urban NEXUS further
- Consider using *Metropolitan Solutions 2015* to continue the discussion in dialogues between local governments and the private sector.
- Applying the NEXUS idea beyond the Water-Energy-Food security NEXUS to other relevant sectors, thus realizing the Urban NEXUS.
- Such programs and projects will require tools, instruments and capacity development as discussed in the *section on recommendations for further research*.

Part 5. Annexes and supporting documents

Annex A: Glossary

Annex B: List and explanation of Supporting Documents (including case studies and case stories)

Annex A: Glossary

Design: the word 'design' or phrases such as 'design approach' or 'design process' are used to indicate the activity of researching, identifying, specifying, and testing something new. This could be a new product, business model, infrastructure, policy, kind of institution, kind of investment program etc. We use the word 'design' to indicate a way to approach a problem that is distinct from other approaches, such as 'planning'. In the Anglophone world there has been a very major discourse and literature, across sectors in domains, about 'design thinking' and a 'design approach' in contrast to planning approaches.

Institutional integration: implies a collaborative effort at different scales of policy making, across sectors, and across disciplines to devise and implement Urban NEXUS solutions.

Institutional reform: is the response to supply-driven institutional set-ups which tend to focus on delivering solutions that satisfy the norms and requirements of the department or agency and its technicians, rather than exploring alternative ways to address the need from a demand-side perspective, engaging with the end users. Institutional reform implies the coordination of institutions- or formation of new institutions- to deliver greater and more accessible benefits from increasingly constrained supplies.

Productivity: this study uses the concept of "productivity" as is applied by urban ecologists and ecological economists. Productivity should therefore be understood as the increased internal productivity of operations and the increased external productivity of communities and end users of urban systems, services and facilities. This departs from conventional historical associations of productivity associated with the efficiency of economic production, to encompass a holistic understanding of the productivity of urban systems and regions as products of human, social, economic, and natural capital.

Productive efficiency: reflecting the systemic focus of the Urban NEXUS approach, an Urban NEXUS solution would seek to establish multiple efficiency improvements across the broader system or group of integrated systems. As a result of such systemic innovation, an advanced Urban NEXUS initiative might change the terms of performance measurement from one of efficient consumption of resource inputs (i.e., reduced waste) to one of a net zero balance (i.e., through resource cycling) or even of net positive resource production.

Resilience: going beyond the 'safe failure' of a system, organization or facility, to instead build local capacity to reduce systemic risks and vulnerabilities by creating back-up resources and systems. Towards this end, the ongoing collaborative effort between sectors and jurisdictions would establish a new regional adaptive capacity: the ability to anticipate changes in conditions and emerging risk factors, and to establish preventative responses to these changes.

Scales: different scales of the built environment and of its infrastructures; of the region's supply chains and resource cycles; and of the policies and operations of local, regional, sub-national and national jurisdictions.

Services: urban services and facilities have conventionally been separated by sectoral functions, resulting in the underutilization of valuable fixed assets. Reflecting such separation, each area of public service is typically managed by a distinct administrative department, overseeing distinct standards and procedures that impede productive and efficient integration of services.

Silos/Silo thinking: "Silo-thinking" refers to the mind-set and practice where an organization such as a municipality or a company is organized and works around the concept of individual functions, departments or sectors. Entire

resource systems often represent such “silos”, right from the natural resource base (e.g. ground water) to their separate facilities (municipal pumping facilities, distribution for irrigation), utilities (regional water company), and institutions (regional water protection board) that manage them, right up to separate national ministries that deal with them (e.g. the Ministry of Water Resources for ground water, or Ministry of Environment for wastewater and sewage).

Suitability: the integration measures in an Urban NEXUS initiative would engage stakeholders in the co-design and co-delivery of the solution set in order to address unique local needs in ways that match or exceed the standards of the best alternatives. In a best case scenario, ‘suitability’ in an Urban NEXUS initiative is the establishment of a customized, financially sustainable solution that meets key policy objectives and the best global standards.

Systems: involve more than the built environment and infrastructures; they include the policies and regulations, business models and processes, financing arrangements, human resources planning, data management etc. that make them function in predictable ways according to basic standards of performance. System integration initiatives establish cascades and cycles of resources between systems, such as the use of biogas from household organic waste in district combined heat and power (CHP) plants

Urban NEXUS: the Urban NEXUS is an approach to the design of sustainable urban development solutions. The approach guides stakeholders to identify and pursue possible synergies between sectors, jurisdictions, and technical domains so as to increase institutional performance, optimize resource management, and services quality. It counters traditional sectoral thinking, trade-offs, and divided responsibilities that often result in poorly coordinated investments, increased costs, and underutilized infrastructures and facilities. The ultimate goal of the Urban NEXUS approach is to accelerate access to services, and to increase service quality and the quality of life within our planetary boundaries.

