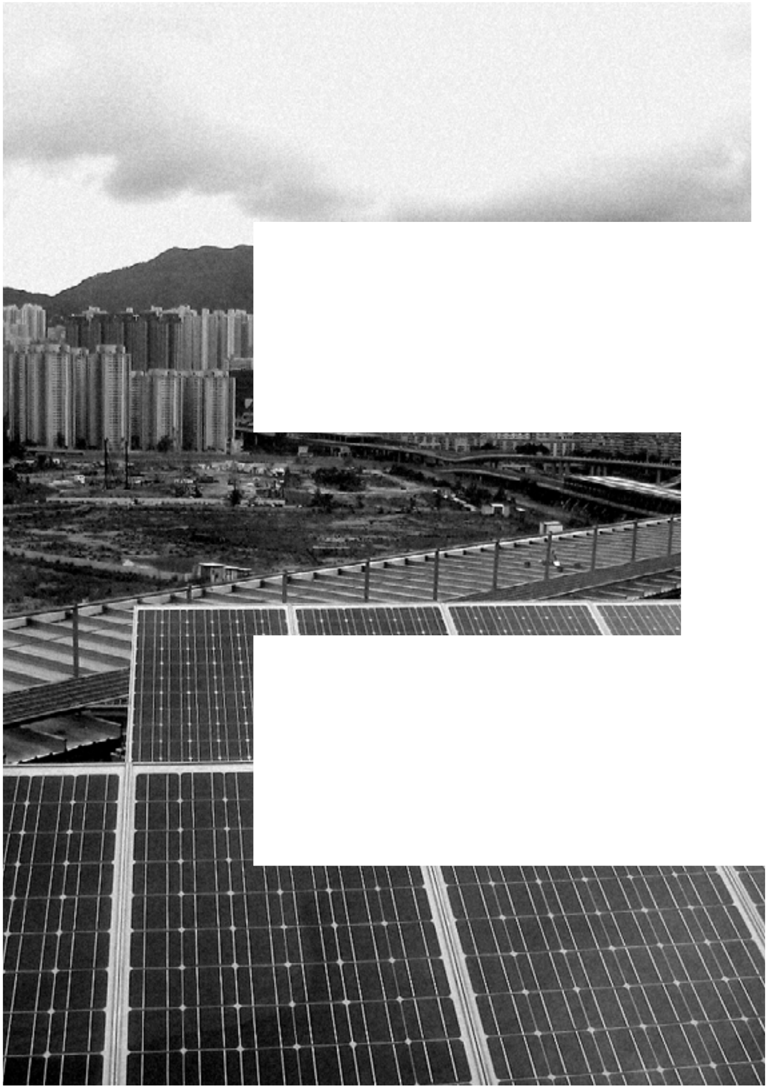
CITY RESILIENCE PROFILING PROGRAMME

UN-HABITAT
FOR A BETTER URBAN FUTURE



With the support of

European Commission

Resource Efficiency Enhancer

Resource Efficiency and Development
Resource Efficiency and Resilience
Resource Efficiency and the City Resilience Profiling Tool

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The **Resource Efficiency Enhancer** was prepared by UN-Habitat as part of the ongoing Urban Resilience Enhancer series. In order to promote collaboration and gather valuable inputs, the enhancers are open to peer review by expert organizations working in relevant sectors. For the Resource Efficiency Enhancer, the United National Environment conducted an in-depth review to provide inputs, comments and suggestions. These inputs have shaped the Enhancer into its current draft that will be subject to further review before finalization (early 2019).

Disclaimer

The Enhancers are under continual development and should not be taken as complete or comprehensive resilience tools. They serve to increase engagement, validate approaches and lead to further engagement of resilience building through the CRPT.

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1. Introduction

In a rapidly urbanizing world, human consumption of natural resources is increasingly problematic. Societies depend on natural resources to provide them with drinking water and food, maintain environmental quality and support the production of goods. Cities use billions of tonnes of raw materials to sustain their urban lifestyles. The consumption rate of natural resources has grown with the increase of population and the sharp rise in urbanization, most visibly in Africa and Asia. Globalization and economic growth have propagated an expansion of the middle-class consumer base, improved standards of living, and spurred changes in consumption patterns. The rise of capitalism produced a social behaviour based on consumption, propelling a feedback loop in which the economy has been developed to increase consumption, rather than resource efficiency. The commodification of every aspect of the economy influenced the logic of consumption of common resources, from water ownership and provision to land speculation, or of the unnecessary yet omnipresent use of disposables.

The demand for natural resources now surpasses the pace at which the planet can regenerate them and, with the global urban population expected to grow another 2.5 billion by 2050, rising material and energy consumption will apply further pressure on ecosystems. Awareness on the urgency of developing sustainable consumption and production patterns is spreading, and the concept of resource efficiency – defined by UN-Habitat as "the sustainable management and use of resources throughout their life cycle, from extraction, transport, transformation, consumption to the disposal of waste, in order to avoid scarcity and harmful environmental impacts"[1]– presents an opportunity to generate a responsible use of resources, while maintaining a certain standard of living.

Box 1. What are natural resources?

The OECD defines natural resources as: "natural assets (raw materials) occurring in nature that can be used for economic production or consumption" and divides them into 4 categories: mineral and energy resources, soil resources, water resources and biological resources.[2] Similarly, the European Commission refers to them as "all natural resources that are inputs to [its] economy, including both physical resources and ecosystem services". [3]

Natural resources can be considered to include, among others, ores, metals, biomass, coal, freshwater, soil, fish, timber, biodiversity, clean air and oceans.

1.1 Causes and consequences of unsustainable resource management

As extraction of natural resources exceeds Earth's ecological regenerative capacity, it creates a deficit between the amount of natural resources consumed and the amount our planet produces. Urban material consumption is, nevertheless, expected to grow even further from 40 billion tonnes in 2010 to about 90 billion tonnes by 2050.[4] As a result of this dynamic, the security of resource supply upon which the global economic and urban systems rely is threatened.

Cities, as primary consumers, occupy 2-3% of the planet's land surface but consume as much as 70-75% of natural resources. As the majority of these resources are obtained from rural and peri-urban areas near and far beyond the urban boundaries, cities depend not only on local surrounding ecosystems for their supply, but their hinterlands that stretch around the globe. Such unsustainable patterns of resource management greatly contribute to the degradation of every type of ecosystem on the planet, and in turn of the global ecosystem called the Biosphere. The shrinkage and deterioration of ecosystems do not only imply a reduction of the Biosphere's capacity to provide such material resources, but also alter other systems that constitute the stable base upon which cities first formed, e.g. the capacity of a forest to regulate the water flow and infiltration.

In order to better understand the cyclic character of ecology in economy, the concept of ecosystem services was developed (cfr. Box 2). The reduction of these services, coupled with increasing climate change-induced effects, have incremented the vulnerability of all kinds of human settlements. In addition to the risk of flooding, sea level rise for instance threatens freshwater reservoirs that provide a source of drinking water or support irrigation systems for agricultural production. It also damages coastal and estuarine ecosystems that supply food or serve as natural protective barriers for cities.

Similar to exacerbating cities' vulnerabilities, climate change impacts also affect the already impacted ecosystems, for instance, through higher concentrations of CO_2 in the atmosphere. As the higher concentrations acidify oceans, consequently dissolving carbonate ions, the fauna that depends on carbonate ions to survive becomes extinct, such as corals, oysters, mussels, and other shelled organisms. The repercussions of this extinction cascade through the food chain of sea life, in turn severely disturbing coastal ecosystems and directly straining the availability of food to cities. The imminent changes are expected to disproportionately burden those groups that are already in some of the most vulnerable of situations, such as the urban and rural poor, first. Adding to this injustice, major migrations will follow, again putting even more stress on cities and consequently on ecosystems.

Box 2. What are ecosystem services?

The OECD defines the term ecosystem as: "a system in which the interaction between different organisms and their environment generates a cyclic interchange of materials and energy".[5] It is important to understand what an ecosystem is, in order to recognise how we depend on them and have been mismanaging our resource consumption.

Ecosystems are the result of millions of years of co-evolution to specific environmental conditions of a myriad of species. This complexity can be fathomed in the great diversity of ecosystems on Earth. Humans appeared within this diversity, and thus society and cities, showing that cities strongly depend on ecosystems' inputs – raw materials, energy, food, water, oxygen etc.

Since cities' economies are based on the extraction, manipulation and conversion, provision, and consumption of natural resources, our economy is deeply entangled with the dynamics of ecosystems. However, overlooked by traditional capitalist views, societies have been externalizing the real cost of extraction and production to ecosystems, thus degrading the cyclic interchange of materials, energy and biodiversity.

Ecosystem services then are an ecological-economic concept that tries to understand non-human ecosystems as part of the economy of cities. The concept allows for the valuation of the ecosystem services to provide a presumed solid and objective economic basis to inform decision-makers. These services have been defined in four categories: i) supporting services such as nutrient cycling, soil formation, and primary production; ii) provisioning services like food, fresh water, wood and fibre; iii) regulating services of the sort of climate regulation, flood regulation, disease regulation, water purification; and iv) cultural services as aesthetic, spiritual, educational, recreational.[6]

Ecosystem services can serve as a tool to analyse resource fluxes between human and non-human ecosystems, which can bring further understanding regarding how to improve our resource efficiency. However, as behavioural patterns constitute a major part of the problem, this tool needs to be complemented with adequate policies regarding the responsible use of common resources as well as social justice issues, in order to produce effective and long-lasting changes.

As the population living in urban areas grows and cities expand, the cost of land acquisition has pushed settlements to environmentally degraded areas, oftentimes contaminated zones, on the urban fringes, steep hills or other high-risk conditions leading to increased health risks for the population living in those areas. The horizontal expansion of cities – through the construction of exclusive gated communities and industrial hubs as well as informal development – and related resource exploitation interfere with vital ecosystem cycles, such as water infiltration, contributing to the further degradation of such areas, and in turn increase vulnerability. The industrial production of goods, for instance, relies on the extraction of unsustainable amounts of raw materials, or contaminates clean water streams through cooling processes and groundwater layers through waste disposal. Informal settlements may also further deteriorate sensitive ecosystems, such as wetlands, coastlines and riverine areas which comprise their primary sources for food and water as well as dumps for solid and bio-waste. [7]

Scarcity of resources resulting from unsustainable consumption and production patterns ultimately contributes to existing social inequalities and increases poverty, affected by wealth distribution, volatile prices, and hardened resource access. Ensuring the continuous resource regeneration capacity of the biosphere therefore poses the challenge to improve the efficiency with which we manage natural resources, in order to achieve both a healthy green economy and healthy ecosystems, globally and locally.

1.2 Role of cities

While a sizeable part of the problem lies in urban areas, cities also hold the potential to significantly contribute to the solution. Being the major consumers of natural resources, and thanks to the increasing recognition of the role of city governments in tackling global issues at the local scale, cities are at the forefront of managing change and are the driving force for action to transform the use of resources. Not only are cities the engines of the economy, knowledge and technology hubs and home to the majority of the global population, they also constitute complex systems of basic services, such as utilities, transportation, housing, social care etc.

Changing the existing patterns of resource use to provide these services to inhabitants and industries, even if slightly, will have breakthrough impacts on the ecosystems producing the resources required for the provision of these urban basic services. As cities consume up to 70-75% of all natural resources, achieving the efficient use of resources will positively influence global matter and energy consumption, and consequently CO_2 emissions.

Building resource efficiency in cities is a priority of the Greener Cities Partnership – a collaboration between the United Nations Environment Programme (UN Environment) and United Nations Human Settlements Programme (UN-Habitat) – that aims to advocate for and promote environmental sustainability in urban development.[8] Due to its potential to mitigate environmental vulnerabilities such as reducing food scarcities or flooding, or increasing air quality through cutting greenhouse gases emissions, the concept of resource efficiency also constitutes an important pillar in UN-Habitat's work on resilient cities.