Urban NEXUS institutional agenda: as an institutional agenda, the Urban NEXUS approach urges governments at all levels and international development organizations to institute fundamental reforms in policies, institutional arrangements, and project development and finance guidelines in order to significantly reduce siloed, uncoordinated and ultimately inefficient urban development approaches and to ensure long-term systemic reforms in spite of intermittent, possibly conflicting, political changes. The Urban NEXUS also promotes more integrated and better coordinated urban development and management efforts between the national, subnational and local levels.

Urban NEXUS Prospect: by definition, a possibility to integrate the routine operations or practices of two or more of a city or metropolitan region’s assets, systems, scales, services, and social groups or behavioral patterns in order to optimize resources. (This requires intensive coordination and collaboration between the departments, jurisdictions, services silos, civic organizations, companies, and disciplines that share responsibility for the development of the city and metropolitan region.)

Urban NEXUS solution: a measure that integrates two or more systems, services, policy or operational silos, jurisdictions and/or social behaviors in order to achieve multiple urban policy objectives and to deliver greater benefits with equal or less resources.

Annex B: List and explanation of Supporting Documents (including case studies and case stories)

Expert contributions

For this study on the Urban NEXUS, ICLEI wished to mobilize the insights and perspectives of experts in the field, and thus invited a range of prominent practitioners and researchers to contribute to the study with brief articles, statements or quotes. The brief articles are referenced throughout the study, and can be downloaded in full as a PDF at: www.iclei.org/urbannexus

All quotes provided in the margin throughout this study, are either taken as citations from these short articles or were kindly provided (between February and April 2014) as short statements by such expert contributors to use as quotes.

Table 4: List of expert contributions (short articles and quotes)

Name / Institution	Title of contribution
Adrian Atkinson, Freelance consultant and trainer in Sustainable Development	1. The Current 'Urban NEXUS' Problematic and Potentials in Cities of the South 2. Urban 'Waste' as Resource: Recycling as a Key Nexus Opportunity
Robert Crauderueff, President and founder of Crauderueff & Associates, a NYC-based green development planning firm, and co-chairs S.W.I.M.'s green roof working group.	Lessons from New York City's Green Roof Incentive Program
Marielle Dubbeling Director, RUAF Foundation	Local food production contributing to climate change adaptation, resource efficiency and poverty alleviation
Dr. Uschi Eid, Vice-Chair of the United Nations Secretary General's Advisory Board on Water and Sanitation (UNSGAB)	Urban NEXUS Quote
Michael Kuhndt, Director of the Collaborating Centre on Sustainable Consumption and Production (CSCP)	The role of sustainable consumption and production (SCP) for the Water-Energy-Food Nexus
Dr. Dinesh Kumar, Executive Director of the Institute for Resource Analysis and Policy (IRAP)	Addressing Rural-Urban Resource Conflicts: Co-Management of Water, Energy and Wastewater Flows for Water and Food Security
Muna Lakhani, Founder and National Co-ordinator Institute for Zero Waste in Africa	A Zero Waste systems approach to organic waste management and sanitation
Hans Mönninghoff, former Deputy Chief Executive of the Lord Mayor of Hannover and Head of the combined Directorate of Economic and Environmental Affairs of the City of Hannover	Hannover's Institutional Nexus: merging municipal departments for synergies between economic and environmental affairs
Prof. Peter Newman, Professor of Sustainability, CUSP, Curtin University, Australia	Solving the Urban Nexus through Local Scale
Jorgen Randers, Professor of climate strategy, Norwegian Business School BI; Member of the Club of Rome and Author of "2052, a global forecast of the next forty years".	Urban NEXUS Quote
Dr. Mark Roseland, founder of Pando | Sustainable Communities Director of the Centre for Sustainable Community Development and Professor of Planning in the School of Resource & Environmental Management	Networking the Nexus: Mobilising Research and Collaboration to Support the Urban Nexus
Dr. Christopher Scott, Professor of Water Resources Policy, Udall Center for Studies in Public Policy and Associate Professor in the School of Geography and Development, University of Arizona	From black to green to gold: Farming with wastewater need not be an urban fringe activity
Rafael Tuts, Coordinator, Urban Planning and Design Branch, United Nations Human Settlements Programme, UN-Habitat	Urban NEXUS Quote
Dr. Ren Wang, Assistant Director General, Agriculture and Consumer Protection Department, FAO	Urban NEXUS Quote

Case Studies and Case Stories

The Urban NEXUS study included the compilation of 30 case studies, including 22 short 1 to 2-page case examples (Urban NEXUS Case Stories), and 8 longer in-depth Case Studies. All are available on the ICLEI global website at **www.iclei.org/urbannexus**. You may also find other ICLEI Case Studies at www.iclei.org/casestudies

The following is a complete list with brief summaries of all of these Case Studies and Case Stories, most of which have been referenced throughout this study:

Table 5: List and summaries of Urban NEXUS case studies and case stories

CITY, COUNTRY	NAME OF URBAN NEXUS INITIATIVE	URBAN NEXUS CASE STUDY / STORY NO.
Dar es Salaam, Tanzania	**Demonstrating the Urban NEXUS approach to link water, energy and food resources in schools**	Urban NEXUS Case Study No. 01
	Through cross-institutional collaboration, two schools in Dar es Salaam operationalized the Urban NEXUS approach as a new design process towards resource-efficient and productive service delivery. The project serves as an example of integrated solutions for optimizing energy, water and food to be scaled up throughout the metropolitan region.	
Nashik, India	**Demonstrating the Urban NEXUS approach to optimize water, energy and land resources in peri-urban agriculture**	Urban NEXUS Case Study No. 02
	The Nashik Municipal Corporation adopted an Urban NEXUS approach to improve resource productivity at the local and regional level in India and to avoid unintended consequences of narrow sectoral approaches leading to unsustainable resources utilization. The Urban NEXUS pilot project introduced the collaborative design and implementation of a set of innovative solutions and programs for optimizing water, energy and land resources in peri-urban agricultural practices in Nashik.	
Austin, USA	**Austin energy green building program**	Urban NEXUS Case Story 2014 -No. 1 and ICLEI Case Study No. 5
	The City of Austin developed locally specific building standards and a rating system for green homes which gives incentives for the local building sector to build high standard eco homes. The City also holds regular workshops on green buildings.	
Belo Horizonte, Brazil	**Waste to energy for more effective landfill site management**	Urban NEXUS Case Story 2014 -No. 2 and ICLEI Case Study No. 154
	http://www.iclei.org/fileadmin/PUBLICATIONS/Case_Studies/3_Belo_Horizonte_-_ICLEI-IRENA_2012.pdf A 114 ha large saturated urban landfill has been converted into a waste-to-energy facility by the municipality, and now generates electricity that is supplied to the grid. The environmental conditions have improved for residents and GHG emissions reduced, and the project leads to an indirect gain in carbon emission reductions (CERs) in keeping with the Kyoto Protocol.	
Lille, France	**Waste to fuel: biogas powered buses in Lille Metropole**	Urban NEXUS Case Study No. 07
	The metropolitan region of Lille has been a pioneer in sustainable waste-to-energy practices since the early 1990s and the initiative is still expanding. Today the entire city fleet is fueled with biomethane produced from organic waste. At the same time, local agriculture benefits from organic fertilizers produced from the residues of the waste's biodigestion. Lille metropolitan region stands as a best-practice example of successful sustainable resource management.	
Chicago, USA	**The Chicago NeighborSpace land trust**	Urban NEXUS Case Story 2014 -No. 3
	The lack of green open spaces in the City of Chicago lead to an initiative in which the City, the regional governments and community movements joined forced to establish the so called NeighborSpace land trust. The trust buys vacant land in the city and distributes it to community groups for their gardening and conservation activities.	
Sao Paolo, Brazil	**Cities Without Hunger: a community garden project**	Urban NEXUS Case Story 2014 -No. 4