The sustainable and efficient management of the resources available to cities, and the consequent protection of ecosystems, ultimately supports the main goal of UN-Habitat's resilience programme: to transform urban areas into safer and better places to live and improve their capacity to absorb and rebound quickly from all potential shocks and stresses. In this line, UN-Habitat developed the City Resilience Profiling Tool (CRPT), a robust and comprehensive methodology for cities to build their resilience through evidence-based, people-centred recommendations. Adopting a systemic, holistic approach to cities, the CRPT understands resource efficiency as a main crosscutting issue throughout its analysis and recognises the potential for reducing environmental and economic dependencies and vulnerabilities. Resource efficiency can also help build a city's resilience by "reducing exposure to the risk of shortfalls in essential inputs." Although[9] there are possible tensions between the two (e.g. redundancies can be considered as inefficient use of resources), they share principles and objectives (such as optimizing resource flows, or cost savings, to name a few), and produce co-benefits to "meet broader sustainability objectives."

In the following chapters, the Resource Efficiency Enhancer first overviews two approaches to develop sustainable production and consumption patterns in cities, then discusses the role of the resource efficiency concept in the 2030 Agenda for Sustainable Development, as well as its interlinkages with the resilience paradigm, and finally outlines how the CRPT understands and studies the use of resources in a city. The Enhancer also incorporates a list of indicators that may help local governments identify strengths and weaknesses in current and future resource management.

2. Consumption and production in cities

Urban growth has led to many new industrial and technological needs, and consequently the need for raw materials has grown. The extraction of construction materials grew by a factor of 34, ores and minerals by a factor of 27, fossil fuels by a factor of 12, and biomass by a factor of 3.6.[10] The impact of this growth can be weighed by looking at the GHG emissions: the construction of buildings and infrastructure constitute one of the largest greenhouse gas emitting sector.[11]

In the last three decades, the concept of sustainability has become a global overarching socio-economic imperative among governments and international organizations. This has contributed to informing and changing unsustainable practices in this sector, including a move to the use of more locally available resources and materials.

However, much progress is still left to be made. In order to transition towards a more sustainable economy, it is necessary to significantly reduce the use of resources. Considering that about 60 per cent of global domestic material consumption[12] of raw materials can be attributed to cities, and that urban areas are expected to significantly grow over the next decades, cities are key for driving resource efficiency, where it is likely to have the largest impact.[13]

2.1 Defining resource efficiency

While a single universal definition of the concept of resource efficiency does not exist, it is generally understood to involve a more productive use of resources, lower costs and reduced environmental impact while still meeting human needs. Similar to UN-Habitat's reading of resource efficiency as "the sustainable management and use of resources throughout their life cycle, from extraction, transport, transformation, consumption to the disposal of waste, in order to avoid scarcity and harmful environmental impacts", the European Commission interprets resource efficiency as allowing "the economy to create more with less, delivering greater value with less input, using resources in a sustainable way and minimizing their impacts on the environment"[14].The International Resource Panel's 2015 report mentions that Resource Efficiency encompasses a number of ideas: "the technical efficiency of resource use (measured by the useful energy or material output per unit of energy or material input); the resource productivity, or extent to which economic value is added to a given quantity of resources (measured by useful output or value added per unit of resource input); and the extent to which resource extraction or use has negative impacts on the environment (increased resource efficiency implies reducing the environmental pressures that cause such impacts)."[15] Considering the share of resources consumed by cities alone, and thus their role in reducing global consumption levels, resource efficiency is – or needs to be – a crucial element of urban governance and policy-making.

The Global Initiative for Resource Efficient Cities (GI-REC) defines a resource-efficient city as "a city that is significantly decoupled from resource exploitation and ecological impact and is socio-economically and ecologically sustainable in the long-term".[16] This definition brings forward the powerful and urgent concept of 'decoupling' as a key action in order to catalyse a dramatically different path. Decoupling means reducing the amount of resources such as water or fossil fuels used to produce economic growth and delinking economic development from environmental deterioration. The objective is to disconnect social well-being and economic growth from environmental degradation, otherwise overall sustainability of human existence cannot be achieved.

Cities can gain considerably from achieving resource efficiency by reducing material needs and energy consumption and offering a better quality of life. Resource efficiency can be improved within individual sectors yet in a world where the capacity to generate resources is limited, efforts should go beyond technological and 'end-of-pipe' solutions to solve environmental problems. This can be done by developing comprehensive approaches and better coordination among sectoral policies, government levels and geographical scales.

Current discussions in the urban development field present the concepts of a circular urban metabolism, based in ecosystem thinking, and the endeavour towards urban compactness as two approaches to reduce resource consumption and build efficient societies. First, circular systems reduce the intake of new resources through the reuse and recycling of waste products, thus restructuring flows into more efficient production and consumption loops, and consequently diminishing the pressure on ecosystems. Second, adopting a compact cities approach helps to plan and control urban extensions, by using land more efficiently in order to reduce a city's spatial and ecological footprint.

2.2 Urban Metabolism

One approach to achieve resource efficiency is conceptualising the city as a living organism in which there are continuous flows of inputs and outputs. Studying the patterns of movements of matter and energy can help local governments pinpoint opportunities for sustainable resource management and reducing a city's impact on the environment. The concept of urban metabolism can be understood through the following analysis: A city obtains resources from its local surrounding hinterland or through trade with other cities. Then, it transforms and uses them in order to produce goods and services that in turn generate economic outputs and social services. This transformation entails the generation of a diversity of waste, which is released into the environment.

The analysis does not only consider goods and services, but also takes into account "grey" infrastructure or man-made fixed infrastructure or built assets that provide key services for daily life such as streets, buildings, powerlines and so on. Gardens, parks, orchards, and greened pedestrian corridors or "green" infrastructure, on the other hand, as well as built surface water containers like dams, diverted rivers, channels, and ponds, comprising "blue" infrastructure, are not considered. As infrastructure has a long duration, and hence generates long-term consequences, its impact lasts for a long time and can force cities to remain locked into unsustainable urban patterns for decades or more.

Studying the city from the urban metabolism perspective helps to accurately understand how natural resources, energy, land, time, and other elements are used by societies to maintain and reproduce themselves. This is particularly important when it is understood that societies have been extracting natural resources following a linear metabolism. As cities consume natural resources but do not produce them, they then depend on areas beyond their boundaries for the supply of such resources. This centralization of demand requires massive logistics and thus, the impact of one city extends not only to the surrounding ecosystems, but far beyond their urban boundaries.

Linearity is particularly problematic due to resources flowing through the urban system without much concern about their origin (in terms of location, as well as the energy required to produce), their consumption, or their destination (waste and other by-products). In the linear model, raw materials are extracted from outside the cities, transformed into goods and services for consumption, and ultimately released as waste and GHG emissions within and mostly beyond city boundaries. Industrial processes and techniques have increased extraction, and thus also waste production and emissions.

Yet, as inputs and outputs remain largely unrelated, and since it is physically impossible to return a manufactured material or harvested energy to its exact original state before it was extracted and processed, a linear metabolism is essentially unsustainable. In the case of cities, this imposes stresses on local resource supplies and the natural environment. A linear system can significantly increase the environmental vulnerability of settlements and deepen existing issues such as urban poverty and gender inequality.[17] With potential scarcities of food, land, or energy as a result, prices can increase or become volatile, or supply lines will need to be stretched further beyond urban boundaries to respond to the demand for goods and services. When clean water, food or energy become harder to come by household tasks, such as cooking and cleaning, are hindered and lead women and girls to spend more time traveling longer distances to obtain primary resources.

To avoid social and environmental injustices, cities must strive for a transition from a linear to a more efficient circular metabolism. A circular metabolism resembles a natural ecosystem by using the waste of one 'organism' or sector to feed another. Properly conducted waste management offers great opportunities to close loops between sources and end users. Reusing, recycling, cascading, and the self-production of resources and energy present primary tools to achieve a circular system and constitute the backbone of a circular economy.

Box 3. Reuse, cascading, recycling, and harvesting

Reusing refers to the action of using an item in its original form several times for the same or different purpose (e.g. reuse of glass bottles). Although reusing is not new in itself and has been deemed an efficient practice, it acquires a new meaning after the surge of disposable items. **Cascading** concerns the reuse of outputs at a reduced quality (e.g. use of greywater for toilet flushing or crop irrigation, composting local bio-waste). **Recycling** means reusing a resource after improving its quality through physical or chemical processing, which would imply the consumption of energy (e.g. transforming plastic bottles into clothing fabrics, re-forging metal). Finally, the **self-production** of resources and energy refers to locally harvesting resources to meet demand (e.g. food production through urban farming, rainwater catchment, renewable energy sources).

In addition to reorganising the flows within a city into a circular system, the form and geographical location of a city heavily influence resource efficiency throughout all sectors. The concept of the compact city will be described in the next section.

2.3 Compact cities

A second approach on resource efficiency deals with the geospatial and morphological issues that urban growth entails. The development of dispersed low-density settlements comprised of small households requires more floor space, which translates into increasing uncontrolled land consumption and speculation. This global phenomenon – though it differs per city – generates urban sprawl, where the surface of cities spreads but population density remains low. A growing city will invariably need more land, mobility and utilities networks, and many more urban infrastructures to provide basic services. This spreading continuously consumes rural and natural lands, which in turn diminishes the local capacity for food and ecosystem services production, such as freshwater availability, generating a dependence that extends into ever farther regions and spanning the city's impact to even more distant places.

In addition to resource consumption, the construction and extension of grey infrastructure will diminish ecosystem services of the sort of water infiltration, runoff regulation, or heat dissipation. Land, for instance, provides not only space for human activities, but it also entails a series of vital features for ecosystem processes, such as water infiltration and regulation, soil formation, vegetation growth, animal movement paths, and more. The moment soil is completely or partially covered or 'sealed' with impervious materials such as concrete, these features are lost. This is detrimental to the sustainable use of land and soil, especially when rich and fertile soils are covered.

Soil sealing also has a great impact on the water cycle (it prevents the recharge of groundwater layers and sharply accelerates runoffs) and thermodynamics, as concrete absorbs more heat than other surfaces, which exacerbates heat island effects.[18] With political buy-in, cities have the option of using green infrastructure such as permeable grounds in urban planning, to drastically reduce the sealing effect and combat damages by grey infrastructure to biodiversity including the reduction of habitats, cutting off ecological corridors, and bringing urban disruption to non-human ecosystem dynamics.

Moreover, as the horizontal expansion of a city requires more motorized mobility to commute between dispersed parts and thus more fossil fuels, urban sprawl has a strong impact on GHG emissions. In spite of these effects, the demand for land keeps increasing, mainly due to demographic and economic dynamics. A report by UN-Habitat elaborates that "sprawl contributes to environmental degradation, including the loss of tree cover and wildlife habitats, as well as polluting drinking water (from urban runoff as a result of an increase in hard surfaces). Increased car usage goes hand in hand with urban sprawl as people live further away from work. [...] It has also caused higher levels of smog and air pollution through greenhouse gas emissions."[19] Urban sprawl of the past and current centuries has produced a series of problems particularly in land consumption and mobility infrastructure. Suburbanization in the United States of America, for instance, entrenched a "reliance on fossil fuels, because low densities cannot support mass transit, but it also [increased] traffic on highways and residential streets."[20]

Decoupling land consumption from population or economic growth is key. Considering land is a non-renewable resource, the dynamics between the land's demand and supply must be regulated so that ecosystems remain intact and potential goods and services provided by land are maintained. By adopting the concept of compact cities, the geo-spatial distribution and morphology of a city densify, and its use of resources becomes more efficient.

Concentrating urban functions on smaller territories intensifies urban social, economic and cultural life, organizes work-home-services activities within smaller distances, and ultimately results in the increased sustainability of cities. Compact development reduces the need to drive and therefore generates positive impacts on greenhouse gas emissions. Building compact cities also improves regulations, limits land consumption, and diminishes the use of construction and maintenance resources for infrastructure. It saves energy consumed in heating/cooling, thanks to denser urban structures, as well as in transport due to shorter commuting distances and times and produces more efficient and cost-effective modes of public transportation.