	Cidades Sem Fome, a Sao-Paulo based NGO, incentivizes urban agriculture on vacant plots in disadvantaged neighborhoods throughout the city. The gardens enhance the residents' self-sufficiency lowering their dependence on social welfare. The sites also include waste management and recycling initiatives, the composting of organic wastes to be used as fertilizers. Additional projects have been launched, such as Hortas nas Escolas (gardens at schools) for awareness raising and teaching.	
Curitiba, Brazil	**The "Ecological Capital" as forerunner for integrated Urban NEXUS planning**	Urban NEXUS Case Story 2014 -No. 5 and ICLEI Case Study No. 77
	Successful integrated urban planning. Wide bus-only lanes, fixed fares prevent peripheral exclusion. Parks have been created to divert flood waters, and developers get tax breaks if their projects include green spaces. "Garbage that's not garbage" program: incentives (bus tickets, food) for slum dwellers to dispose their wastes in municipal centers. Landfills employ homeless and recovering alcoholics.	
El Alto, Bolivia	**Large-scale ecological sanitation in the peri-urban District 7**	Urban NEXUS Case Story 2014 -No. 6
	Provision of sustainable, ecological toilets in the peri-urban areas of El Alto to improve the health and living conditions of the residents, and increase agricultural productivity by treating the waste matter from the toilets to make ecosan fertilizers.	
Volta Redonda, Brazil	**Eco-oil Program: a community development project linking cooking oil waste to energy and community education**	Urban NEXUS Case Story 2014 -No. 7 and Urban NEXUS Case Study No. 106
	http://www.iclei.org/fileadmin/PUBLICATIONS/Case_Studies/ICLEI_cs_106_Volta_Redonda_2009.pdf Each liter of oil disposed in rainwater drainage system pollutes 14 million liters of water. The eco-oil program uses a process which converts used cooking oil into biofuel. Financial incentives have been put in place for people/businesses to bring their used oil to participating schools, which act as collection centers.	
Machangara Basin, Ecuador	**Machangara River Basin: inter-institutional collaboration for enhanced resource conservation**	Urban NEXUS Case Story 2014 -No. 8
	The Machángara Basin Council is effectively using inter-institutional coordination to facilitate technical, administrative, economic and logistic cooperation for the integral management of water resources to enhance regional energy, potable water and food irrigation.	
Rio de Janeiro, Brazil	**Favela-Bairro: an integrated approach to formalizing urban slums**	Urban NEXUS Case Story 2014 -No. 9
	After years of demolishing favelas and unsuccessfully displacing their inhabitants to social homes in the city, the city of Rio de Janeiro opted for a new solution: through major infrastructure upgrades, social programs and other initiatives the favelas were integrated into the formal city. The project is co-funded by the Inter-American Development Bank.	
Freiburg, Germany	**District Vauban: a sustainable model for, "learning while planning"**	Urban NEXUS Case Story 2014 -No. 10
	Built on the site of a former military barrack on the, Vauban Eco-district combines the preservation of building stock with passive house standards, solar energy and a co-generation energy plant as well as the preservation of an adjacent biotope. The planning of the mixed-use and car reduced neighborhood has been realized with great community involvement, with input mainly coming from citizen initiatives represented by "Forum Vauban".	
Toronto, Canada	**Green Roof Bylaw: institutional coordination to enable the greening of the city from above**	Urban NEXUS Case Story 2014 -No. 11
	City policy requiring new commercial, institutional and multifamily residential developments to have green roofs as a designated percentage of their roof cover. Resulted in great gains in energy savings, absorption of rainwater runoff and a better urban environment. Recent discussions concern the promotion of urban agriculture on these green roofs.	
Ehlanzeni, South Africa	**The Integrated Water Harvesting Project for food security and income generation**	Urban NEXUS Case Story 2014 -No. 12
	The Ehlanzeni district integrated water program targets four of the poorest communities in Mpumalanga Province, sustainably improving their livelihoods through a water - food - health NEXUS that aims to boost agricultural production and community incomes.	