Additionally, deliberately planning the urban form helps direct urban growth towards areas suited for development. Planned city extensions, as part of a broader compaction strategy, can therefore include the measure of "recycling" land, which refers to the regeneration of developed land that is not currently in use or available for re-development (e.g. brownfield sites).[21]

A challenge when building compact cities is to balance high density with sufficient green areas, public spaces, and further amenities, which are necessary to better the liveability of cities. Integrated spatial planning at the appropriate scales must be complemented by housing, mobility and employment measures to produce a balanced mix of uses. These measures aim to prevent problems such as lack of urban green space, overcrowding, transit congestions, heat island effects, and rising cost of land and rent.

2.4 Conclusion

The shift to resource efficiency, either through building compact cities and/or generating circular metabolisms, will require high institutional, technical and financial commitments by various scales of government. The success of the transition will greatly depend on existing political will to mobilise sufficient funding, bring a multitude of stakeholders to the table, and overcome the difficulty of competences that are fragmented across scales and sectors. [22]

In order to achieve resource efficiency, societal behaviour must be considered in addition to the need for balanced spatial organisation and better urban planning, design and management. While restructuring existing systems, identifying new forms of organisation, harvesting local resources, developing new green technologies, and integrated urban development planning go a long way, these efforts will need to be accompanied by attempts to change citizens' behaviour, most importantly travel behaviour and lifestyle. A radical change in ways of living and spending can have a profound impact on the individual use of resources and contribute to global sustainable levels of resource consumption and production. This notion is embodied in the 2030 Agenda for Sustainable Development – the framework that will guide and monitor (urban) development over the next decade – in its call to "by 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature".[23]

3. Resource efficiency in the 2030 Agenda for Sustainable Development

In 2015, member states of the United Nations joined civil society stakeholders and agreed on the 17 Sustainable Development Goals (SDGs). The goals collectively aim to achieve economic, social and environmental sustainable development that includes all people and produces long-lasting gains. Building upon the achievements of the Millennium Development Goals, the SDGs outline the 2030 Agenda for Sustainable Development.[24] Due to growing awareness about the consequences of current and future resource scarcity, the resource efficiency concept features as one of the core principles of the 2030 Agenda as well as throughout the Agenda's related frameworks, e.g. the New Urban Agenda and the Paris Agreement.

3.1 Sustainable Development Goals 11 and 12

Sustainable Development Goal 11
Make cities and human settlements inclusive, safe, resilient and sustainable

SDG 11 recognises that cities increasingly host the bulk of the global population and urges for sound and inclusive urban policy and planning that reduce vulnerability in the lives of urban residents everywhere, starting with those in the most precarious, often informal, situations. While it aims to improve access to housing, basic services, transport systems, green and public spaces, it also strives to scale down cities' impacts on the environment, reduce vulnerability to disaster risks and empower urban populations to participate in the planning and management of their communities. Particularly through the emphasis on sustainable cities, Goal 11 highlights the importance of adequate resource management.

Sustainable Development Goal 12
Ensure sustainable consumption and production patterns

Decoupling economic growth from natural resource consumption is key to addressing environmental pollution and degradation and attaining sustainable development. SDG 12 calls for sustainable business practices and responsible consumer behaviour and sets targets to control the material consumption of nations and cities, reduce the amount of waste produced, and discourage the use of fossil fuels. It also acknowledges the impact of curtailing food waste, safely managing chemicals, and promoting sustainable tourism.

Synergies between SDG 11 and 12

There are many synergies between the two goals, but particularly regarding sustainability and urban development it is of crucial importance to flesh out the connections between SDG 11 and SDG 12. To reduce the environmental impacts of cities, it is important for policy-makers to think about ways to contain or manage urban sprawl, pollution and waste, both by increasing the resource efficiency of buildings, services and infrastructure, and by investing in sustainable and low carbon infrastructure. This should go along with increased investments in safe, affordable and accessible infrastructure that enables the adoption of sustainable lifestyles (for instance recycling centres, public transport, green buildings). Policy-makers and advocates also have a responsibility in shaping public opinion and a culture on sustainable lifestyles through education and training, awareness raising, sustainability information on products and services, policies and incentives.


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3.2 National and local actions

Resulting from the Habitat III conference in Quito in 2016, the New Urban Agenda guides local and national governments in the planning, management and financing of urban development over the next 20 years.[25] Similar to the Sustainable Development Goals, the NUA vision document highlights the resource efficiency principle as a key policy objective and refers to the need to steer urban and economic growth away from unsustainable consumption and production patterns. It calls for a sustainable management of resources by integrating cities and their hinterlands in spatial planning and adopting ecosystem-based approaches. In doing so, the NUA advocates for alleviating environmental degradation, strengthening human settlements and simultaneously mitigating risks associated with climate change-induced natural hazards.

Article 63

We recognize that cities and human settlements face unprecedented threats from unsustainable consumption and production patterns, loss of biodiversity, pressure on ecosystems, pollution, natural and human-made disasters, and climate change and its related risks, undermining the efforts to end poverty in all its forms and dimensions and to achieve sustainable development. Given cities' demographic trends and their central role in the global economy, in the mitigation and adaptation efforts related to climate change, and in the use of resources and ecosystems, the way they are planned, financed, developed, built, governed and managed has a direct impact on sustainability and resilience well beyond urban boundaries.

Article 71

We commit ourselves to strengthening the sustainable management of resources, including land, water (oceans, seas and freshwater), energy, materials, forests and food, with particular attention to the environmentally sound management and minimization of all waste, hazardous chemicals, including air and short-lived climate pollutants, greenhouse gases and noise, and in a way that considers urban-rural linkages, functional supply and value chains vis-à-vis environmental impact and sustainability and that strives to transition to a circular economy while facilitating ecosystem conservation, regeneration, restoration and resilience in the face of new and emerging challenges.

Article 76

We commit ourselves to making sustainable use of natural resources and focusing on the resource efficiency of raw and construction materials such as concrete, metals, wood, minerals and land. We commit ourselves to establishing safe material recovery and recycling facilities, promoting the development of sustainable and resilient buildings and prioritizing the use of local, non-toxic and recycled materials and lead-additive-free paints and coatings.

3.3. Paris Agreement

As the outcome of the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2015, the Paris Agreement primarily aims to strengthen global response to climate change, by restricting global temperature increase to a maximum of 2 degrees Celsius above pre-industrial levels, as well as bolstering adaptation and resilience-building efforts and opening up financing opportunities. To this date, the Agreement has been ratified by 181 of 197 Parties to the Convention.[26]

While the concept of resource efficiency is not mentioned in the Agreement, it will inherently constitute one of the main strategies to achieve the final objective of transforming towards sustainable, low-emission societies. Article 7 of the Agreement refers to the sustainable management of natural resources as a pathway to protect people, livelihoods and ecosystems, and thus towards enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change. Paragraph 9(e) of this article reads "building the resilience of socioeconomic and ecological systems, including through economic diversification and sustainable management of natural resources." [27]

3.4. Aichi Biodiversity Targets

The Aichi Biodiversity Targets comprise 5 Strategic Goals and 20 targets that aim to generate awareness on and reverse the loss of biodiversity, protect ecosystems and their services, and ensure the sustainable use of biodiversity components, by the end of the United Nations Decade on Biodiversity in 2020. By valuing and safeguarding biodiversity and ecosystems for the benefit of all life on Earth, including humans, the Aichi Targets contribute to a continued availability of ecosystem services and resources, all the while advocating for their sustainable and equitable use and urging implicitly for resource efficiency.[28]

- Strategic Goal A. Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society
- Strategic Goal B. Reduce the direct pressures on biodiversity and promote sustainable use
- Strategic Goal C. Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity
- Strategic Goal D. Enhance the benefits to all from biodiversity and ecosystem services
- Strategic Goal E. Enhance implementation through participatory planning, knowledge management and capacity building

4. Resource Efficiency and Resilience

There is no universal city model, hence there is no single path to achieve resource efficiency. Depending on the context, the many ways for improving resource efficiency vary in feasibility. Cities, societies, and ecosystems are complex, interrelated systems. Similar to the resilience paradigm, the concept of resource efficiency is grounded in complex systems thinking. It is no coincidence that both principles advocate for holistic approaches that study all components of a system and the relationships between them, as this allows for a deeper understanding of the interlinkages and mutual dependencies of resources, energy, and services that comprise eco-urban systems.

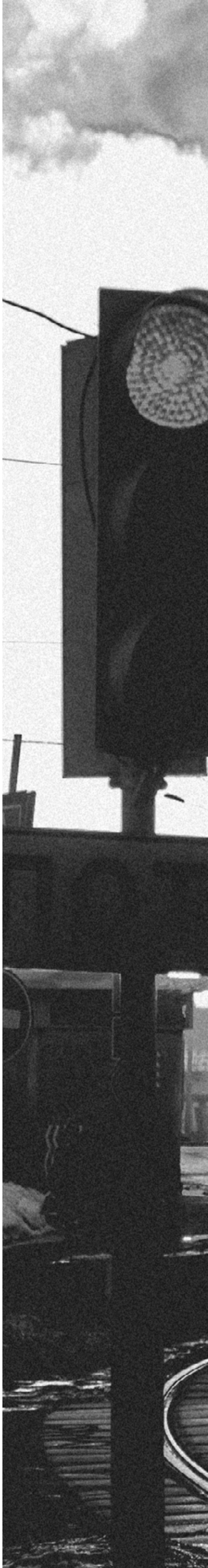
The concepts of resource efficiency and resilience have great potential for complementarity and mutual reinforcement as together they can tackle challenges from short- to long-term periods. Applying the resilience paradigm to address broader capacities for sustainable development, rather than to merely counter vulnerability, provides insights on how to better manage resources to reduce, respond to and recover from disturbances, by holistically engaging with vital ecosystems and supply chains. In this way, cities can develop preparedness to shocks and stresses in its resource management, not only to survive such disturbances, but to guide urban development towards a sustainable future.

One of the core principles of resource efficiency is risk management. Resource efficiency addresses it by seeking to reduce the impacts on the environment as a way to reduce environmental degradation, economic costs, and social issues. The improvement of an ecosystem inherently betters the ecosystem services it provides, an example of this is how wetlands protect against flooding by regulating the water flow and increasing water infiltration. Additionally, an improved management of resources with ecosystem-based approaches also helps to reduce costs from the reliance on technical solutions. Thus, the restoration of ecosystems is key to manage risk in urban, peri-urban and rural contexts. Furthermore, if the combination between the effects of climate change and a decrease on ecosystem services is considered, the importance of finding efficient ways of managing resources is fundamental for sustainable development and urban resilience.

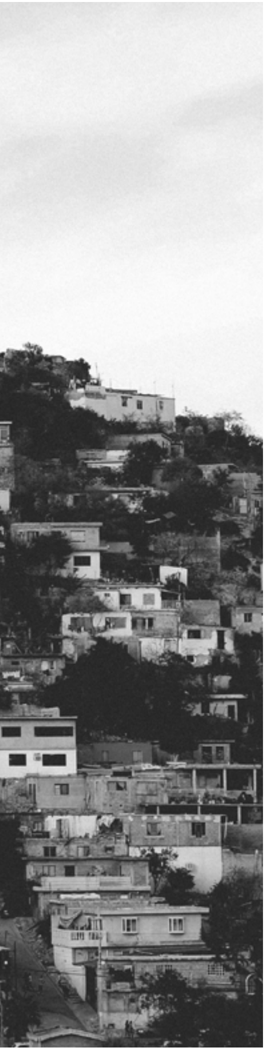
The endeavour to build resource-efficient and resilient cities also has the potential for conflict. Low-income and marginalised groups are more prone to be affected, as the reduction of resource consumption levels might lead to distributional injustices or problematize access to energy, water and other natural resources. These issues may interlink with existing social injustices such as gender inequality, poverty or informality in an urban system, leading to some sectors of the population to be more vulnerable than others to a change in resource consumption patterns.

However, focusing on resilience and resource efficiency can also generate a political momentum to tackle inequalities. Social resilience requires that all inhabitants have equal access to common resources and their sensible and responsible consumption, as well as adequate and affordable access to basic services, such as water, energy, health, education etc., For being able to build preparedness to shocks and stresses. In order to achieve overall urban resilience, it is vital to address social justice and guarantee that resource efficiency measures must be inclusive.