California/ Silicon Valley, USA	**Joint Venture Silicon Valley: regional collaboration for integrated planning and sustainable growth**	Urban NEXUS Case Story 2014 -No. 13
	Started in 1993 in order to maintain Silicon Valley's competitive edge, Joint Venture Silicon Valley provides analysis and action on issues affecting the region's economy and quality of life, in a context of constant seismic risk. The organization builds the framework for regional thought, analysis and action by assembling Silicon Valley's leaders in business, government, academia, labor and the nonprofit sector to assess the challenges of economic development, infrastructure, transportation, communications, education, health care, disaster planning, climate change.	
Hannover/ Kronsberg, Germany	**Kronsberg District: scaling up integrated planning with KUKA**	Urban NEXUS Case Study No. 04
	Kronsberg eco-district was built prior to the EXPO 200 hosted in Hannover and showcases a best-practice example of ecologically and socially just planning according to Agenda 21 principles. The project has been a joint effort of several municipal departments and was overseen by the "Kronsberg Environmental Liasion Agency".	
Linköping, Sweden	**Waste-to-Energy Power Plant: biogas powers public transport in Linköping**	Urban NEXUS Case Story 2014 -No. 14
	The municipality of Linköping installed 3 macerators (2 in restaurants and 1 in a hospital), used to store and ferment organic waste collected in canteens and restaurants throughout the city. The organic waste is then used in a newly built biogas plant. The biogas is then used mostly for public transport buses.	
London, UK	**Feeding the 5K: efficient management of surplus harvest**	Urban NEXUS Case Story 2014 -No. 15
	The campaign brings together different organizations that can help reduce food waste from surplus production and aesthetic selection by food wholesalers and retailers through the redistribution of food to the hungry and the homeless, using food not fit for human consumption for livestock feed, and for renewable energy production through composting (food waste pyramid). The flagship campaign, Feeding the 5K, hosts free public lunches for 5000 people in various cities using ingredients that would have otherwise been trash.	
eThekwini/ Durban South Africa	**NEXUS opportunities at the Mariannhill Landfill Conservancy Plant**	Urban NEXUS Case Study No. 06
	A sustainably designed landfill uses a closed loop system to prevent toxic material from contaminating the surroundings; the Mariannhill landfill site also controls release of GHGs (greenhouse gases) through a gas-to-electricity plant which generates electricity while treating methane. The landfill is also a conservancy, with several varieties of indigenous plants (aided by a Plant Rescue Unit), and a registered national birding site.	
MedellÍn, Colombia	**The Integral Urban Development Project in Medellin: fighting crime through targeted urban interventions**	Urban NEXUS Case Study No. 08
	Through Integral Urban Projects (PUIs) the City of Medellin, under the guidance of the Autonomous Municipal Company of Urban Development, set out to reintegrate the most segregated and violent neighborhoods. The concept, also known as urban acupuncture, encompasses the improvement of built environments, the establishment of public spaces, environmental preservation and restoration as well as the strengthening of community services.	
Mexico City, Mexico	**Mercado del Trueque: how Mexico City is turning trash into food**	Urban NEXUS Case Story 2014 -No. 16
	A monthly barter market where city residents can exchange cardboard, paper, glass, and other recyclable waste for vouchers using which they can buy fresh produce from participating farmers from the surrounding districts. While initially only inorganic waste was accepted, the market has expanded to include electronic waste.	

Oakland (San Francisco), USA	**Oakland Food Policy Council: towards a sustainable, local and equitable food system**	Urban NEXUS Case Story 2014 -No. 17
	A 21-seat council was created to analyze the Oakland food system from production through consumption and waste management, and recommend changes to make the system more equitable and sustainable. Its aims include innovative solutions to improve local or state food systems, spurring local economic development, and making food systems more environmentally sustainable and socially just.	
Portland, USA	**EcoDistricts: regenerating cities from the neighborhood up**	Urban NEXUS Case Story 2014 -No. 18
	EcoDistricts, an entrepreneurial non-profit organization established in 2009, functions as knowledge platform and offers a framework strategy for sustainable city renewal on the neighborhood level. An annual summit is organized with planning experts for knowledge exchange and the sharing of best-practice examples. The initiative was first tested in four pilot districts in the City of Portland. Currently a new project on a larger scale, the Target City program, is launched.	
Shimla, India	**A dual Urban NEXUS strategy for integrating climate change resilience with low emissions development**	Urban NEXUS Case Story 2014 -No. 19
	The Municipal Corporation of Shimla (MCS) has been working to counteract the City's infrastructure and resource challenges with newly established cross-sectoral action plans. Measures are accompanied by institutional capacity building, training programs, awareness raising and educational campaigns through a newly established division, the "Public Relations Cell". Thus far, a total of 30 resilience interventions were identified for intervention with an integrated focus on infrastructural upscaling for water supply, transportation and tourism based on technical and financial feasibility.	
Stockholm, Sweden	**The Hammarby Sjöstad District: a closed-loop system integrating water, waste and energy**	Urban NEXUS Case Story 2014 -No. 20
	Development of an urban district (Hammarby Sjöstad) on a brownfield site, which is designed to be twice as efficient as a regular district, in terms of reduced environmental impact and energy use. This is done through a unified infrastructure of energy, water and waste, densifying existing urban areas, access to public transit, and better construction practices.	
New Delhi, India	**Sulabh International Social Service Organisation**	Urban NEXUS Case Story 2014 -No. 21
	Sulabh International Social Service Organization, a nonprofit entity, works to eliminate social discrimination and the notions of "untouchability" in India by working at intersection of sanitation infrastructure and India's lowest castes that are condemned to the cleaning and carrying of human waste. In order to address this wicked challenge, the organization has developed and manufactured environmentally friendly two-pit, pour flush composting toilet called Sulabh Shauchalaya as well as vocational training programs to support integration of the Dalits into the workforce. Sulabh International also transforms the waste into alternative energy sources using biogas plants.	
Orinoco River Basin, Colombia	**Sustainable development in fragile ecosystems**	Urban NEXUS Case Story 2014 -No. 22
	The Orinoco River Basin in Colombia is facing major challenges amidst a surge of new infrastructure, oil extraction industries and industrial scale agriculture. The application of an Urban NEXUS approach will determine whether the region becomes a model for development, or an ecological failure.	
Berkeley, USA	**The Edible Schoolyard: An educational seed-to-plate system for the students and the community**	Urban NEXUS Case Story 2014 -No. 23
	What began as an initiative at Martin Luther King, Jr. Middle School in Berkeley, California in 1995 has since spread to schools across the USA and the Edible Schoolyard brings these together. The program brings children, teachers and the local community together to learn horticultural and cooking skills while promoting environmental awareness.	