Finally, overall urban resilience does not rely in just one sector, as each sector is comprised of systems related to other sectors. It is a concept that permeates all human interactions, from individual resilience, to social, political, and economic resilience. Resilience transverses all levels: local, regional, national, and global, and joins them into one complex system. Building the resource efficiency of one sector should therefore not go at the cost of another sector's resilience, but rather contribute to a comprehensive urban resilience. Aiming to enable the benefits of improving resource efficiency across interconnected sectors to build towards overall, inclusive urban resilience, the CRPT applies the crosscutting concept throughout its holistic, multi-sectoral, multi-stakeholder study of urban systems.



5. Resource Efficiency and City Resilience Profiling Programme (CRPP)



Considering the many benefits that embedding strategies to enhance resource efficiency into resilience-building efforts entail, the resource efficiency concept has been inserted throughout the entire City Resilience Profiling Tool (CRPT). Understanding cities as complex, interdependent and integrated systems, the CRPT provides a framework that promotes holistic thinking, needed to transcend sectoral approaches and join a wide range of stakeholders of diverse scales and diverging responsibilities.

To protect societies from shocks and stresses exacerbated by environmental degradation or climate change, such as scarcities, the CRPT helps local governments identify opportunities to reduce their dependency on ecosystems, redirecting resource flows and reducing emissions, while maintaining adequate levels of service that fulfil the basic needs of all citizens. Gathering reliable and localized data on various aspects of resource management is essential to develop an evidence base and devise lasting and inclusive strategies, plans, and projects that improve resource efficiency and inherently strengthen a city's resilience.

5.1 Built structures and land

A first aspect to study is the share of built structures, i.e. buildings, infrastructure and paved surfaces, in urban environments. To meet urban population growth, cities expand ever further covering valuable plots of land with impervious materials and reducing the potential for water infiltration, heat and climate regulation, erosion protection etc. Disturbing ecosystems and the services we obtain from them can have disastrous consequences, such as increased floods or landslides.

In addition to the sealing of soil, the construction of infrastructures depends on the extraction of considerable amounts of raw materials and constitutes one of the largest greenhouse gases-emitting sectors. The sprawl of urban areas means expanding basic services networks, such as utilities, public transportation, health care and education, waste disposal sites etc. This forces the further construction of the infrastructure required to operate these services. However, if the density of the consumer base thins with the sprawling of urban areas, then the use of resources needed to construct these buildings and infrastructure systems grows inefficient and wasteful.

Stimulating the use of sustainable local materials, as well as urging for infill, land recycling or responsibly planned city extensions, can help to control land consumption, improve resource management, and curtail emissions. This will bolster the stability and continuity of ecosystem services, and the support of climate change mitigation efforts.

5.2 Managing supply and demand

With rising urban and global populations, the monitoring of the consumption level of land, energy, water, fuel, and food is essential to identify unsustainable patterns. Depending on the service and data availability, numbers should be obtained for the city-scale as well as per capita and/or sector.

The share of renewable and/or local alternatives wielded for the supply of basic services should also be studied. For instance, providing public transportation significantly contributes to energy consumption, yet governments may choose to employ vehicles running on green electricity or biofuel, as well as providing non-motorized options such as bicycles.

To shed further light on a city's ecological footprint, local authorities should analyse the extraction of sources and supply chains on which these services rely and assess their dependency on hinterlands for the import of resources. Increasing self-reliance positively impacts on the resilience and sustainability of cities, as it decreases emissions from transport and diminishes vulnerability to disruptions in supply chains due to shocks and stresses.

Tackling unsustainable consumption patterns in utilities and mobility within cities should include investing in adequate infrastructure, free of spills and losses, but also generate changes in consumerist lifestyles. Local governments should look to steer away from our linear commodities-based economies, to encourage circular practices such as reuse, rainwater harvesting and energy recovery, as well as to promote responsible and sustainable mobility through facilitating walkability and public transportation options, and ultimately aim to engender profound lifestyle changes while sustaining similar standards of living.

5.3 State of environment

Human activities produce a wide variety of impacts on ecosystems, such as land occupation, soil sealing, water cycle alteration, water and air pollution, construction material usage, flora and fauna extraction, severing of ecological corridors etc. With the increase of our reach in the form of culture, knowledge, and technology, these impacts have followed one another with an accelerating pace and growing in magnitude. These two features have reached unparalleled levels as a result of the exponential industrial development of the past two centuries, the explosion of population growth, and the exacerbation of consumerism.

The accumulation and occurrence-rate of these impacts have significantly disrupted the self-sustaining and self-regenerative capacity of ecosystems. Our own complex ecosystems, namely cities, are utterly dependent on the resources obtained from ecosystems, and their regenerative capacity. However consolidated the understanding that cities and ecosystems are deeply interconnected is, it has not been until relatively recently that an economic concept would pay attention to these non-human features that keep cities stable: ecosystem services.

These features provide the city with food and freshwater, fertile soil, water cycle regulation, erosion regulation, temperature regulation, construction and manufacturing materials, aesthetic and psychological inputs for well-being, and many other services.

These features are not easily recovered, biodiversity for instance requires a very long time to regenerate itself to a healthy functional state. The disappearance of a forest or a coral reef can happen in a matter of months, but the recovery of these complex system relationships takes hundreds of years. Furthermore, many of these changes cannot be reversed by humans directly, rather we can merely lift our stressors from the ecosystems and wait for them to self-regenerate.

This illustrates the dire need of paying attention to the way we extract and use natural resources, as well as how we manage our byproducts and waste, in order to avoid impacting the ecosystem to a level of collapse. The understanding and integration of ecosystem dynamics into all the sectors of what constitutes a city, are key for the development of sustainable and resilient cities and our survival as civilization.

5.4 Intersecting vulnerabilities

Vulnerabilities are not disconnected from each other nor evenly distributed throughout the population of a city. Situations such as poverty, lack of access to public services, or discrimination due to race, age group, or gender, increase the vulnerability of certain social groups. High costs of land acquisition make access to housing more difficult and pushes people to areas where land is cheaper, usually far from public services or work niches, or in places where environmental hazards are high.

This marginalization increases exposure to hazards, and the lack of proper means for preparedness and recovery creates environmental vulnerabilities, as well as the reduction of certain settlements' resilience and thus the overall resilience of the city. The potential for deepening underlying inequalities in resilience-building capacity is a factor that the concept of resource efficiency must take into account. Resulting from such intersecting vulnerabilities, the impacts of climate change will disproportionately affect these groups first and the hardest. This will in turn cause dynamics that might result problematic, such as the appearance of resource scarcity and immigration flows.

Resource efficiency must consider the equitable distribution of resources as an efficient form to guarantee an overall and specific increase on resilience and reduction of vulnerability. Therefore, reducing consumption of resources should happen while maintaining the same or even improving standards of living of all citizens.

5.5 Conclusion

In applying the concept of resource efficiency to cities, two promising approaches exist: the first one deals with understanding resource flows and their full lifecycle, while the second one addresses the geospatial dynamics that, as a result of land acquisition and the needed expansion of infrastructure, produce an inefficient distribution of resources that decreases overall and specific urban resilience.

In order to bring the abstract concepts of resilience and resource efficiency into concrete policies, plans and strategies, local governments can use a variety of tools for inciting efficiency, such as incentives to redirect flows of resource use (extraction, processing, consumption, and waste disposal), analysis and definition of ecosystem services, regulations of commodities and common resources exploitation and its rules for compliance, large investment in greener infrastructure, and environmental education.

Transitioning toward a sustainable and inclusive economy, modifying consumption patterns and pushing for an equitable distribution of resources, will require considerable time as well as institutional, financial and human resources, and should be grounded in extensive evidence, in order to devise informed, effective and equitable action. With its system-based and people-centered approach, the City Resilience Profiling Tool supports local and national officials to study and understand the transversal complexity and benefits of building inclusive resource efficiency into a city's consumption and production processes. To this end, the following chapter gathers a list of indicators extracted from the CRPT that help to identify the causes and levels of resource use as well as the impacts on ecosystems and people, and can constitute the knowledge base required to pinpoint potential opportunities and devise recommendations to build a sustainable, resilient and resource-efficient future.

6.Resource Efficiency Indicators

Implementing far-going strategies, such as restructuring an urban economy into a circular system or reconfiguring the city's morphology to a compact form, will require extensive, reliable and localised data to analyse and recommend actions for a reduction of and efficiency in the use of natural resources. Embodying the transversal nature of the resource efficiency concept, this chapter gathers indicators from across the City Resilience Profiling Tool (CRPT), and in particular from the City ID and Urban Elements data collection sets, that are required to obtain a holistic understanding of current and future resource management in urban settings.

The CRPT is informed throughout its components by the following aspects – grounded in the four facets elaborated in the previous chapter: built structures and land, managing supply and demand, state of environment, intersecting vulnerabilities – to study the sustainability of production and consumption patterns:

- **Consumption levels**

These indicators inform about the coverage of infrastructure for the provision of basic services (utilities, basic social services, mobility, housing) depending on the resource. This also includes indicators that capture data regarding the extent of and reliance on external supply chains. Cases where lack in access to an infrastructure network contributes to environmental risks (e.g. wastewater or sanitation facilities) are also incorporated.

- **Service operation**

Disruptions in the delivery of certain services can result in severe environmental contamination or health risks. Indicators referring to operational function inform about efficiency in the management of processes by assessing the continuity of services and processes.

- **Maintenance and monitoring**

Measures related to the care of urban systems such as infrastructure, industrial activities, and waste disposal, as well as the preservation of ecosystems and biodiversity, shed light on possible system flaws (e.g. ageing infrastructure) that may generate high GHG emissions or environmental degradation, and thus reduce resource efficiency.

- **Sustainable initiatives**

Throughout the CRPT, these indicators directly identify efficiency in the use of resources, as well as the existence of specific sustainable practices (e.g. sustainable transport, rainwater collection, environmental awareness campaigns), thus informing about initiatives that already engender the transition towards resource efficiency and resilience building.

Taking into consideration the entanglement of resource management with underlying social inequalities and vulnerabilities (e.g. urban poverty, marginalisation, gender inequality), data and observations coming from the Resource Efficiency Enhancer should be complemented with other materials provided by the CRPT that enter into more detail on access to basic services and quality of life, such as the Human Rights Enhancer, Upgrading from Informality Enhancer, Gender Equality Enhancer and Social Resilience Guide. The Climate Action Enhancer and the Poor Infrastructure Improvement Enhancer, furthermore, can strengthen the understanding regarding climate change mitigation and adaptation, and the role of infrastructure in fulfilling resource-efficiency strategies.