Hamburg, Germany	**Achieving energy-efficiency through the Hamburg Water Cycle in the Enfolder Au eco-neighborhood**	Urban NEXUS Case Story 2014 -No. 24
	In Hamburg's eco-district Enfolder Au, water is used in manifold ways. Black water from toilets is transported to a biogas plant and diverted into grey water, usable for toilet flushing and gardening. The biogas is used to heat the district. The combination of black water recycling, careful thermal insulation and photovoltaic installations are sufficient to cover the entire heating needs of the neighborhood, along with 50% of electricity needs. In addition, rainwater is harvested and used for lawn watering in the district.	
Tianjin, China	**Sino-Singapore Tianjin Eco-City –a bilateral institutional NEXUS**	Urban NEXUS Case Study No. 5
	Tianjin Sino-Singapore Eco-City is a mega project between the Chinese and Singapore governments which both contribute with public and private expertise forming working groups and consortia, in order to realize the project in a multi-stakeholder effort. The Eco-City is developed on formerly polluted land in the Chinese Binhai Area. It follows principles of mixed use planning with high densities along the tram line and a green park running through the city like a spinal axe. The latest eco technologies in terms of transport, waste management, building techniques and water management will be employed throughout the city.	
Toronto, Canada	**Deep Lake Water Cooling System: using Lake Ontario's chilly waters to cool down an entire district**	Urban NEXUS Case Story 2014 -No. 25
	In Toronto, a loop has been created to first divert potable water from Lake Ontario into the cooling system of the City's financial district and then after slight re-cooling into its potable water system from which it goes back to the lake after treatment. The system saves large amounts of energy and GHG emissions otherwise spent on cooling and uses a valuable resource in a twofold way. It also saves operating costs, reducing tariffs and creating income for the city.	
Amman, Jordan	**Urban agriculture: finding multi-purpose solutions through collaborative action**	Urban NEXUS Case Story 2014 -No. 26
	In order to address Amman's pressing issues of water and food security, land fragmentation, and poverty alleviation, the municipality instituted the Urban Agriculture Office, which encourages and oversees the farming of idle urban and peri-urban land, including rooftops and small plots between buildings. Current land use guidelines requiring that 15% of each plot should be used for greening or agriculture. The project also includes recycling and upscaling components and initiatives to provide water access such as grey water reuse and rainwater harvesting. Urban farming significantly helps the urban poor in Amman and contributes to the City's food security while solving issues of land fragmentation.	
Mexico	**Urban and Industrial Environmental Management Program**	Urban NEXUS Case Story 2014 -No. 27
	The project is about urban and industrial environmental management with emphasis in the areas of solid waste and contaminated sites, the integrated management of which was implemented in Quintana Roo, Guerrero and the State of Mexico. Three lines of action: sharing of knowledge and experiences, capacity building, and instruments for environmental management; urban development and water resources; climate change.	
Vancouver, Canada	**Targeting Food Security: Vancouver's Sustainable Regional Food System Strategy**	Urban NEXUS Case Study No. 03
	The regional district government of Vancouver, Metro Vancouver, decided to tap into its potential of local farming with ample agricultural land and excellent farming conditions. The newly implemented "Regional Food System Strategy" encompasses a systems approach including various stakeholders from civil society, the farming and food industry, governments and academia. The strategy aims to promote Vancouver's food security, make fresh produce more accessible, to encourage citizens towards healthier diets and preserve farmland and water bodies.	
Dhaka, Bangladesh	**Waste concern pilot project: "cash for trash"**	Urban NEXUS Case Story 2014 -No. 28
	Compost plants using the resource of organic waste are set up in different neighborhoods, employing former waste pickers to recycle the waste and run the plants. This improves both the city environment and the condition of slum-dwellers (especially women).The resulting bio-fertilizers are then sold on the national market, offering the first and for now only alternative to chemical fertilizers.	

Nagpur, India	**Water sector audit: efficient use of water and energy resources in one of India's largest metropolises**	Urban NEXUS Case Story 2014 -No. 29
	http://www.iclei.org/fileadmin/PUBLICATIONS/Case_Studies/ICLEI_cs_110_Nagpur_2010.pdf A master plan which aimed to improve efficiency and energy use in the water supply and distribution system, and reduce wastage of water through poor infrastructure. This resulted in the use of wastewater for thermal plants, instead of fresh water, and a reduction in transmission/distribution losses and losses through leakages.	

Source: thenextpractice.com

The Lead Author
Jeb Brugmann

In 1990 Jeb Brugmann founded ICLEI - Local Governments for Sustainability, and served as ICLEI's Secretary General from 1991-2000, building its global programs and operations. He played a substantial international role in the establishment of the field of urban sustainability planning, establishing the Local Agenda 21 (LA21) initiative that was endorsed at the 1992 UN Earth Summit as well as the first LA21 programs in nine countries. He worked extensively in the field of climate change mitigation establishing the first international research program on urban greenhouse gas emissions in 1991 and co-founding the worldwide Cities for Climate Protection Campaign in 1993.

From 2002-2004 Jeb served as President of Globalegacy International, an incubator for enterprise-led approaches to poverty reduction in low-income urban districts. He worked with the Asian Development Bank, US Agency for International Development and the city and county of Honolulu to design and facilitate a two-year program for the mayors and senior city managers of more than 40 Asia-Pacific cities to advance their local sustainability practices.

In 2004, Jeb co-founded The Next Practice (TNP) innovation consultancy together with Prof. C.K. Prahalad, jointly establishing the new corporate sector field of 'base of the pyramid' business innovation to address many facets of household-level poverty, including in the energy, banking, agriculture, food, and pharmaceutical sectors. Today, TNP also focuses on innovation in the urban development sector to address sustainability, health, and resilience challenges.

Having worked with scores of municipalities in 28 countries as well as supporting a range of corporate clients to achieve outcomes with both social and commercial impact, Jeb thus brought a wide and highly experienced perspective to this study.

Jeb has a degree in economics from the University of Massachusetts and is a graduate of Harvard University in public management. He is also a Senior Associate with the University of Cambridge (UK) Programme for Sustainability Leadership. His latest book is titled Welcome to the Urban Revolution: How Cities Are Changing the World.

Lead author
Jeb Brugmann, The Next Practice Ltd.

Co-authors and editors
Kathrine Brekke and Lucy Price, ICLEI World Secretariat

Study team
Kathrine Brekke, Lucy Price, and Monika Zimmermann (ICLEI World Secretariat); Sarah Birch, Irina Velasco (ICLEI Africa Secretariat), and Engineer Mussa Natty, Kinondoni Municipal Director (KMC); Emani Kumar and Ritu Thakur (ICLEI South Asia Secretariat); Joanna Flatt (The Next Practice).

Special advisors and reviewers
Carmen Vogt, Alexandra Linden, Jan-Christoph Schlenk, Michael Petersik, and Renard Teipelke (GIZ); and Adrian Atkinson (Consultant).

Contributors of case studies and case descriptions
Sarah Birch (ICLEI Africa Secretariat); Ritu Thakur (ICLEI South Asia Secretariat); and Lucy Price and Louisa Weiss (ICLEI World Secretariat).

Contributing students of the Master Governing the Large Metropolis, Science Po Paris: Angèle Cauchois, Martin Abbot, Chaitanya Kanury, Louise Cousyn, and Victoria Vital Estrada.

Expert contributors of short articles and quotes
Adrian Atkinson (Consultant and trainer in Sustainable Development), Robert Crauderueff (President and founder, Crauderueff & Associates, and Co-chair of S.W.I.M), Marielle Dubbeling (Director, RUAF Foundation), Uschi Eid (Chair of the UN Secretary General's Advisory Board on Water and Sanitation, UNSGAB), Michael Kuhndt (Director, the Collaborating Centre on Sustainable Consumption and Production, CSCP), Dinesh Kumar (Executive Director, Institute for Resource Analysis and Policy, IRAP), Muna Lakhani (National Coordinator, Institute for Zero Waste in Africa), Hans Mönninghoff (Former Deputy Mayor, City of Hannover), Peter Newman (Prof. and Director, Curtin University Sustainability Policy Institute), Jorgen Randers (Professor, Member of the Club of Rome, and Author of „2052, a global forecast of the next forty years"), Mark Roseland (Director, Centre for Sustainable Community Development, Simon Fraser University, Vancouver), Christopher Scott (Professor, University of Arizona), Rafael Tuts (Coordinator, Urban Planning and Design Branch UN-HABITAT), and Ren Wang (Assistant Director General, Agriculture and Consumer Protection Department, FAO).