	SET 1 - CityID	SET 4 - Urban Elements
Questions directly referring to resource efficiency		
Questions indirectly informing on resource efficiency		
Total	41	328

SET 1

City ID

2 Spatial Context

TOPIC

2.2	**Ecosystems**	
2.2.1	Ecosystems types	
2.2.2	Landforms	
2.2.3	Surface water bodies	
2.2.4	Water supply sources	
2.2.5	Energy sources	
2.2.6	Wastewater treatment and discharge	
2.2.7	Solid waste treatment and disposal	
2.3	**Urban Area**	
2.3.1	Total urban footprint	
2.3.2	Land use	
2.3.4	Vacant land	
2.3.6	Housing typologies	
2.3.7	Construction types and materials	
2.3.8	Main public transport modes	
2.3.9	Main freight transport modes	

4 Population and Demographics

TOPIC

4.1	**Population Characteristics**	
4.1.1	Population size	
4.1.2	Population density	CPI-ID 1.6
4.2	**Population Dynamics**	
4.2.1	Population growth rate	
4.2.8	Migration rate	
4.2.10	Daytime population (weekday)	
4.2.11	Daytime population (weekend)	
4.2.12	Nighttime population	
4.2.13	Tourism rate	

Features

5 Economy and Livelihoods

TOPIC

5.2	**Urban Economy**	
5.2.2	Main economic sectors	
5.2.3	Industrial and natural resources extraction	
5.2.4	Main export product(s)	
5.2.5	Main export partner(s)	
5.2.6	Main import product(s)	
5.2.7	Main import partner(s)	

6 Shocks, Stresses and Challenges

TOPIC

6.1	**Shocks, Stresses and Challenges Identification**	
6.1.1	Shocks	
6.1.2	Stresses	
6.1.3	Main health risks	
6.1.5	Main risk-prone areas	
6.1.6	Challenges attributed to climate change	
6.1.7	Humanitarian challenges	
6.2	**Significant Crisis [+]**	
6.2.1	Crisis type(s)	
6.2.3	Main Issues	

SET 4

1. Built Environment

1.1 Urban Form

COMPONENT

Indicators

		Alignment
1.1.1	**Urban Growth Model**	
1.1.1.1	Land consumption rate to population growth rate in the past 10 to 15 years.	SDG 11.3.1[C] CPI-UGL 3.1[C] ESCI 41[P] NUA 13e, 15(c-iii), 43, 49, 50, 51, 52, 65, 69, 81, 95, 96, 98
1.1.1.2	Percentage of urban footprint located in hazardous areas.	NUA 13(g), 29, 64, 77, 78
1.1.2	**Open Areas and Street Layout**	
1.1.2.1	Percentage of open areas within the urban footprint.	SDG 11.7.1[A] NUA 36, 67
1.1.2.1.1	Percentage of open areas within the urban footprint considered pervious.	NUA 67
1.1.2.2	Percentage of streets within the urban footprint.	CPI-ID 5.3[C] NUA 37, 100
1.1.2.3	Street intersection density.	CPI-ID 5.1[P] NUA 50, 51, 54, 100, 114(c), 117
1.1.2.4	Public open space per 100 000 population.	ESCI 46[P] ISO-37120 13.2[A] SDG 11.7.1[A] NUA 36, 53, 67, 97, 99, 100, 109

1.2 Land Tenure

COMPONENT

Indicators

		Alignment
1.2.1	**Legal Status of Land**	
1.2.1.1	Percentage of city area held under recognised land tenure.	GLII 3[A] NUA 13(a), 14(b), 35, 104, 137, 156
1.2.1.2	Percentage of city area considered informal.	SDG 11.1.1[A] ESCI 50[A] CPI-ESI 2.1[A] NUA 20, 25, 33, 52, 77, 97, 103, 107, 108
1.2.3	**Land Administration**	
1.2.3.1	Percentage of city area with complete land administration data.	GLII 13[P] NUA 13(a), 14(b), 35, 104, 137, 156

1.3 Housing

COMPONENT

Indicators

		Alignment
1.3.1	**Availability of Adequate Housing**	
1.3.1.1	Percentage of homes in hazardous location.	SDG 11.1.1[P] ESCI 43[A] CPI-ID 1.1[A] NUA 13(a), 13(b), 14(a), 29, 31, 64, 77, 78, 95, 109

1.4 Built Assets

COMPONENT

Indicators

		Alignment
1.4.1	**Robustness of Critical Facilities**	
1.4.1.1	Percentage of critical facilities in hazardous locations.	ESCI 39[P] NUA 13(g), 29, 64, 77, 78
1.4.2	**Robustness of Key Buildings**	
1.4.2.1	Percentage of key buildings in hazardous locations.	ESCI 39[P] NUA 13(g), 29, 64, 77, 78

SET 4

2. Supply Chain & Logistics

COMPONENT

Indicators

2.1 Water Resources

		Alignmen
2.1.1	**Water Resource Diversity**	
2.1.1.1	Proportion of water supplied from each source.	NUA 49, 63, 7 73, 76, 77
2.1.1.1.1	Seasonal variability.	WRI 3.2[A]
2.1.1.1.2	Inter-annual variability.	WRI 3.3[A]
2.1.1.2	Does the city have an operational prioritisation of water sources based on water level data?	NUA 70, 73
2.1.1.3	Does the city have strategies in place for alternative resources in times of unavailability of primary water sources?	
2.1.1.3.1	Frequency the city needs extra support from alternative sources.	
2.1.2	**Water Balance**	
2.1.2.1	Water consumption per capita (liters/day).	ISO-37120 21. ISO-37120 21 ESCI 2[P] NUA 13 (h), 49, 119
2.1.2.1.1	Proportion of water consumed by sector.	NUA 45
2.1.2.1.2	Trends in water consumption in the past 10 years.	SDG 6.4.1[A] NUA 71
2.1.2.1.2	Please describe the periods of occurance and reasons for any spikes in consumption.	
2.1.2.2	Level of water stress.	SDG 6.4.2[C] ESCI 6[A]
2.1.2.2.1	Does the city monitor groundwater levels?	WRI 3.1[A]
2.1.3	**Water Resource Management**	
2.1.3.1	Existence of Integrated Water Resource Management (IWRM) toolbox components in place.	SDG 6.5.1[A] NUA 72, 12(
2.1.3.1.1	Are advocacy groups representing women and groups in vulnerable situations involved in the IWRM process?	NUA 72
2.1.3.2	If the city belongs to a transboundary basin area, is there an operational arrangement for water cooperation among relevant authorities?	SDG 6.5.2[P] NUA 71, 72
2.1.3.3	Does the city have established and operational policies and procedures for participation of local communities in water management?	SDG 6.b.1[P] NUA 72
2.1.3.4	Is the city implementing water demand management strategies?	NUA 71

COMPONENT

2.2 Energy Resources

		Alignmen
2.2.1	**Energy Resource Diversity**	
2.2.1.1	Proportion of energy consumed from each source, based on shares in total final consumption.	IEA[A] CityStrength NUA 49, 63, 76
2.2.2.1.1	Energy price volatility.	
2.2.2.1.2	Oil price volatility.	
2.2.1.2	Number of supply routes and suppliers for each energy source	IEA[A] CityStrength NUA 70
2.2.1.2.1	Spare capacity available, per source.	
2.2.1.3	Does the city have strategies in place for alternative resources and interventions during unavailability or volatility of primary energy sources?	
2.2.1.3.1	Frequency the city needs extra support from alternative sources.	
2.2.2	**Energy Efficiency and Clean Consumption**	
2.2.2.1	Energy intensity.	ESCI 22[P] SDG 7.3.1[C] IEA/EEA[A]
2.2.2.1.1	Proportion of Total Final Consumption by sector.	NUA 75, 12:
2.2.2.1.2	Trends in energy intensity in the past 10 years.	
2.2.2.1.3	Please describe the period of occurance and reasons for any spikes in consumption.	
2.2.2.2	Renewable energy share in the total final energy consumption (%).	SDG 7.2.1[C] ISO 37120 7. ESCI 24[C] EIST ECO 1: CPI-ES 3.1[C] NUA 34, 44, 54 121

SET 4

2. Supply Chain & Logistics

Indicators		2.2.2.2.1	Trend in renewable energy share in the past 10 years.	NUA 34, 44, 54 121
	2.2.3 Energy Resource Management			
		2.2.3.1	Existence of energy efficiency regulations in place.	ESCI 23[P] NUA 44, 75, 1 121
		2.2.3.1.1	Are advocacy groups representing women and groups in vulnerable situations involved in the energy efficiency process?	
		2.2.3.2	Does the local government finance clean/renewable energy transition and energy efficiency initiatives?	CPI-ES 3.1 NUA 14(c), 34, 54, 66, 121
		2.2.3.2.1	If yes, what is the percentage of municipal financing for these initiatives in the last multi-year local budget?	

COMPONENT	2.3 Food Supply			Alignmen
Indicators	2.3.1 Availability of Food Supply			SDG 2.1.2[A]
		2.3.1.1	Average dietary energy supply adequacy (disaggregated by basic food commodity groups, if possible).	FAO-FS I_1.1 I_1.3[A], I_1.4[A], I_ NUA 13(a), 14(34, 67, 123
		2.3.1.1.1	Food supply variability.	FAO-FS I_3.6
		2.3.1.2	Average value of food production per capita (disaggregated by basic food commodity groups, if possible)	FAO-FS I_1.2 NUA 13(a), 14(34, 49, 63, 67,
		2.3.1.2.1	Food production variability.	FAO-FS I_3.5 NUA 67, 70
		2.3.1.3	Percentage of functional area with arable land (disaggregated by tenure type, if possible)	NUA 70, 12
		2.3.1.3.1	Trend in arable land in the past 10 years.	NUA 69
		2.3.1.3.2	Percentage of arable land equipped for irrigation.	FAO FS I_3.2
		2.3.1.4	Cereal import dependency ratio.	FAO FS I_3.1 NUA 70
		2.3.1.4.1	Trend in cereal import dependency in the past 10 years	
	2.3.2 Food Supply Chain Efficiency			
		2.3.2.1	Food loss and waste in the food supply chain (disaggregate by specific food types, if possible) [+]	SDG 12.3.1[A] NUA 51, 71, 1
		2.3.2.1.1	Trend in food loss and waste in the past 10 years.	
		2.3.2.1.2	Are there existing initiatives applied in the local level to prevent food loss and waste?	NUA 123
		2.3.2.3	Proportion of households obtaining food through different avenues. (please disaggregate by sex of householder and groups in vulnerable situations, if possible)	
		2.3.2.3.1	Percentage of household food needs covered by own production.	NUA 95
		2.3.2.4	Does the city have policies and programmes promoting sustainable food systems?	NUA 51, 71, 95,
		2.3.2.4.1	Are advocacy groups representing women and groups in vulnerable situations involved in setting sustainable food systems policies and programmes?	
	2.3.3 Food Supply Chain Continuity			
		2.3.3.1	What level of disruptions does the food supply chain face? (per food supply chain stage, if possible) [+]	NUA 70, 12
		2.3.3.1.1	If significant, please indicate reason(s).	
		2.3.3.2.1	Food price volatility.	
Indicators		2.3.3.3	Does the city have access to food reserves and/or other strategies for food emergencies?	

SET 4

2. Supply Chain & Logistics

COMPONENT	2.4 Urban Logistics		Alignmen
	2.4.1 Goods Transport Modal Share and Diversity		
	2.4.1.1	Proportion of goods (tonnes) hauled by different transport modes.	SDG 9.1.2[P]
	2.4.2.1.1	Trends in dependecy on each mode used within the functional area in the past 10 years.	
	2.4.2.1.2	Trend in dependecy on each mode used from or to the functional area in the past 10 years.	
	2.4.3 Logistics Network Efficiency		
	2.4.3.2	Percentage of retailers in city considered independent.	
	2.4.3.3	Existence of public policies at the local level aimed at encouraging more sustainable practices in urban logistics systems?	NUA 13(f), 7: 114(d)
	2.4.3.3.1	Are advocacy groups representing women and groups in vulnerable situations involved in setting logistics-related public policies?	
	2.4.4 Logistics Management and Continuity of Operations		
	2.4.4.1	What level of disruptions does the urban logistics network face? (per goods transport mode, if possible) [+]	
	2.4.4.1.1	What is the most common cause of disruption?	NUA 70
Indicators	2.4.4.4	Existence of integrated coordination body/ system for managing urban logistics operation?	CityStrength :

SET 4

3. Basic infrastructure

COMPONENT

		Alignmen
3.1.1	**Energy - Energy Supply for Buildings**	**Alignmen**
3.1.1.2	Coverage of Energy Network	
3.1.1.2.1	Percentage of households with an authorized connection to public network, per energy supply type [+]	ESCI 17[C] & 1 NUA 14(a), 25, 52, 54, 66, 70, 77, 88, 98, 106,
3.1.1.3	Efficiency in Energy Consumption	
3.1.1.3.1	Buildings Sector (Residential + Services) energy consumption per capita (ToE/cap).	EISD ECO9 ESCI 21[A] ISO_37120 7. NUA 13(h), 14 32, 44, 45, 51, 75, 97, 111, 119,
3.1.1.3.1.1	Trend in Consumption.	
3.1.1.3.1.2	Consumption disaggregated by end use.	
3.1.1.3.1.3	Consumption by energy sources.	
3.1.1.3.2	Percentage of non-revenue consumption in public network, per energy supply type [+]	CityStrength
3.1.1.3.3	Energy consumption of public buildings per year (kWh/m2).	ISO_37120 7. NUA 121
3.1.1.3.3.1	Trend in Consumption.	
3.1.1.3.4	Energy consumption of Public Spaces and Street lighting (kWh/m2).	
3.1.1.3.4.1	Trend in Consumption.	
3.1.1.3.5	Percentage of customers with Smart Electricity Meters.	
3.1.1.3.5.1	Is real time electricity consumption data accessible to general public?	
3.1.1.4	Continuity of Energy Supply Operations for Building Sector	
	Per energy supply type [+]	
3.1.1.4.1	Average number of interruptions per customer per year in the public network	ESCI 19[A] ISO_37120 7. NUA 70
3.1.1.4.2	Average length of interruptions (in hours) in public network	ESCI 20[A] ISO_37120 7.
3.1.1.4.2.1	Is the design of the distribution network compartmentalised enough to deal with faults on the line?	
3.1.1.4.3	Are there ways to supply priority assets and/or key energy consumers in case of disruptions?	CityStrength NUA 144
3.1.1.4.3.1	Which are the priority assets/key energy consumers of the city in relation to the infrastructure network in question?	
3.1.1.5	Maintenance and Monitoring of Energy Supply Networks for Buildings	
3.1.1.5.1	What maintenance and monitoring measures are applied in the public network, per energy supply type? [+]	NUA 120
3.1.2	**Energy - Energy Supply for Mobility**	**Alignmen**
3.1.2.1	Vehicle Supply Network Coverage	
3.1.2.1.2	Existence of alternative clean fuel vehicle network, per energy supply type [+]	
3.1.2.2	Efficiency in Fuel Consumption	
3.1.2.2.1	Transport energy consumption (ToE/capita).	EISD ECO10 NUA 13(c), 14 45, 63, 69
3.1.2.2.1.1	Trend in consumption	
3.1.2.2.1.2	Disaggregated by end use.	
3.1.2.2.1.3	Disaggregated by energy source.	
3.1.2.2.2	Alternative low/non-carbon fuels share (%)	EISD ECO12[A] 13[A] NUA 65, 75, 7 101
3.1.2.3	Continuity of Energy Supply Operations for Mobility	
3.1.2.3.1	What level of disruptions does the service face, per source? [+]	NUA 70
3.1.2.3.1.1	Are majority of the disruptions internal or external?	
3.1.2.4	Maintenance and Monitoring of Energy Supply Networks for Mobility	
3.1.2.4.1	What maintenance and monitoring measures are applied, per network? [+]	

Indicators

SET 4

3. Basic infrastructure

COMPONENT

Indicators

3.2.1 Water - Water Supply		Alignment
3.2.1.1	**Access to Drinking Water**	
3.2.1.1.2	Are there obligations/incentives in the building codes for secondary source/reusing of water?	NUA 73
3.2.1.2	**Water Supply Network Coverage**	
3.2.1.2.1	Percentage of households covered by piped water supply network.	ESCI 1[C] ISO 21.1[C] SDG 6.1.1[A] NUA 14(a), 25, 34, 65, 91, 106, 120
3.2.1.2.1.1	If percentage is considered inadequate (or less than 75%), please indicate reason(s).	
3.2.1.2.3	Is the capacity of the network able to cope with seasonal increases in water demand?	
3.2.1.3	**Efficiency of Water Supply Operations**	
3.2.1.3.1	Percentage of unaccounted for water (water loss).	ESCI 5[C] ISO 21.7[C] NUA 73
3.2.1.3.3	Are there ways to supply water to priority infrastructure?	
3.2.1.3.3.1	What are the priority infrastructure of the city in relation to water?	
3.2.1.3.4	What level of unplanned disruptions does the service face?	NUA 70
3.2.1.3.4.1	Are majority of the disruption internal or external?	
3.2.1.3.4.2	Please describe strategies used to address disruptions.	
3.2.1.3.5	Are there are mechanism in place to ensure a minimum average time for addressing unplanned disruptions?	NUA 78, 101
3.2.1.4	**Monitoring and Maintenance of Water Supply**	
3.2.1.4.1	Is the city conducting regular sampling of water in supply network for compliance with water quality standards?	NUA 13(a), 34, 119
3.2.1.4.2	What maintenance and monitoring measures are applied?	NUA 67, 120

3.2.2 Water - Wastewater and Sanitation		Alignmen
3.2.2.1	**Access to Sanitation**	SDG 6.2.1[C]
3.2.2.1.1	Percentage of population with access to sanitation facilities (Please disaggregate by sex and groups in vulnerable situation, if possible)	SDG 1.4.1[P] ISO 37120 21.: CPI-ID 1.3[P] NUA 13(a), 34, 120
3.2.2.2	**Wastewater Network Coverage**	
3.2.2.2.1	Percentage of households connected to a wastewater network.	ESCI 10[C] ISO 20.1[C] NUA 13(a), 34, 119
3.2.2.2.1.1	If percentage is considered inadequate (or less than 60%), please indicate reason(s).	
3.2.2.2.2	Is the network able to cope with seasonal increase in wastewater?	
3.2.2.2.3	Is the network able to cope with seasonal increase in rain/stormwater (if combined sewer system)?	
3.2.2.3	**Wastewater Treatment and Discharge**	
3.2.2.3.1	Proportion of wastewater that is safely treated.	SDG 6.3.1[C] ESCI 8[C] NUA 73
3.2.2.3.1.1	If percentage is considered inadequate (or less than 60%), please indicate reason(s).	
3.2.2.3.2	Proportion of hazardous wastewater that is safely treated.	SDG 6.3.1[A] ESCI 8[A] NUA 71, 73
3.2.2.3.2.1	If percentage is considered inadequate, please indicate reason(s).	
3.2.2.3.3	Proportion of sludge that is safely treated.	NUA 73
3.2.2.3.3.1	If percentage is considered inadequate, please indicate reason(s).	
3.2.2.3.4	Return flow ratio - Percentage of available water that has been previously used and discharged upstream as wastewater.	WRI 3.5[C] NUA 73
3.2.2.4	**Efficiency of Wastewater Operation**	
3.2.2.4.1	Total number of sewage overflows reported per 100km of sewer main per year.	NUA 70, 11;

COMPONENT

SET 4

3. Basic infrastructure

COMPONENT / Indicators			Alignment
	3.2.2.4.2	Total number of sewer main breaks and/or chokes per 100 km of sewer main per year.	NUA 70
	3.2.2.4.3	Average response time for sewerage incidents (including mains breaks and chokes).	NUA 78, 10:
3.2.2.5	Maintenance and Monitoring of Wastewater System		
	3.2.2.5.1	What monitoring and maintenance measures are applied?	NUA 120
	3.2.2.5.2	Is the city conducting regular sampling of wastewater discharge for compliance with water quality standards?	
	3.2.2.5.3.1	Percentage of time Wastewater Treatment Plant (WWTP) operates with no remaining system redundancy.	

3.2.3 Water - Stormwater

COMPONENT / Indicators			Alignment
3.2.3.1	Stormwater Collection		
	3.2.3.1.1	Percentage of urban area covered by stormwater collection system.	NUA 14(c), 25, 65, 91
	3.2.3.1.1.1	If percentage is considered inadequate, please indicate reason(s).	
	3.2.3.1.2	Is the city's drainage system currently able to cope with seasonal increase in rain/stormwater?	CityStrength 17[A] NUA 119
	3.2.3.1.3	Is the city reusing rainwater to reduce drinking water consumption?	NUA 73
3.2.3.2	Stormwater and Flood Management Strategies		
	Water Sensitive Urban Design		
	3.2.3.2.2	Does the city regularly and extensively consider the use of alternative water sensitive urban design solutions?	UNISDR Scorecard D4.2.1[A] NUA 37, 51, 124
	3.2.3.2.4.1	If yes, what is the percentage of total urban runoff retained through water sensitive urban design solutions?	
	3.2.3.2.3	Percentage of impervious surface coverage within urban area.	
	3.2.3.2.4	Do building codes or standards that address water sensitive urban design and/or onsite stormwater solutions exist?	UNISDR Scorecard D4.3[A] NUA 111, 121, 124
	3.2.3.2.4.1	Are zoning rules, building codes and standards widely applied, properly enforced and verified?	UNISDR Scorecard D4.4[A]
	3.2.3.2.4.2	If no, please indicate reason(s).	
3.2.3.4	Monitoring and Maintenance of Stormwater System		
	3.2.3.4.1	What monitoring and maintenance measures are applied?	UNISDR Scorecard D8.1.2[A] NUA 120
	3.2.3.4.2	Is the city conducting regular sampling of stormwater discharge in compliance to water quality standards.	

SET 4

3. Basic infrastructure

3.3 Solid Waste		Alignment
3.3.1	Solid Waste Collection Coverage	CityStrength 15[A]
3.3.1.1	Proportion of solid waste collected out of total solid waste generated by the city, per category of waste (municipal/non-municipal; hazardous/non-hazardous; including through waste drop-off facilities for non-municipal).	SDG 11.6.1[P] & 12.4.2[P] ISO_37120 16.2[P] & 16.9[P] CPI-ES 2.1[A] NUA 71, 74, 119
3.3.1.1.1	If the proportion of solid waste collected is considered inadequate, please indicate reason(s), per category of waste [+]	
3.3.1.1.2	If informal solid waste collection exists, please characterise the amount collected and, if available, specify quantity (tonnes), per category of waste [+]	
3.3.1.2	Number of waste pickers per 100 000 residents	
3.3.3	Pre-treatment of Solid Waste	
3.3.3.1	Main method(s) used for pre-treatment (specify percentage, if available).	SDG 12.5[A] ESCI 15[P] NUA 71, 74, 119
3.3.3.2	Legal obligation of pre-treatment for non-municipal solid waste generators?	NUA 71, 74, 119
3.3.4	Treatment: Recovery of Solid Waste	
3.3.4.1	Proportion of solid waste treated out of total generated, by type of treatment.	SDG 12.5.1[P] & 12.4.2[P] ESCI 14[C], 15[C] & 16[C] ISO_37120 16.3[P] & 16.10[P] CPI-ES 2.3[C] NUA 71, 74, 119
3.3.4.2	Characterise the recovery trend of solid waste in the last 10 years.	
3.3.5	Treatment: Disposal of Solid Waste	
3.3.5.1	Percentage of solid waste that is disposed of out of the total solid waste generated, by types of disposal and types of waste.	SDG 11.6.1[P] & 12.4.2[P] ISO_37120 16.4[C], 16.5[C], 16.6[C], 16.7[C] & 16.8[C] ESCI 11[C] & 13[C] NUA 71, 74, 119
3.3.5.2	Are controlled disposal sites accessible to businesses, private individuals or informal collectors for the delivery of wastes normally accepted at the site? (If yes, please select site(s) and specify who has access)	
3.3.5.3	Characterise the trend of solid waste that has been landfilled in the last 10 years.	
3.3.6	Continuity of Operations of the Solid Waste System	
3.3.6.1	What is the average number of days the solid waste systems are out of service per year?	NUA 71, 74, 119
3.3.6.1.1	For collection and for treatment, what is level of impact of the disruptions? [+]	
3.3.7	Maintenance and Monitoring of Solid Waste System	
3.3.7.1	For collection and for treatment, what maintenance and monitoring measures are applied? [+]	NUA 71, 74, 119
3.3.7.2	Remaining useful life of the site where the landfill is located (in years, based on capacity and municipal solid waste generation projections). [+]	ESCI 12[C] NUA 71, 74, 119

COMPONENT

Indicators

3.4.1 Telecommunications - Phone and Internet		Alignment
3.4.1.4	Maintenance and Monitoring of the Network	
3.4.1.4.1	What maintenance and monitoring measures are applied, per network type? [+]	

3.4.2 Telecommunications - Television and Radio		Alignment
3.4.2.4	Maintenance and Monitoring of the Broadcasting System	
3.4.2.4.1	What are the maintenance and monitoring measures applied, per broadcasting system: TV, Radio [+]	