Design and layout
Angelo Becker, ICLEI World Secretariat

The Urban NEXUS in Brief

The Urban NEXUS is an approach to the design of sustainable urban development solutions. The approach guides stakeholders to identify and pursue possible synergies between sectors, jurisdictions, and technical domains, so as to increase institutional performance, optimize resource management, and service quality.

It counters traditional sectoral thinking, trade-offs, and divided responsibilities that often result in poorly coordinated investments, increased costs, and underutilized infrastructures and facilities. The ultimate goal of the Urban NEXUS approach is to accelerate access to services, and to increase service quality and the quality of life within our planetary boundaries.

GIZ and ICLEI, 2014

Human civilization is facing increasingly urgent resource constraints that will require a dramatic optimization of the way we use and reuse resources in the future. Isolated "business as usual" solutions aimed at resource-efficiency in just one sector, miss out on crucial opportunities to efficiently resolve the pressing resource challenges of the 21st century.

Cities are bustling hubs of resource flows, consumption and production. This makes them the "nexus" where significant economic, social, political and ecological resource systems inter-link and compete. New approaches are needed to successfully manage the complexities of this urban "nexus".

The "Urban NEXUS approach" seeks out synergies and benefits from system integration in cities and metropolitan regions at the different scales of the built environment and its infrastructures; to integrate the city-region's supply chains and resource cycles; and the policies and operations of local, regional, sub-national and national jurisdictions.

For that purpose, **an Urban NEXUS solution is one that integrates two or more systems, services, policy or operational "silos", jurisdictions or social behaviors**, in order to achieve multiple urban policy objectives and to deliver greater benefits with equal or less resources. Urban NEXUS solutions typically involve a set of coordinated measures that span the fields of technology, policy, planning, finance, business models, institutional design, and communications - amounting to a new "solution set". The Urban NEXUS approach is fundamentally a **process of solution customization**, and is therefore contingent on the valuable input from all relevant stakeholders.

As an **institutional agenda**, the Urban NEXUS approach encourages governments at all levels and international development organizations to review current resource governance mechanisms and institute fundamental reforms in institutional arrangements, policies, project development and finance guidelines, in order to significantly reduce isolated, uncoordinated and ultimately inefficient urban development approaches in the long term.

Urban NEXUS thinking also offers a potential framework for the achievement of ambitious **global objectives** on sustainable urban development, i.e. in the course of debating the New Urban Agenda at the Habitat III conference or the Sustainable Development Goals within the post-2015 Development Agenda.

IMPRESSUM

Published by
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in collaboration with ICLEI – Local Governments for Sustainability, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ)

This publication should be cited as: "GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS: towards resource efficient and integrated cities and metropolitan regions, GIZ Eschborn."

GIZ registered offices
Bonn and Eschborn, Germany

Sector Project "Sustainable Development of Metropolitan Regions"
Postfach 5180
65726 Eschborn, Germany

E: info@giz.de
www.giz.de

ICLEI – Local Governments for Sustainability
ICLEI World Secretariat

Kaiser-Friedrich-Straße 7
53113 Bonn, Germany

E: urban.research@iclei.org
www.iclei.org/urbannexus

Printed by
Druck- und Verlagshaus Zarbock GmbH & Co. KG
Sontraer Str. 6
60386 Frankfurt

Printed on FSC-certified paper

Design and layout
ICLEI World Secretariat, Bonn

Cover phtoto credits
Luciano Mortula Photo: © Shutterstock

As at
October 2014
ICLEI and GIZ are responsible for the content of this publication.

On behalf of the
German Federal Ministry for Economic Cooperation and Development (BMZ),
Division 312 (Water; Urban development)

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn, Germany
Tel. +49 (0) 228 99 535 - 0
Fax +49 (0) 228 99 535 - 3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin, Germany
Tel. +49 (0) 30 18 535 - 0
Fax +49 (0) 30 18 535 - 2501

poststelle@bmz.bund.de
www.bmz.de