COMPONENT

SET 4

4. Mobility

COMPONENT

4.1 Urban Mobility		Alignment
4.1.1	**Diversity of Transport Modes and Modal Share**	
4.1.1.1	Percentage of commuting trips using each of the following modes (Please disaggregate by sex, if possible).	SDG 9.1.2[P] ESCI 56[P] CPI-ID 4.1[P] ISO-37120 18.3[A], 18.5[A]
4.1.1.2	Percentage of population using paratransit modes of transportation (Please disaggregate by sex, if possible).	NUA 54
4.1.1.3	For each mode of transport, characterise the growth rate. [+]	
4.1.1.4	Percentage of passengers that transfer between modes more than once per journey (Please disaggregate by sex, if possible).	SUTP[A] NUA 50, 54, 98, 114, 118
4.1.2	**Coverage of Urban Mobility Networks**	CPI-ID 4.3[A] ISO-37120 18.1[A], 18.2[A]
4.1.2.1	Road network density (km / 100 000 population).	ESCI 52[C]
4.1.2.2	Road density dedicated for public transport only (km / 100 000 population).	ESCI 53[C] CPI-ID 4.3[A] NUA 114(a), 118
4.1.2.3	Railway density (km / 100 000 population).	CPI-ID 4.3[A] NUA 118
4.1.2.4	Navigable water network density per population (km / 100 000 population).	CPI-ID 4.3[A] NUA 114(c)
4.1.2.5	Density of side walks and pedestrian paths (km / 100 000 population).	ESCI 55[C] NUA 100, 113, 114(a), 118
4.1.2.6	Bicycle lanes density (km / 100 000 population).	ESCI 54[C] ISO-37120 18.7[C] NUA 100, 113, 114(a), 118
4.1.2.7	Cable line density (km / 100 000 population).	CPI-ID 4.3[A] NUA 118
4.1.3	**Access to Urban Mobility Systems**	SDG 1.4.1[A] SDG 11.2.1[P] UN-Habitat*[P]
4.1.3.1	Percentage of city population within 500 m distance to nearest public transport stop. Please disaggregate by modes of transport.	SDG 11.2.1[P] IND03 UN-Habitat*[P] NUA 13(a), 54, 114, 118
4.1.3.3	Percentage of households with at least one car (Please disaggregate by sex of the head of the households, if possible).	OECD[A] ISO 37120 18.4[C] NUA 114
4.1.3.5	Average commuting travel time using various modes of transport.	SUTP[P] CPI-ID 4.2[P] NUA 54, 98, 188
4.1.4	**Continuity of Urban Mobility Operations**	
	Per transport mode [+]	
4.1.4.3	If the mode selected is public, what is the average passenger capacity during peak hours?	NUA 54, 118
4.1.4.4	What is the average travel speed on major thoroughfares during peak hours?	ESCI 59[C] NUA 54, 98, 118
4.1.4.5	Does this mode have a central control system?	NUA 50, 66
4.1.4.6	What is the average age of the transport fleet?	ESCI 57[C] NUA 54, 114, 118
	All transport mode	
4.1.4.8	Does the city have an integrated central control of all transport modes?	NUA 50, 66

Indicators

SET 4

4. Mobility

4.2 Inter-Regional Mobility

COMPONENT

Indicators		Alignment
4.2.1	Diversity and Modal Share of Inter-Regional Mobility Systems	
4.2.1.1	Percentage of trips using each of the follwing modes	SDG 9.1.2[P]
4.2.1.1	For each mode of transport, characterise the growth rate. [+]	
4.2.3	Access to Inter-Regional Mobility Systems	
	For each inter-regional transport facility [+]	
4.2.3.3	Is it accessible through at least one public urban transport mode?	NUA 50, 98, 114(c), 118
4.2.4	Continuity of Inter-Regional Mobility Operations	
	For each mode of inter-regional or international mobility [+]	
4.2.4.4	What is average age of the fleet?	ESCI 57[A] NUA 50, 54, 115, 118

SET 4

5. Municipal Public Services

COMPONENT

	5.1 Cemeteries and Crematoriums		Alignmen
Indicators	5.1.1	Diversity of Burial Sites and Crematoriums in the City	
	5.1.1.2.1	Percentage of deceased cremated in the past year.	
	5.1.1.2.2	Trend of cremations in the city in the past 10 years.	
	5.1.2	Coverage of Burial and Cremation Services	
	5.1.2.3	Do current burial and cremation infrastructures meet the needs of the population?	
	5.1.2.3.2	Do protocols exist regarding the long-term storage of non-cremated remains awaiting burial or cremation?	
	5.1.2.4	Does the municipality have plans for further development of the burial and crematory infrastructure?	
	5.1.3	Access to Burial and Cremation Services	
	5.1.3.3	Are cremation services located on the same site as burial services?	
	5.1.3.4	Are there burial and cremation services not connected to the public transportation network?	
	5.1.4	Quality and Safety Monitoring of Burial Sites and Crematoriums	
	5.1.4.2	Existence of regulations and protocols.	
	5.1.4.3	Is compliance with the existing regulations or protocols monitored and enforced?	
	5.1.4.4	Do any public or private burial sites or crematoriums pose a contamination risk?	

	5.4 Cultural Heritage and Cultural Activities		Alignmen
	5.4.1	Diversity and Typology of Cultural Heritage and Activities	SDG 12.b[A]
	5.4.1.1	Existing local cultural heritage according to the municipality.	SDG 2.5[A], 6.6 14.5.1[A], 15.1.2 15.4.1[A], 15.7[A] CPI-ID 2.2[A] NUA 38, 124, 1
	5.4.4	Management of Cultural Heritage and Cultural Facilities	SDG 8.9[A], 11.
	5.4.4.1	Public expenditure per capita spent on all cultural heritage (tangible, intangible and natural)	SDG 11.4.1[A] NUA 10, 38, 6
	5.4.4.2	Measures the municipality undertaken as part of its expenditure on cultural heritage	NUA 10, 38, 6 97, 124, 125
Indicators	5.4.4.3	Have advocacy groups representing women and groups in vulnerable situations, in particular ethnic minorities, been involved in the development of cultural policies/plans?	NUA 125

COMPONENT

	5.9 Public Lighting		Alignmen
	5.9.2	Coverage of Public Lighting	
	5.9.2.2	Does the municipality use a night lighting schedule?	
	5.9.2.2.1	Does the municipality switch off lighting for the entire city during the specified schedule?	
	5.9.3	Maintenance of Public Lighting Infrastructure	SDG 7.3[A]
	5.9.3.1.1	Do regulations or standards exist regarding the design and performance of the lighting types used?	
	5.9.3.2	What operation and maintenance measures are applied?	
	5.9.3.2.1	Percentage of installed public lighting infrastructure that is not functioning	
	5.9.3.3	Percentage of public lighting infrastructure equipped with electricity metering infrastructure.	
	5.9.3.3.1	Annual energy consumption (in megawatt hours) of the public lighting infrastructure over the past 10 years	
	5.9.4	Continuity of Public Lighting Operations	
	5.9.4.2	Percentage of public lighting infrastructure that is remote-control operated.	
	5.9.4.1.2	Does a central control system exist?	

SET 4

6. Social Inclusion and Protection

COMPONENT

6.3.4 Access to Basic Social Services - Food		Alignment
6.3.4.3	Continuity of Operations of Food Provision Services	
6.3.4.3.1	Describe the availability of products/regularity of shortages in accessing fresh foods.	
6.3.4.3.1.1	If food shortages are significant, please describe the cause(s) of the disruption(s).	

SET 4

7. Economy

COMPONENT

7.1 Local Economic Structure		Alignment
7.1.1	Industrial Composition	
7.1.1.1	Industrial diversity using composition by city product sector shares	CPI-P 1.1[A] CPI-P 2.2[A] ARUP 6.3[A] NUA 45, 60
7.1.1.1.1	Manufacturing share of Local City Product	SDG 9.2.1[P]
7.1.1.2	Gross City Product (GCP) and GCP per capita for the past 10 years	SDG 8.1.1[P] ESCI 66[C] CPI-P 1.1[A] NUA 13(d), 50, 56, 60
7.1.2	Business Composition	
7.1.2.2	Proportion of total businesses that can be classified as informal (by sector if possible)	SDG 8.3.1[A] CPI-P 3.3[A] NUA 13(d), 58
7.1.2.4	Number of enterprises related to the circular economy per 100,000 inhabitants	SDG 8.4[A], 11.6[A] NUA 71 AAAA I[A]

COMPONENT

7.3 Market Connectivity		Alignment
7.3.3	External Market Integration	SDG 8.A[A]
7.3.3.2	Top 5 import and export partners (domestic and international) by value	ARUP 6.5[A] NUA 15(c-iv), 89, 95, 130, 134, 135
7.3.3.3	Five largest imports and exports (by value)	OECD A1.5[A] NUA 15(c-iv), 89, 95, 130, 134, 135

SET 4

8. Ecology

COMPONENT

8.1 Ecosystem Services

	Indicators	Alignment
8.1.1	Ecosystem Services Condition and Trends	SDG 15.1[A], 14.2[A]
8.1.1.1	Level of preservation (good, bad) of the provisioning services the inhabitants are obtaining from the ecosystem, as well as the trend (enhanced, stable, degraded) over the past 10 years.	NUA 63, 68
8.1.1.2	Level of preservation (good, bad) of the regulating services the inhabitants are obtaining from the ecosystem, as well as the trend (enhanced, stable, degraded) over the past 10 years.	NUA 63, 68
8.1.1.3	Level of preservation (good, bad) of the cultural services the inhabitants are obtaining from the ecosystem, as well as the trend (enhanced, stable, degraded) over the past 10 years.	NUA 63, 68
8.1.2	Ecosystem Services Maintenance	SDG 15.1[A], 14.2[A]
8.1.2.1	Services the local government is aware that the city is obtaining or can obtain from the ecosystem.	NUA 65
8.1.2.2	Existence of policies or plans that the local government developed or is developing to preserve the ecosystem services selected in 8.1.2.1.	SDG 15.9[P], 2.3[A], 2.4[A], 2.C[A], 6.6[A], 12.2[A], 14.4[A] NUA 13(h), 14(c), 65, 71
8.1.2.2.1	Does the local government involve advocacy groups representing women and groups in vulnerable situations in the development of measures to preserve ecosystem services?	
8.1.2.2.2	Existence of educational and awareness measures (e.g. global citizenship education, education for sustainable development) to encourage a lifestyle in harmony with nature, for all sexes, ages and groups in vulnerable situations.	SDG 12.8.1[P] NUA 14(c)
8.1.2.2.3	Existence of educational and awareness measures that consider climate change mitigation, adaptation, impact reduction and early warning.	SDG 13.3.1[P] NUA 14(c)
8.1.2.3	Does the local government take the ecosystem services approach or a different environmental approach into consideration in local policy and planning?	NUA 65, 71
8.1.2.4	Is the local government involved in transboundary agreements or collaborations to enable policy and planning for the implementation of ecosystem services approaches?	UNISDR Scorecard 5.3.2[C] NUA 71

COMPONENT

8.2 Ecological Footprint

	Indicators	Alignment
8.2.1	Biocapacity	
8.2.1.1	Biocapacity of the region over the last 10 years	SDG 14.4[A], 15.1[A], 15.1.1[P] NUA 69, 71
8.2.2	Ecological Footprint of Consumption	SDG 12.2[A]
8.2.2.1	Ecological Footprint of Production (10 year trend).	NUA 13(h), 14(c), 45, 49, 51, 63, 75
8.2.2.1.1	Break down the data (gha/pop) based on land use type and consumption output.	
8.2.2.2	Ecological Footprint of Consumption (10 year trend).	NUA 13(h), 14(c), 45, 49, 51, 63, 75
8.2.2.2.1	Break down the data (gha/pop) based on land use type and consumption output.	

8.3 Biodiversity and Green Infrastructure

	Indicators	Alignment
8.3.1	Native Biodiversity in the City	
8.3.1.1	Change in number of native species over the past ten years (Please disaggregate by species on the Red List of Threatened Species, if available)	SDG 15.5[A] ISO-37120 8.8[P] NUA 63, 67
8.3.1.2	Proportion of invasive alien species as percentage of all species.	SDG 15.8[A] NUA 63
8.3.1.2.2	Does the local government take measures (regulation, monitoring, enforcement) to prevent or control invasive alien species?	SDG 15.8.1[P] NUA 13(h), 14(c), 67
8.3.1.3	Proportion of natural areas and urban green spaces in the city as a percentage of the urban area.	NUA 37, 67, 100, 109
8.3.1.5	Proportion of urban green space cover (including vegetation canopy cover and blue areas), as percentage of the size of the functional area.	NUA 63

SET 4

8. Ecology

COMPONENT

8.3.2	Protected Natural Areas in the Region and Connectivity		
	8.3.2.1	Proportion of natural areas in the region that is protected.	SDG 6.6^{A}, 14.5.1^{P}, 15.1.2^{P}, 15.4.1^{P} NUA 63
	8.3.2.3	Total size of the number of areas (in ha) that connect protected natural areas and urban green spaces in the city, using the Green Infrastructure Index as measure.	NUA 67, 100
Indicators	8.3.2.4	Does the city take the biodiversity in these corridors, and in their green spaces and blue areas in general, into consideration?	SDG 15.9^{P} NUA 13(h), 14(c)
8.4	**Environmental Quality**		**Alignment**
8.4.1	Greenhouse Gas Emissions		
	8.4.1.1	CO2 emissions (tones of CO2 per inhabitant).	ESCI 29^{C} ISO-37120 8.3^{P} CPI-ES 1.3^{C} NUA 65, 71, 75, 79, 101
	8.4.1.2	CO2 intensity (grams per unit of real GDP).	ESCI 30^{C} NUA 65, 71, 75, 79, 101
8.4.2	Air Quality		ESCI 26^{C}
	8.4.2.1	Particulate matter (PM10) concentration (24-hour average).	ESCI 27^{C} ISO-37120 8.2^{C} SDG 11.6.2^{P} NUA 13(a), 54, 55, 64, 65, 67, 71, 119
	8.4.2.1.1	Exceedance days (above 50µg/m3).	
	8.4.2.2	Fine particulate matter (PM2.5) concentration (1-year average).	SDG 11.6.2^{C} ISO-37120 8.1^{C} CPI-ES 1.2^{C} NUA 13(a), 54, 55, 64, 65, 67, 71, 119
	8.4.2.2.1	Exceedance days (above 25µg/m3).	
	8.4.2.3	Nitrogen dioxide (NO2) concentration (1-hour average).	ISO-37120 8.4^{P} NUA 13(a), 54, 55, 64, 65, 67, 71, 119
	8.4.2.3.1	Annual average concentration	
	8.4.2.3.2	Exceedance days (above 200µg/m3).	
8.4.3	Water Quality		SDG 6.3.2^{A}
	Ground water quality		
	8.4.3.1	Pollutants present in ground water that have transgressed the established limit.	NUA 13(h), 64, 71, 73
	8.4.3.1.1	Specify additional pollutants of concern: primary pollutants, their characteristics and other factors that affect ground water.	
	8.4.3.1.2	Please describe the source of pollution, if applicable.	
	Surface freshwater quality		
	8.4.3.2	Pollutants present in inland surface water that have transgressed the established limit.	NUA 13(h), 64, 71, 73
	8.4.3.2.1	Specify additional pollutants of concern: primary pollutants, their characteristics and other factors that affect inland surface water bodies.	
	8.4.3.2.2	Please describe the source of pollution, if applicable.	
	Marine water quality of Class I Water		
	8.4.3.3	Pollutants present in Class I Water that have transgressed the established limit.	SDG 14.1^{A}, 14.3.1^{P} NUA 13(h), 64, 71, 74
	8.4.3.3.1	Additional pollutants of concern: primary pollutants, their characteristics and other factors that affect marine water bodies of Class I.	
	8.4.3.3.2	Please describe the source of pollution, if applicable.	
	Marine water quality of Class II Water		
	8.4.3.4	Pollutants present in Class II Water that have transgressed the established limit.	SDG 14.1^{A}, 14.3.1^{P} NUA 13(h), 64, 71, 74
	8.4.3.4.1	Additional pollutants of concern: primary pollutants, their characteristics and other factors that affect marine water bodies of Class II.	
	8.4.3.4.2	Please describe the source of pollution, if applicable.	

COMPONENT

SET 4

8. Ecology

8.4.4 Additional Pollution			
	8.4.4.1	Are there areas in the city with significant land pollution (e.g. brownfield sites, riverbeds, agricultural sites etc.)?	
	8.4.4.1.1	Please describe the source/origin of pollution, if applicable.	
	8.4.4.2	Are there currently areas in the city with significant thermal pollution (e.g. heat island effect)?	NUA 54
	8.4.4.2.1	Please describe the source/origin of pollution, if applicable.	
	8.4.4.3	Are there currently areas in the city with significant radioactive pollution (e.g. nuclear power plants, industrial sites, hospitals etc.)?	
	8.4.4.3.1	Please describe the source/origin of pollution, if applicable.	
	8.4.4.4	Are there currently areas in the city with significant noise pollution?	ISO 8.7[A] NUA 54, 67, 71
	8.4.4.4.1	Please describe the source/origin of pollution, if applicable.	
	8.4.4.5	Are there currently areas in the city with significant light pollution?	
	8.4.4.5.1	Please describe the source/origin of pollution, if applicable.	
	8.4.4.6	Other types of pollution not included in this report. [+]	
	8.4.4.6.1	Please describe the source/origin of pollution, if applicable.	
8.4.5 Monitoring of Environmental Quality			
	8.4.5.1	Existence and monitoring of greenhouse gas inventory.	ESCI 28[C]
	8.4.5.2	Existence, monitoring and enforcement of air quality regulations.	ESCI 25[C] CPI-ES 1.1[A]
	8.4.5.3	Existence, monitoring and enforcement of water quality regulations.	SDG 6.3[A] SDG 14.1[A]
Indicators	8.4.5.4	Existence, monitoring and enforcement of regulations regarding the additional types of pollution identified in Indicator 8.4.4. [+]	ESCI 32[P]

7. Questionnaire

In order to make the Resource Efficiency Enhancer effective and easily applicable, a semi-structured questionnaire format was adopted to internally evaluate the CRPT. This questionnaire is expected to support the CRPT in contributing to UN-Habitat's work to support local governments in better managing natural resources in cities as well as understanding the impacts of unsustainable patterns on people, and in developing strategies to reduce consumption and improve efficiency in the use of resources. The questionnaire includes the following five sections:

1. Basic information for contextualisation
2. Resource Efficiency Targeting
3. Resource Efficiency Identification
4. Resource Efficiency-informed Actions for Resilience (A4Rs)
5. M&E aspects for further applicability of recommendations

The questionnaire was designed as a complementary tool to support each team member in applying critical thinking when addressing the efficient use of natural resources. The process of studying resource efficiency in a city should remain an iterative one, and it is expected that CRPT piloting in cities will bring new insights and enrich the current approach. At a later stage, the Enhancer is envisioned to lead to further research on the root causes and impacts of unsustainable patterns of consumption and production, and to contribute to broader policy-making and strategy development in cities, thus fulfilling a new role, and shifting from tool strengthening to capacity building in cities to address challenges.

1. Basic Information about CRPT	
Analytical set	Select: SET 1 to 4, or A4Rs
Urban Element	Select: Element 1 to 8
(Supra) Component	Full name
Expert in charge with the component	Name and role in the project
Resource Efficiency expert (countercheck)	Name and role in the project
Date of assessment	

2. Resource Efficiency Targeting [component level]	
Questions	**Answers**
2.1 Is the component relevant for identifying unsustainable resource use?	Yes [ ] No [ ] Not determined yet [ ]
2.2 Select the aspects for which the component, or a part of its indicators, may be relevant	**1.** Land consumption [ ] **2.** Consumption levels and footprint [ ] **3.** Managing supply (e.g. local or renewable alternatives, sustainable infrastructure) [ ] **4.** Managing demand (e.g. circular practices) [ ] **5.** State of environment [ ] **6.** Intersecting vulnerabilities [ ]
2.3 Is the component relevant for resource efficiency policies?	Yes [ ] No [ ] Not determined yet [ ]

3. Resource Efficiency Identification [name the indicator or the supporting indicator]	
Questions	**Answers**
3.1 Does the indicator refer to the (re-)use of energy, food, water or land?	Yes [ ] No [ ]
3.2 Does the indicator refer to ecosystem services or biodiversity?	Yes [ ] No [ ]
3.3 Does the indicator refer to the coverage of service supply networks?	Yes [ ] No [ ]
3.4 Does the indicator refer to the consumption level of services?	Yes [ ] No [ ]
3.5 Does the indicator refer to circular practices?	Yes [ ] No [ ]
3.6 Does the indicator refer to operational quality (disruptions) of services?	Yes [ ] No [ ]
3.7 Does the indicator refer to the maintenance and monitoring of infrastructural or environmental quality?	Yes [ ] No [ ]
3.8 Does the indicator refer to policy and planning concerning sustainable practices?	Yes [ ] No [ ]
3.8.1 Does the indicator consider the inclusion of groups in vulnerable situations in decision-making?	Yes [ ] No [ ]

4. Actions for Resilience [name the A4R relevant or the analysed component]	
Level of analysis The articulation with the New Urban Agenda implies work at the following five levels. Specify whether the recommendation for action for resilience is supported by resource efficiency at each of these levels.	**UN-Habitat thematic area of interest** Areas of interest for addressing resource efficiency, according to UN-Habitat's branch structure. Select every relevant one.
4.1 Local implementable actions Yes [ ] No [ ] If not, explain why:	**1.** Urban legislation, land, governance [ ] **2.** Urban planning and design branch [ ] **3.** Urban economy [ ] **4.** Urban basic services [ ] **5.** Housing and slum upgrading [ ] **6.** Research & capacity development [ ] **7.** Risk reduction and rehabilitation [ ]
4.2 Financing the urbanisation Yes [ ] No [ ] If not, explain why:	**1.** Urban legislation, land, governance [ ] **2.** Urban planning and design branch [ ] **3.** Urban economy [ ] **4.** Urban basic services [ ] **5.** Housing and slum upgrading [ ] **6.** Research & capacity development [ ] **7.** Risk reduction and rehabilitation [ ]
4.3 Strategies, planning, design Yes [ ] No [ ] If not, explain why:	**1.** Urban legislation, land, governance [ ] **2.** Urban planning and design branch [ ] **3.** Urban economy [ ] **4.** Urban basic services [ ] **5.** Housing and slum upgrading [ ] **6.** Research & capacity development [ ] **7.** Risk reduction and rehabilitation [ ]
4.4 Existing rules and regulations Yes [ ] No [ ] If not, explain why:	**1.** Urban legislation, land, governance [ ] **2.** Urban planning and design branch [ ] **3.** Urban economy [ ] **4.** Urban basic services [ ] **5.** Housing and slum upgrading [ ] **6.** Research & capacity development [ ] **7.** Risk reduction and rehabilitation [ ]
4.5 Harmonisation with national urban planning Yes [ ] No [ ] If not, explain why:	**1.** Urban legislation, land, governance [ ] **2.** Urban planning and design branch [ ] **3.** Urban economy [ ] **4.** Urban basic services [ ] **5.** Housing and slum upgrading [ ] **6.** Research & capacity development [ ] **7.** Risk reduction and rehabilitation [ ]

5. M&E		
Questions	**Answers**	
5.1 Are any resource efficiency-related baselines used in the analysis?	Yes No If not, explain why:	[ ] [ ]
5.2 Are any resource efficiency-related aspects monitored when implementing the recommendations for actions for resilience?	Yes No If not, explain why:	[ ] [ ]
5.3 Is any evaluation carried out in order to assess whether the recommendations were implemented?	Yes No If not, explain why:	[ ] [ ]

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info@cityresilience.org
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